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The monitoring system of a qualitative structure of special physical preparation in cross-country race on motorcycles with a side-car

Abstract. *Purpose: to develop and to prove methods of an assessment and a control of special physical preparation of motorcycle racers on motorcycles with a side-car.* **Material and Methods:** *the analytical synthesis of data of scientific literature, the construction and the use of special semantic spaces, the processing of video filming, the biomechanical analysis of the motive activity.* **Results:** *the analysis of the main difficulties is carried out which are arising in the achievement of good results of motorcycle racers on motorcycles with a side-car. Methods of an assessment of each of the making components of the system "a sportsman – a motorcycle – an environment" are defined, components of special physical preparedness which weren't lit in special literature earlier are established.* **Conclusions:** *methods of a quantitative assessment of qualitative characteristics of special physical preparedness are stated which can be used in all sports.*

Keywords: *motorcycle races, special physical preparedness, methods of an assessment of physical preparedness, universality of preparedness.*

Introduction. The characteristic feature of technical sports is their applied predestination directed on training of highly skilled professionals in the corresponding kinds of activity. Not less a significant factor of these sports is a test of the used technique, and the continuous improvement of its technique with an operation condition in the raised modes of loading [1]. The role of a human factor in systems "a person – a car – an environment" is especially accurately opened along with the solution of these tasks in them. The improvement of the used technique increasingly opens weaknesses of such link of the system "a person – a car – an environment " which a person is [2].

It attracts ergonomic adaptations of the operated technical means taking into account individual characteristics of a person for convenience of a work with them in extreme and special conditions of their operation. On the other hand, the problem of preliminary professional selection of sportsmen is more and more sharply put who are capable to provide the effective management of a technical object [3].

One of the most available to researches and covering all questions, problems of interaction of components of the system "a person – a car – an environment" is cross-country race on motorcycles with a sidecar. All sharply standing questions of a problem of interaction of a person with a person in the structure of formation of a crew; the importance of coherence of their actions in driving and measures of unambiguity of an assessment of conditions of the competitive environment; and also the share importance of physical, mental fitness of sportsmen in the achievement of joint success in receiving the end result are concentrated in this type of cross-country race [4]. The evidence of not resolved questions which limit possibilities of success of the competitive activity of sportsmen causes the need of the development of the general approaches of creation of theoretical and methodical ensuring of quality standard of characteristics of physical fitness of the qualified sportsmen for technical and applied sports that it is possible to carry out on the basis of motocross-riders on motorcycles with a sidecar. To number of such general questions, characteristic for all technical and applied sports, belong: a maintenance of structure and share ratio of special and general physical fitness of a crew; an assessment of an admissibility of complexity of the overcome routes; an assessment of complexity of overcoming of each element of the route; an assessment of the category of complexity of obstacles in the route and the category of qualification of a sportsman; an assessment of universality of training of a sportsman.

Communication of the research with scientific programs, plans, subjects. The conducted researches are executed according to the plan of the research work in the sphere of physical culture and sport on a subject 2.1.125 "The improvement of sports training of sportsmen-pilots in motoring (number of state registration is 0106UIII990).

The objective of the research: the development and justification of methods of an assessment and control of special physical fitness of sportsmen in cross-country race on motorcycles with a sidecar taking into account their specific features.

Materials and methods of the research: the analytical synthesis of data of scientific literature; the semantic sign spaces providing qualitative characteristics of the compared objects; video filming; biomechanical analysis of movements.

Results of researches and their discussion. Cross-country race competitions, especially on motorcycles with a sidecar, are the extremely difficult for an assessment of results of a performance. It is connected with that they are carried out on the most various sites of the route, length of a circle, average speed, and arrival duration, on various soil, a relief and with other excellent indicators. It excludes possibility of coordination in cross-country race, comparisons of the absolute temporary measures which are recorded at various competitions. In each concrete competition the absolute time in an assessment of passing of all distance and also its separate sites are used for high-quality representation of the performed competitive task. The possible comparison with the previous competitions can be carried out only in relative sizes that causes the necessity of the translation them in system of relative sizes. Such approach received a wide use at the solution of a question of an assessment of similarity of the compared multi-component objects [5]. It is required the construction the sign semantic spaces with introduction by a uniform measure between its elements and definition of the standard of comparison receiving an assessment of the qualitative structure of the compared objects and the establishment of regularities of changes of the controlled indicators [6]. The transfer to relative units is reached by a submission of the estimated characteristic as a percentage, or in shares of unit, the relative chosen standard. As the standard results of

the leader either model characteristics or the best result of a sportsman relatively to his concrete indicators can act. In all cases the criterion of comparison carries out a role of conditional average and acts as a reference mark. [7]. Y. I. Trofimets developed the deepest and substantial monitoring system and estimates of comparative characteristics for the analysis of results in cross-country race [8]. Its system of an assessment of results in cross-country race as indicator of the level of preparedness of a sportsman was used in the conducted researches with more expanded interpretation of its application in practice.

