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COMPUTER-AIDED TRAINING DESIGN AS A FACTOR IN SPORTS TRAINING PROCESS MANAGEMENT[1]

Summary: The paper presents the training system design process as a part of the management system. The authors describe the essential characteristics of the design process. The process of training design involves series of successive steps which result in a set of data forming the training cycle project. It contains a set of assumptions, conditions, objectives and measures that lead to the objectives achievement. The project should be dedicated to a particular sportsman and not to a training group or a sports discipline, as well as it should not include detailed solutions, especially as for training means selection. The paper presents also the 7-step algorithm of the training system design process. The last section of the paper presents the software simplified algorithm and comments on its use.

Keywords: design, process training, information system.

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1. Introduction

Managing sports training involves the planning, organization and control of the training process in such a way as to predict optimum training loads (quantity and quality) by selecting appropriate measures (general, directed and specialist) in macro-, meso- and micro-training cycles. This article presents a computer-aided process of designing sports training. It contains a preliminary description of what the design of training systems consists in, followed by a description and explanation in two sections of the modules necessary in developing such a system and the program outline for the computer-aided process of managing sports training. This paper is the first part of the research conducted by its authors on the subject, while the second part will include a description of the program using BPMN 2.0.

In successive parts of the paper the authors describe the assumptions for training system design, the design algorithm and the factors hindering optimum training

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system design. In addition, they describe the modules of a computer program supporting training design, a diagram of such a program as well as its operational requirements.

2. Essence of the designing of training systems

Designing a training process is an element of the system of managing the training process. For this reason, it is one of the basic tasks of a coach, while the designing ability is among the basic determinants of a coach's education.

In defining design-related concepts we have relied on the classic work by W. Gasparski. According to him: "a design means an idea, intention, new idea, suggestion, proposal" [Gasparski (ed.) 1988, p. 21]. The definition of design is inextricably linked to the concept of designing, i.e. an activity whose end product is a design. One of the definitions states that designing, i.e. preparation of a design, "consists in setting a goal and thinking of ways leading, in given circumstances, to its implementation" [Pszczołowski 1978, pp. 189, 190]. A training system is an open one, which means that it is subject to the impact of external factors. Therefore, according to the theory of open systems formulated by von Bertalanffy, it is characterized by: equifinality – every path that leads to the goal is possible [Perechuda, Cieśliński 1993]. It may, therefore, be supposed that sports training programming must be an open system, the formalization of which may only take the form of fuzzy sets, i.e. those where elementary factors (motor, mobility and psychological efficiency achieved through loads and specific training measures) enter into mutual relations by forming a system of training cycles in the form of micro-, meso- and macro-cycles. Elementary factors and relations between them form sets which in sports are referred to as the system of organization and management [Witkowski, Cieśliński, Stefaniak 2011].

As may be noted, it is extremely difficult to define, in an unambiguous manner, the designing of training systems both as an activity and a design being the product of that activity, due to the fact that a sports training system is an open fuzzy set, which means that it is impossible to assign, in an unambiguous manner, a specific factor to specific relations forming an unambiguously specified set which, in turn, forms in the overall training system. Different authors provide different definitions, which result either from a different understanding of that concept or from an ambiguous translation of those concepts from foreign languages.

According to *A Guide to the Project Management Body of Knowledge* the essence of a coach's work is project management, i.e. "the application of knowledge, skills, tools and techniques to design activities, in order to meet the project's requirements" (quoted after: [Heerkens 2003, p. 11]). It is only possible when a coach obtains reliable knowledge and has practical experience [Heerkens 2003].

Designing a training process consists in the performance of a sequence of successive activities, the effect of which is a set of data forming a training cycle design. It contains a set of assumptions, conditions, goals and measures that lead to the implementation of goals. A design should be created for a specific sportsperson, and not for a training group or, even less so, for a sports discipline. A design should contain detailed solutions, most of all with regard to the selection of training measures [Barszowski, Kosendiak 1999].

Taking the above assumptions into account, the authors attempted to describe a design algorithm. The results of their work have been described earlier [Kosendiak 1990, 2005, 2006]. What has emerged as a result is an algorithm which should consist of seven steps, with the first step being universal, as it may apply to many athletes specializing in a given discipline. The remaining six steps of the algorithm are individual actions concerning a specific athlete.

