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EFFICIENCY IN SPORT AND TRAINING MANAGEMENT THEORY

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Abstract All trainers aim at helping the athletes in their charge to be highly successful in their field, i.e. competition sports activity. The quality of an athlete is actually determined upon how successful he or she is at performing the chosen sports activity, i.e. upon his or her efficiency. Consequently, a vital issue in trainers' work with athletes is how to develop efficiency. It can be said that the objective of the sports training is to increase efficiency. The analysis of each kind of sports activity proves that the effectiveness depends on five basic factors: the precision of performing a movement (sports technique); energetic abilities of the body; contractile qualities of muscles; flexibility of joints and connective muscle tissues; and application of proper tactics during the competition. The author grounds each of the factors briefly and explains their contribution to the process of increasing the efficiency of the sports activity. Also, the author proposes elements of the system for management and controlling of the process of sports training, with the following parameters: condition of aerobic abilities; condition of anaerobic abilities (both fractions); the level of sport technique effectiveness; and recovery rate after "peak" trainings. The proposed system enables coaches to have a permanent insight into the state of all the factors observed, i.e. to assess the actual level of competitive sports abilities of athletes, so that it is possible to introduce appropriate corrections in case of any training mistakes.

Key words: sports training, training management, efficiency in sport, theory

INTRODUCTION

Before we go on to discussing the issues of developing physical skills and managing the training process, there are other important matters to consider. First, it is essential to define the final objective, i.e. the desired result at competitions, especially the most relevant ones. Secondly, it is necessary to establish the ancillary objectives that are to be accomplished in the process of training, the success of which should lead to achieving desired results at competitions. Another important question that concerns training management is the definition of its subject matter.

THEORY OF EFFICIENCY IN SPORT

All trainers aim at helping the athletes in their charge to be highly successful in their field. The quality of an athlete is actually determined upon how successful he or she is at performing the chosen sports activity, i.e. upon his or her **efficiency**. Consequently, a vital issue in trainers' work with athletes is how to develop efficiency. It can be said that the objective of the sport training is to increase efficiency. Therefore, efficiency is defined as the subject matter of training management.

An analysis of any sports activity reveals that efficiency is dependent on five essential components [10]:

1. Precision of performing a movement (a sports technique).
2. Energetic abilities.
3. Contractile properties of muscles.
4. Flexibility of joints.
5. Tactics.

We shall try to describe each of these aspects in greater detail.

Precision of performing a movement. Movements employed in an activity must be learned well and practiced with precision. This is the first stage in increasing efficiency. Sports vocabulary recognizes it as mastering the technique of the chosen sports discipline, while in other fields it is called acquiring basic skills.

Energetic abilities. As every sports activity requires energy, it is vital to maximize the extent to which the human body is able to produce it. This above all refers to aerobic energy production, since it is through the aerobic mechanism that the body is supplied with the energy it needs. The underlying principle here says that there must be a balance between the work energy produced and the oxygen consumed after inhalation. The balance, when disturbed by over-production of the aerobic mechanism or occasional production of energy by anaerobic mechanisms, must be restored after work through "recompensing oxygen debt". This is the primary function of the cardiovascular system.

The improvement of the aerobic mechanism has a positive effect on the work of the entire cardiovascular system, which then enables better blood supply to body tissue. In return, the tissue does not only get rich on oxygen, but also on building matter and other materials necessary for its successful recovery and regeneration. Also, faster elimination of metabolites and other waste matter contributes to quicker recovery and, generally, to better functioning of the body. This is of crucial importance, because a great deal of work on increasing efficiency or at "peak" trainings in most sports depends on the employment of anaerobic energy sources, which results in serious disturbances in homeostasis and calls for quick response of the body towards recovery.

Contractile properties of muscles. A movement is always a result of manifestation and realization of a force. The force can be manifested (and a part of it realized) at muscle contraction, and this can happen in three relatively independent ways [3, 14]:

a. force in relation to muscle length;
b. force in relation to how long it is manifest;
c. force in relation to how quick muscles contract.

These are basic characteristics of the muscle contraction model. The prevalence of one over the others will depend on the sports activity.