The following indicators acted as such criteria of an assessment: "The maximum high-speed indicator" (MS) reflects the level of special preparedness of a sportsman and is determined by a formula:

$$MS = \frac{absolutely\ the\ best\ result\ (s)}{the\ best\ result\ of\ a\ racer\ (s)} \times 100\%$$

where an absolute value of the best result acts as the standard of comparison and can be the model characteristic, or its function is carried out by the leader's time, or the best indicator of a racer, it is necessary to divide this size into time which is shown by a racer in a concrete arrival. The essential feature of this criterion of an assessment consists that when the best result of passing of a circle of a racer, who plays a standard role, undertakes as comparison absolutely the size of the standard changes from current state of a sportsman, as well as the average speed of passing of a circle. Thus the criterion of an assessment can remain without a change. Only changes of absolute values of the compared sizes tell about the developed exhaustion. If the absolute result of the best passing of a circle in general undertakes as the criterion of comparison, the criterion of comparison in that case used will show an exhaustion measure. In this case the received result (MS) is called the maximum high-speed indicator of this racer.

The MS can be determined by time of the best circle on routes with various covering (firm, sandy, mud, snow and any other). The size of this indicator characterizes high-speed opportunities of a racer. This criterion can be calculated for an assessment of time spent for a certain element of the route. The closer size MS to unit is, the higher the level of preparedness is. At an assessment of the level of special endurance a wide use finds an index of "a speed reserve". In this case it is necessary to take away time of the fastest passing of a circle from the average time of passing of a circle.

$$\frac{t(general)}{n(the\ best)} - t(the\ best) = t(reserve)\ ; t(average) - t(the\ best) = t(reserve)\ ; t(average) \rangle t(the\ best)$$

The more "reserved speeds", the worse special endurance is developed. The validity of this situation is explained by that endurance is characterized by time of preservation of a performance of work of the set intensity. The well-developed dynamic stereotype of control of the level of a deviation of the internal environment when performing a work of the corresponding intensity allows a sportsman to estimate duration of its course with certain accuracy. The lower accuracy of perception of these changes is; the more differences of mistakes in determination of optimum speed are that increases the average time of passing of a circle.

The special endurance (SE) is estimated as a percentage that allows establishing a limit of its achievement by the specific individual or level of its learning ability in feeling of the state and possibility of calculation of these. For this purpose the use a deviation of time of the «best» circle (TBC) by the time of an «average» circles (TAC). In this case the indicator of special endurance will be defined by a formula:

$$SE = \frac{TBC}{TAC} \times 100\%\ .$$

According to the semantic contents and final expression indicators of "maximum speed" and "special endurance" are identical that is explained by the physiological mechanism defining their manifestation. Thus, indexes as MS, and by SE can be used not only for the assessment of total productivity of training of a sportsman, but also for the establishment of qualitative structure of this indicator. These criteria are determined by time spent for overcoming of an element of the route; on various coverings of the route that allows estimating a measure of complication of the brought factor; for calculation and comparison of the results reached by the racer in exercises: "an exit from a turn (T) – dispersal (D) – braking (B) – an entrance to a turn (T)" (TDBT). To define the maximum high-speed indicator of TDBT, for this purpose the chosen criterion of comparison (the model characteristic of TDBT) shares for time received by a racer. The indicator (MS) calculated thus taking into account the time (TDBT) characterizes high-speed opportunities of a racer and can be used in a formula of the determination of special preparedness.

In this case $$MS = \frac{model\ characteristics\ of\ TDBT}{time\ of\ TDBT\ of\ a\ racer} \times 100\%\ .$$

It is absolutely similarly possible to define the qualitative structure of special preparation for definition of the steepness of roughness of the route, springboards, a relief and other factors and, in particular, change of the motorcycle, the workmate (passenger). Such specification of the analysis of obstacles in the route can be brought to a separate element. In this case time of passing of separate typical sections of the route, turns of various radiuses, overcoming of ledges and ledges, waves, long starting dispersal are controlled. Than fuller the structure of private indicators (MS), the more especially the exact passport of individual preparation can be made for a specifically taken sportsman. All metric data can be obtained and stored in high-speed video of competitions or training process when passing the route.