Designing a training cycle consists in the execution of the following steps as part of the designing algorithm [Kosendiak 2013]:

- defining sports rivalry in a given sports discipline in terms of specifying the requirements that it imposes on the sportsperson to ensure that they can be successful in their sport;
- preparing a full profile of the sportsperson to which the design relates, which will then provide the basis for determining the structure of training goals and selecting measures for their implementation;
- preparing a structure of training goals, formulating aims and their corresponding primary goals, specifying intermediate goals and setting tasks which the sportsperson should implement in a given cycle;
- building the time structure of training (structure of the macro-cycle, meso-cycles and micro-cycles), which will serve the implementation of the previously formulated training goals;
- defining and classifying training measures, which will serve the implementation of goals and preparation of the strategy for using those measures in individual elements of the time structure of a training cycle;
- designing a control system for the training process that would be adequate to the structure of the training goals, in line with the principle that there is no reason to perform any measurements in the training process, the results of which cannot be confronted with anything and cannot be used to optimize the management of the training process;
- precise designing of logistic activities, the aim of which is to ensure external conditions for goal implementation.

When discussing the designing of training systems, one must always refer to optimum activity [Pszczołowski 1978; Armstrong 2002; Kosendiak 2010]. The evaluation of each design should be binary, i.e. either the project is good, implementable and executable or it is imperfect and requires corrections. It is evident that, during the designing process, one may face a number of limitations which may be due to a number of different reasons. It must be borne in mind, first of all, that knowledge of sports training is based either on statistics-supported experience or on the experience of an individual sportsperson. Statistics-based reasoning is always prone to a certain degree of error, which is of particular importance in sports sciences, as research is usually conducted on small groups, composed of persons that have undergone a specific selection process (based on sports talent). Sport is, however, the domain of outstanding individuals, which defy all statistics. Therefore, knowledge on sports training is often found in case-study works, which give a real picture (as opposed to an averaged, statistical picture) of things as they are. Their conclusions may, however, only apply to the sports individual under examination and should not, necessarily, be extended to a larger population. For this reason, it is especially important that successive steps of the designing algorithm should become specific optimization tasks. It is, then, guaranteed that particular individual designing algorithm operations are the best possible operations [Kosendiak 2013].

3. General structure of a program that aids the designing of training systems

A program for the computer-aided design of training systems should consist of six basic modules (see [Kosendiak 2013]) which are, so to speak, sub-programs activated depending on the operation that the user wishes to perform. These modules include:

- **Module for designing training structures.** This module is used for entering data in the system. By means of this module, the user will be able to design the structure of a training macro-cycle. The design will cover the macro-cycle time structure (training periods, meso-cycles, micro-cycles), the calendar of events, training goals, training camp dates, medical examinations, control tests, etc.
- **Module for designing training loads.** This module is used for entering data concerning training loads in the system. In this program module, the user will define the structure of their training loads that is adequate to the sports discipline practiced by them. As the program has a universal character, the load structure may be designed in such a way as to ensure that it is adequate to the user's actual needs. The user may make use of the classification of training loads as suggested by the program or define training measures according to their own criteria, which the program makes possible. They must, however, take into account in the description of loads such parameters as the load code, load name, verbal load description, unit of measure and heart rate zone.
- **Module for recording (entering) training loads executed.** This module will be available both to the coach and to the sportsperson and will be used for entering in the system, on a regular basis, the loads executed, in accordance with the descriptions defined in the load defining module. The user will be able to enter the training contents executed in individual training units (loads, reactions to loads, how they felt, any reflections and comments). By recording a training loan executed, the user enters the following data: the date, training measure code, verbal description of the measure executed, loan volume value (in accordance with the

unit of measure adopted), intensity of the measure, body reactions (HR, La and others) and, possibly, verbal description of how they felt and what they observed in relation to the execution of a given training unit.