Flexibility of joints. If joints are not optimally flexible, their movements will be greatly impaired. Muscles then suffer additional exertion, because besides generating force in order to perform the movement, they are also employed in surmounting the resistance of ligaments and tendons that belong to the joint. This demands additional energy expenditure and has negative effect on efficiency, at the same time increasing the susceptibility to injury.

Tactics. The success at achieving objectives in a sports activity may sometimes rest on the choice of the tactical approach. In any event, it is necessary to reach the desired efficiency level for the work done within the set time and at the set intensity or frequency (depending on the activity in question).

As we have seen, provided that sufficient energy has been supplied beforehand, every physical activity (including sports) is manifested and realized through force by particular muscle contraction.

Each physical activity is a result of two processes (Figure 1):

- the reaction to an event registered by the senses,
- the decision upon performing an action.

All related information is processed in the central nervous system (CNS).

The nerve impulses transmit the order issued by the CNS to the muscles, which contract in response, and thus perform a physical activity through the manifestation and realization of force. Efficiency greatly depends on the extent to which the force is realized.

The principal force parameters that characterize the contractile properties of muscles are as follows [3, 14]:

1. force-muscle length (maximal force);
2. force-time (explosive force);
3. force-contractile velocity (velocity force).

Should there be a need for the manifestation of any of the parameters in a period of time, corresponding sources of energy will immediately be employed, at the extent required by the intensity of the manifestation itself. The parameters may be manifested as exertion or as movement. Exertion occurs under the static (isometric) regime, and is manifested either as positions (or maintaining postures) or as sustainment, while movement occurs under the dynamic (isotonic) regime, as repetition (or repeating the movement) or as locomotion (or body motion).

In each mode of manifestation described above, joint flexibility appears as a limiting factor, and it therefore should always be at its optimal level.

Training Management and the Basic Training Principles

There is a wide selection of training methods available that are aimed at increasing efficiency, and our choice will depend on the approach we want to adopt. However, regardless of the method, we must not ignore the significance of two biological mechanisms that reflect the essence of every training method: **homeostasis** and **adaptation**.

Biochemical and physiological aspects recognize homeostasis as the body's tendency to maintain its internal biochemical and physicochemical stability, as well as the stability of its internal organs and tissue [4, 5, 10, 11]. The functioning of these in return influences the maintenance of the internal stability and the stability of the body's primary physiological functions, which is relatively dynamic and should vary within set boundaries. Any physiological or physical stimulus may disturb the relatively dynamic equilibrium of the body, and it is this concept that lies in the foundation of all training methods.

Adaptation is understood as the body's response to various disturbances of the homeostasis, activated when such disturbances are regular and sufficiently long-lasting. The nature of the disturbance and of the change in the external environment will affect the adaptation process of the bodily functions to the new conditions. It is then that a change occurs within the body that establishes yet another homeostatic level. **Adaptation is always specific** [5, 11].

Gradually, adaptive changes in the body become an obstruction to further rise of efficiency. The reason for slower adaptive change lies in the fact that a highly trained body sustains the load (even when it is gradually increased) so that it induces fewer disturbances to homeostasis, subsequently causing fewer adaptive changes. The body has simply adjusted to the set conditions and become resistant to the load it has been subjected to.

When a skill has been mastered and adaptive changes have become resistant to load, the work on increasing efficiency should take the direction towards discovering the means of causing strong disturbance to homeostasis during muscle work without significant rise in the amount and intensity of work near their maximum. Since positive effect of load is realized through increased synthesis of albumin [5, 11], it is important to stimulate the activation of homeostatic regulation to such an extent that it becomes necessary to mobilize the body's energetic and plastic reserves.

The improvement in any sports activity occurs when there is a rise in the success rates in performing the activity, i.e., with the rise in efficiency. This applies to any activity that involves physical exertion. Therefore, every influence on the activity should be subordinated to the primary goal of increasing efficiency. It is important to emphasize that no work on the improvement of particular physical properties should be done for its own sake. Everything that is done must lead to an increase in efficiency.