The calculation of SE gives the chance to construct the rational duration of training run taking into account the current state of the racer at the considered preparation stage. An essential indicator of rational duration of training run is the border, at which SE=96%.

Special preparedness SP of the racer can be presented by the integrated indicator consisting of any number of

the compound components reflecting special preparation. However such compound find application in practice, as: an indicator of the maximum high-speed (MS) and an indicator of the special endurance (SE) In this case SP will be presented as SP=MS+SE,

$$SP = \frac{absolutely\ special\ time\ of\ a\ cirle}{the\ best\ time\ of\ a\ racer} \times 100\% + \frac{absolutely\ the\ best\ time\ of\ circle\ of\ a\ racer}{time\ of\ an\ average\ circle\ of\ a\ racer} \times 100\%$$

As each of fractions aspires to 100 in its limit, the sum of SP will aspire to 200. For reduction of all coefficients to the uniform size it is expedient to enter the coefficient before SP, the return to a number of the used composed, and then SP will have the limit either 1, or 100.

The example of creation of a settlement index of SP is carried out as follows: absolutely the best time of a circle in controlled arrival at the racer 170 s, the best time of a circle 175 s, the average time of a circle is 179 s:

$$SP = \frac{170}{175} \times 100 + \frac{175}{179} \times 100 = 97{,}1 + 97{,}7 = 194{,}8$$

The universality of preparation. That the route of cross-country has rather wide heterogeneity on a relief, soil, quantity of the obstacles complicating its passing, their share ratio in the complete structure of a passable distance, the important indicator of success of performances is such indicator as universality of preparedness. The coefficient of universality of a racer is used for its assessment (U) which pays off as the relation of indicators of special preparedness on this route to SP which is shown on the firm route.

$$U = \frac{SP\ of\ the\ sandy\ route}{SP\ of\ the\ firm\ route} = U_n \cdot on \cdot a \cdot covering.$$

The comparison of an indicator on a relief of the crossed firm route with an indicator (SP) on the uniform route is carried out for an assessment of the universality on a relief:

$$U = \frac{SP\ of\ the\ sandy\ route}{SP\ of\ the\ plain\ route} = U_n \cdot on \cdot a \cdot relief.$$

The universality of preparation assumes its many-components which cover a high class of driving of the motorcycle on the sandy, crossed and other types of coverings, and also a number of other components entering an arsenal of special physical training of a racer. For representation of such structure of results of many-sided preparation it is necessary to use the uniform standard (SP) of comparison concerning which it is estimated all other components (SP) of preparedness. Or the best of the existing results acting is got out as the model characteristic and size of comparison for each component making universal preparedness. In this case the criteria of comparison carry out a role of unit entered as the standard of measurement. For what circular petal charts with modification of representation of the received results of an assessment in sequence of their uniform distribution are used that is represented as follows on the distributive chart [10] (pic.).
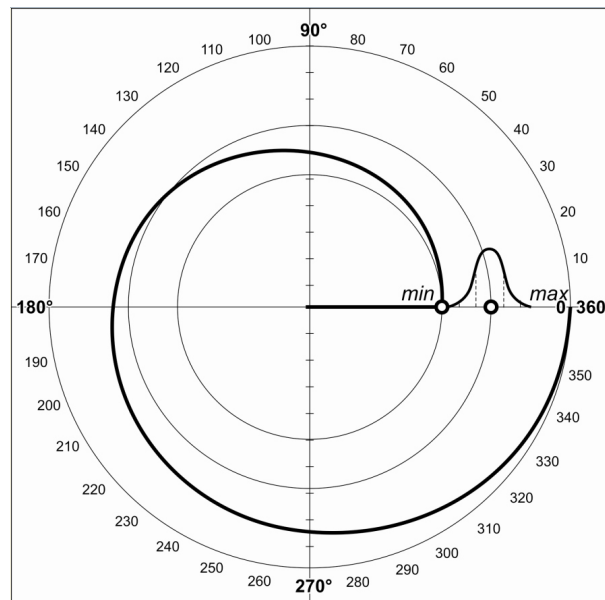
Pic. The distributive diagram