The key role in such a process belongs to "peak" trainings and efficiency trainings [10]. "Peak" trainings are aimed at enabling the athlete to maintain the defined level of efficiency throughout a set period of time and at set intensity or frequency. In sports practice such trainings are called special endurance trainings. On the other hand, efficiency trainings isolate the work on the efficiency of the technique employed to perform the movement of the chosen activity. They are also known as velocity trainings and special strength trainings.

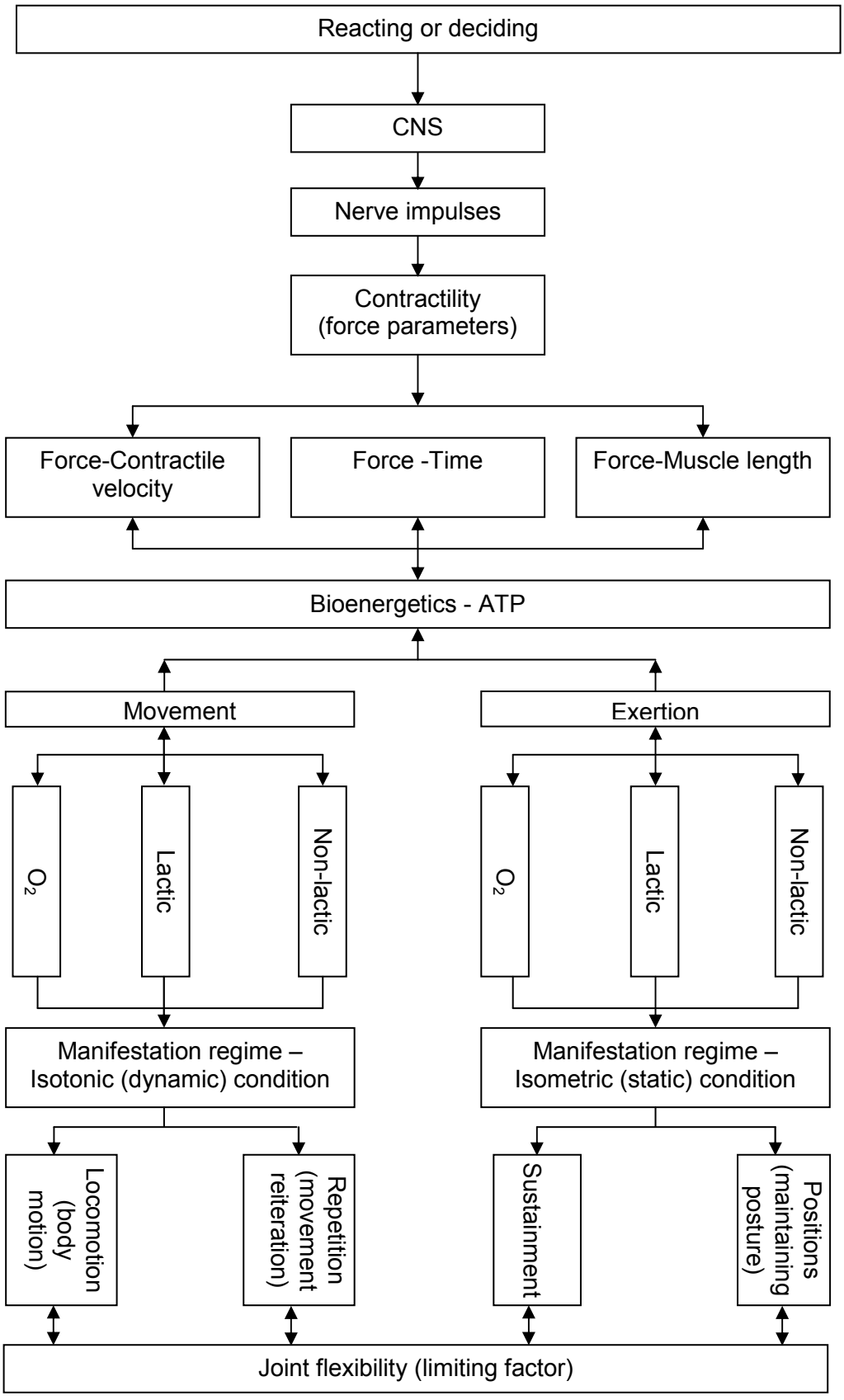

Figure 1. Basic physiological pattern of physical activity reaction

Bearing in mind the recovery rate after "peak" load, we should plan the order of particular segments in the process of training – and especially so within the micro-cycle – in such a way that the "peak trainings" occur at intervals that enable supercompensation [5, 11, 13]. The micro-cycle contains a particular series of trainings that together make up the training process. Units of work must be logically ordered, each one being directed towards treating specific targets that affect the result. Through the stages of preparation, pre-competition, and competition, athletes gradually assume the desired work pace. In the instance of a week-long micro-cycle (the commonest in practice), the logical ordering of training units would be as follows [2, 9]:

- Day one – work on efficiency.
- Day two – “peak” training.
- Day three – aerobic training.
- Day four – rest (active).
- Day five – “peak” training.
- Day six – aerobic training.
- Day seven – rest.

Day one is spent on work at increasing efficiency. In most cases, this means working on maximal speed of movement, both simple and complex (e.g. a tactical combination in games or martial arts). Therefore, loads here are of anaerobic (non-lactic) type. Exercises that are employed should be done at maximal intensity, which means that they have to be so highly trained that the athlete performing them can focus on speed entirely, disregarding the accuracy of the performance. Such work should not cause fatigue, even in the least, since the end result should be maximal efficiency. Down with even the slightest fatigue, an athlete is not able to work at maximal intensity; and, as stated above, adaptation is always specific.

Day two is dedicated to “peak” trainings, where athletes directly prepare for competition. Loads are mostly anaerobic (glycogenic-lactic), or mixed (aerobic-anaerobic). The mixed type of load means work with the maximal load on the aerobic source, entering occasionally the anaerobic, mainly glycogenic-lactic, zone. For example, the mixed type of load characterizes sports games. These are very strenuous trainings with high energy consumption, which result in a sharp drop in glycogen levels and serious reduction in protein