It is possible to present any number of the components entering an arsenal of special physical preparation in the distributive diagram. The basis of its construction and the subsequent use consist that commensurability of a variation of the components defining the structure of creation of special physical preparation and a measure of its universality as on qualitative structure, and quantitative expression of each component leaving is established in it. If all components master on the absolute values of the standard, they are distributed on border of a big circle. In the return case if all of them reach a maximum permissible trifle of expressiveness, all of them settle down on an internal circle. In a beam of average

expressiveness of their absolute values they settle down on an internal circle. The distance from an internal to external circle defines a measure of individual share of a component of special preparedness in the structure of universal preparedness.

In all other cases force of expressiveness of a component in providing the end result in the structure of universal preparedness can vary ranging from the minimum to the maximum expressiveness. Their rank sequence in high-quality expression of the structure of universal preparedness will be defined by a logarithmic spiral which begins from the smallest value of a variation number of components of the structure of universal preparedness to the greatest value of its components. Any petal diagram can be presented in the form of the distributive diagram that allows receiving the additional information which isn't revealed in the usual petal diagram.

The assessment of competitive reliability as an indicator of success of performances is based on the theory of reliability developed in engineering psychology [11]. The assessment of reliability characterizes stability of manifestation of result at the realization of the existing level of preparedness (SP).

The reliability coefficient (Re) is calculated on a formula

$$\text{Re} = \frac{SPc}{SPt},$$

where SPc – a manifestation of special preparedness at competitions; SPt – a manifestation of special preparedness in conditions of the training process.

The more this coefficient to unit is, the higher competitive activity of a racer is. The assessment of reliability of the competitive activity of a motocross-rider reflects, in how much the result of competition decreases rather potential opportunities of a sportsman.

The coefficient of reliability allows controlling an action of a factor of the importance of the level of competitive process and the arising responsibility for the achievement of success in it. The use of coefficient of reliability allows entering an objective measure of special conditions in which the activity of a sportsman proceeds and the level of conscious responsibility is defined for the achievement of success.

The use of coefficient of reliability allows constructing the space displaying the structure of complexity of the competitive activity and to enter a measure of its admissibility for sportsmen that enters an objective assessment of the level of sports qualification [12].

It is necessary to know an indicator of profitability (P) which practically reflects the intensity of work in arrival for the characteristic of individual opportunities in ensuring success. The profitability of specific work determines the level of special endurance. It is established on the level of energy consumption when performing a standard test (loading). In practice of sport a wide use was found by indirect indicators. An intensity assessment, on heart rate during the standard work is the most widespread among them. The less heart rate in the course of passing of arrival and during restoration, the higher profitability of work of a sportsman is. Anyway it is necessary to know the volume of the performed work, time for which it is executed, and the corresponding characteristic of heart rate. The profitability is expressed in cross-country race by the relation of the shown result (SP) to the heart rate (HR). These relations are called an indicator of profitability (P):

$$P = \frac{SP}{HR}.$$

In a profitability indicator actually the numerator has the relative characteristic which isn't exceeding the size of 200% or in transfer to units 2, and a denominator is given in heart rate in a minute that is the dimensional characteristic reflecting average heart rate. Practically the indicator of profitability reflects what measure of intensity of the work of an organism expressed in a private indicator of work of heart reaches a performance (SP). In this case it is necessary to express average heart rate, characteristic for passing of a distance in dimensionless sizes of rather potential opportunities of an organism of a sportsman.

The relative intensity of physiological loading on HR is determined by a formula:

$$I_{HR} = \frac{HRloading - HRrest}{HR\max. - HRrest} \times 100\%$$

In such case $P = \frac{SP}{Ihr}$.

This indicator fully answers the creation of dimensionless criteria of comparison which have an individual focus of an assessment of opportunities of a sportsman, and at consecutive accumulation of statistical material allow optimizing the organization of the training process with the establishment of the forecast about the level of its learning ability.

Conclusions. The received criteria of an assessment of the qualitative structure of special and general physical fitness of sportsmen-motorcycle racers on motorcycles with a sidecar allow carrying out the comparative analysis with the establishment of level of manifestation of certain parties of physical fitness and objectively to establish the level of qualification opportunities of a sportsman, and also universality of his preparedness.

The weakest and strong link in preparedness; either limitation or congenital predisposition in possibility of its development that provides the purposeful professional selection and the organization of special physical preparedness allows defining the established measures of manifestation of qualitative characteristics of special physical fitness.