synthesis in working muscles, since these processes require the energy that has been entirely spent on working [5, 11, 13]. The body’s internal environment also changes, which all leads to a drastic fall in working ability. In the resting stage the affected bodily functions should return to normal. Rest develops in stages, one of them being the supercompensation stage. Depending on the function we are working on, the next “peak” load will be introduced at that very stage. Top athletes have developed their energetic abilities to such an extent that regardless of the maximal load exerted on the functions during training, they do not show any increase in energy consumption. Changes mostly occur at the structural level of muscle tissue. Insufficient energy required for protein synthesis during work causes breakdown of albumin, which in return negatively affects the contractility of muscles. Recovery of this particular function requires 2-3 days, and supercompensation of the function occurs only then.

Day three, therefore, cannot contain a “peak” training, so aerobic training is planned instead. This solves two problems. Firstly, aerobic abilities are maintained at the desired level. Secondly, such work stimulates albumin synthesis, since necessary substances are supplied through bloodstream more quickly, ensuring the energy required for metabolic processes.

Day four consists of active rest. This means light loads that should stimulate ongoing recovery. It is desirable to plan other recovery techniques (sauna, massage, etc.). In athletes in top training condition it is possible to employ efficiency exercises; however, this should be done to a lesser extent in comparison to the first day of the micro-cycle.

Day five should find athletes in the supercompensation stage, as considerable time has elapsed since the previous “peak” training. This means that next such training is justifiable.

Day six, according to the principles stated above, contains an aerobic training, while **day seven** supposes complete rest.

If athletes are supposed to participate in a competition or a match (which usually happens at the end of the micro-cycle), the second “peak” training is omitted and preparatory exercises are done instead. Besides, loads exerted on athletes participating in a competition or a match are similar to those sustained at “peak” trainings, so that the pace of work is not affected. Moreover, taking part in

competitions enhances the development in tactics, which is itself an important factor that contributes towards efficiency.

The entire years-long work that raises sports efficiency from ground to top levels can be divided into a number of phases, depending on what type of efficiency-developing work is dominant at a particular stage. This will affect the choice of exercises and loads to be applied during "peak" trainings.

Therefore, after the technique of performing movements in the chosen activity has been mastered, further work on improving efficiency is done through gradually increasing the volume and intensity of work (sports practice recognizes this as "general physical fitness"), and then work is directed towards increasing the employment of muscle potential (so as to increase force realization), thus actually improving the coefficient of usefulness (sports practice recognizes this as "special physical fitness") in an activity.

In other words, it is of primary importance to decide upon the final objective, which is to reach a particular level of efficiency that should guarantee that desired results are achieved. In order to succeed, it is prerequisite to make suitable "material" and provide it with sufficient energy. This means that muscles must be able to endure high loads, while the body must sustain enough energy to work. Therefore, general physical fitness domineers the first couple of years in an athlete's development, as well as the beginning of each macro-cycle during preparation period. The achievement of this will guarantee success at realizing the entire work planned for "peak" and efficiency-enhancement trainings, as well as quick and successful recovery after them.

According to what we have stated above, effective organization of training management requires constant data input on the following parameters [7, 8, 9]:

1. aerobic abilities;
2. anaerobic abilities (both lactic and alactic fractions);
3. effective technique;
4. recovery rate after "peak" trainings.

It has already been mentioned that the positive effects of load are realized by increased albumin synthesis. Therefore, it is important to activate the homeostatic regulation so as to necessitate the overall mobilization of energetic and plastic reserves of the body. To do so, it is essential that during "peak" and efficiency trainings maximal loads be exerted upon particular energy sources, both with respect to intensity and duration of work. The same applies to aerobic trainings. This can be achieved through "model training" [7, 8], which, when done thoroughly, indicates that a particular energy source has been well developed. Besides, it is only when the energy sources are able to sustain maximal loads that it is possible to work further on developing of efficiency and the ability to maintain it at the defined level for the given time and at the given intensity or frequency. We have already emphasized that adaptation is always specific. It is important to monitor efficiency levels at training sessions throughout the training cycle, simultaneously keeping track of the level of efficiency demonstrated by athletes at competitions. This will enable us to bring athletes' efficiency to the levels required to achieve a desired result at main competitions in season.

A very important parameter that has to be observed at all times is **recovery** after "peak" trainings. It is essential that athletes have fully recovered before undergoing another such training, which should take place when they are in the supercompensation phase. Sports practice has already developed factors that make it possible to monitor athletes' recovery and to estimate how prepared they are for the next substantial load at the onset of the supercompensation phase.

CONCLUSION

Training management is quite a complex process and its adequate organization requires meeting of a number of important conditions.

Firstly, it is necessary to establish whether an athlete's physical fitness is at the desired level. Without such information it is impossible to organize work on increasing efficiency in an adequate manner. The level of general physical fitness is determined upon the results of laboratory tests.

Secondly, it is important to define efficiency in the chosen sports activity and the factors that affect the results. This is achieved through an analysis of competition activity.

Finally, it is necessary to define methods that will help monitor the factors affecting the results and efficiency. Model trainings are used for this purpose, since they are designed to bring the factors to perfection. If there is close monitoring of the results achieved by athletes during model trainings and the level of efficiency reached at those trainings, and if the findings are compared to those achieved at

seasonal competitions, it is possible to bring both to the level planned for the main competition. Obviously, the system enables a permanent insight into the state of all the factors observed, so that it is possible to introduce appropriate corrections in case of any aberrations.

It is important to emphasize the fact that although the same principles apply to work involving every aspect of physical exercise, the makeup of efficiency and the contents of model trainings vary among sports. This can be clearly seen from our examples which illustrate possible methods of training management within a range of different groups of sports.

The principles on which management of sports training relies apply easily to other fields, such as armed forces, where work involves a complex organization under unified command. This approach helps develop a system of commands and information, which can provide reliable data when evaluating the state of combat preparedness or the efficiency score of any given unit. Besides, the reliability of the information obtained by this system can be utilized not only for rational operative planning, but also for successful leadership in a possible combat.

PRACTICAL APPLICATION

Training management is quite a complex process and its adequate organization requires meeting of a number of important conditions. By using the proposed system, coaches will be able to have a permanent insight into the state of all the factors observed, i.e. to assess the actual level of competitive sports abilities of athletes, which enables introducing of appropriate corrections in case of any training mistakes.

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