The presented control methods of qualitative characteristics of activity of a sportsman in the system "a person – an object of management – an environment" allow establishing limit complexity of functioning of this system with the determination of a share value in this restriction of each of its compound components that is a basis of the improvement of the complete system and allows establishing in it limit opportunities of a person, as the limiting factor of the complete

functioning of the system "a person – an object of management – an environment".

Prospects of further researches. The stated methods of a quantitative assessment of qualitative characteristics of the special physical preparedness, which is represented in dimensionless sign semantic spaces, are applicable in all types of sports activity that opens new opportunities in the conducted researches.

References:
1. Slavendi G. Chelovecheskiy faktor t.2 Ergonomicheskiye osnovy postroyeniya proizvodstvennoy sredy [The human factor v.2 Ergonomic bases of construction of the production environment], Moscow, 1991, 500 p. (rus)
2. Samsonkin V. N. Teoreticheskiye osnovy avtomatizirovannogo kontrolya chelovecheskogo faktora v cheloveko-mashinnykh sistemakh na zheleznodorozhnom transporte : dis. ... doktora tekh. nauk. [Theoretical Foundations of automated control of human factors in the man-machine systems in railway transport], Kharkov, 1997, 440 p. (rus)
3. Bleyer A. N. Psikhologiya deyatelnosti v ekstremalnykh usloviyakh v ekstremalnykh usloviyakh [Psychology of work in extreme conditions in extreme conditions], Moscow, 2008, 254 p. (rus)
4. Zabrodin Yu. M., Zazykin V. G. Osnovnyye napravleniya issledovaniy deyatelnosti cheloveka operatora v osobykh i ekstremalnykh usloviyakh v kn. Psikhologicheskiye problemy deyatelnosti v osobykh usloviyakh [Main research areas of human activity operator in special and extreme conditions in the book. Psychological problems of activity in special conditions], Moscow, 1985, p. 5–17. (rus)
5. Druz V. A. Buren N. V., Zhernovnikova Ya. V., Pugach Ya. I. Obzornyy analiz «Obzornyy analiz teoretiko-metodicheskikh osnov postroyeniya sistemy massovogo kontrolya i otsenki urovnya fizicheskogo razvitiya i sostoyaniya fizicheskoy podgotovlennosti razlichnykh grupp naseleniya» [To review "overview of the theoretical and methodological foundations of building a system of mass control and assess the level of physical development and physical readiness of various groups of the population"], Kharkov, 2014, 128 p. (rus)
6. Pugach Ya. I. Osnovnyye polozheniya postroyeniya semanticheskogo prostranstva semanticheskogo prostranstva dlya uporyadochennogo predstavleniya rezultatov issledovaniya [The main provisions of the construction of the semantic space of semantic space for the orderly presentation of research results], Sofiya, 2013, t. 39, p. 5–13. (rus)
7. Ashanin V. S., Pugach Ya. I. Postroyeniye semanticheskikh prostranstv dlya opisaniya psikhologicheskoy deyatelnosti cheloveka v ekstremalnykh usloviyakh [Building a semantic space to describe the psychological human activities in extreme conditions], Kharkov, 2014, 88 p. (rus)
8. Trofimets Yu. I. Moto-kross [Moto-cross], Moscow, 1990, 142 p. (rus)
9. Samsonkin V. N., Druz V. A. Metody statisticheskoy zakonomernosti v upravlenii bezopasnostyu dvizheniya na zheleznodorozhnom transporte [Methods of statistical regularities in the management of traffic safety on the railways], Donetsk, 2005, 160 p. (rus)
10. Azhippo A. Yu., Pugach Ya. I., Druz V. A., Zhernovnikova Ya. V. Slobozans'kij nauk.-sport. visn. [Slobozhanskyi science and sport bulletin], Kharkiv, 2015, vol. 4(48), p. 7–14. (rus)
11. Dushkov B. A., Lomov B. F. Osnovy inzhenernoy psikhologii [Fundamentals of Engineering Psychology], Moscow, 1986, 448 p. (rus)
12. Pugach Ya. I., Druz V. A. Fizicheskoye vospitaniye i sport v vysshikh uchebnykh zavedeniyakh [Physical education and sport in higher educational institutions], Belgorod-KharkovKrasnoyarsk-Moskva, 2014, p. 172–182. (rus)

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