- **Module for recording participation in competitions.** This is another module used for entering data concerning participation in competitions. It will be available both to the coach and to the sportsperson. In this segment, the user may enter the following data: the date, verbal description of their participation, place won, result achieved, other participation parameters (e.g. intermediate times, results in individual attempts, statistics), etc., body reactions (HR, La and others) and, possibly, a verbal description of how they felt and what they observed in relation to their participation in the competition.
- **Module for analyzing loads executed (creation of charts, diagrams, etc.).** This element of the program is meant to be helpful in analyzing the loads executed, in order to optimize training in future cycles. It will enable a presentation of the loads executed in the form of charts or diagrams in accordance with various periodical criteria selected by the user: e.g. in accordance with the type of load, heart rate zone or other criteria. It will also be possible to generate specifications on an annual or monthly basis or according to training periods, meso-cycles, etc.
- **Module for analyzing participation in competitions and results of control of the training process.** By using charts or diagrams, it will be possible to specify, on an annual macro-cycle basis, control and competition results. In this program module, the user may generate in the form of charts or diagrams changes in the values of specific training effects, as well as changes in the values of sports results, as long as such results are measurable. It is assumed that the program should enable the creation of any number of designs, recorded as separate data files, separately for each sportsperson.

4. Program outline

The supporting program should operate according to the following outline (This is an outline of two experimental versions of the program; it may change as a result of the user's comments following program tests. The results of an analysis of the program's effectiveness will be published in another paper).

1. Start of the program.
2. Logging in, defining the user.
3. Selection of functions: 3.1 or 3.2 or 3.3 or 3.4 or 3.5 or 3.6 or 3.7.
  3.1. Training macro-cycle designing – selection between editing the design saved and creating a new design:
    3.1.1. enter fixed data:
      3.1.1.1. enter the coach's name
      3.1.1.2. enter the sportsperson's details
      3.1.1.3. competition

3.1.1.4. results so far
3.1.1.5. enter the start date of the macro-cycle
3.1.2. select the type of macro-cycle
3.1.3. specify the number and duration of meso-cycles in the preparation period
3.1.4. specify the number and duration of meso-cycles in the competition period
3.1.5. establish the types of micro-cycles in individual meso-cycles
3.1.6. design the structure of goals and control
3.1.6.1. establish control dates
3.1.6.2. establish control methods
3.1.7. design participation in competitions:
3.1.7.1. establish the hierarchy of participation in competitions
3.1.7.2. establish the dates of main competitions
3.1.7.3. establish the dates of other competitions
3.1.8. establish the dates and venues of training camps
3.1.9. save the results
3.1.10. go back to Section 3.

3.2. Preparation of the structure of training loads:
3.2.1. divide training measures
3.2.2. describe training measures
3.2.3. define your own groups of training measures
3.2.4. go back to Section 3.

3.3. Definition of training loads:
3.3.1. enter the load code
3.3.2. enter the load name
3.3.3. add a verbal description of the load
3.3.4. establish the unit of measure
3.3.5. describe the heart rate zone
3.3.6. have all groups of training loads been described? If not, jump to 3.2.1. If yes:
3.3.7. save the data entered and go back to Section 3.

3.4. Recording of training loads:
3.4.1. enter the date
3.4.2. next training session No.
3.4.3. enter:
3.4.3.1. code
3.4.3.2. name of the training measure
3.4.3.3. volume of the measure
3.4.3.4. if all the measures have not been entered, jump to 3.4.3
3.4.3.5. otherwise 3.4.4
3.4.4. define and enter values of training effects, reactions to loads, etc.

3.4.5. if all the data have not been entered, jump to 3.4.4
3.4.6. otherwise, save the data and jump to 3.

3.5. Recording of participation in competitions:
3.5.1. enter the competition date, venue and rank
3.5.2. enter the results (including intermediate results, etc.)
3.5.3. enter a verbal description of the participation in the competition
3.5.4. if all the data have been entered, save the entry and go back to 3.

3.6. Analysis of the loads executed:
3.6.1. select the load (or loads for the overall presentation, a maximum of 5 codes)
3.6.2. select the presentation period:
3.6.2.1. macro-cycle
3.6.2.2. training periods
3.6.2.3. months
3.6.3. present data according to
3.6.3.1. total load
3.6.3.2. number of units containing a given load
3.6.4. select the presentation method:
3.6.4.1. chart
3.6.4.2. diagram
3.6.5. you may print the charts or diagrams or save them in a file
3.6.6. memorize the operations performed and jump to Section 3.
3.6.7. Analysis of training effects
3.6.8. select the type of analysis – training effects? jump to 3.7.2, or participation in competitions? jump to 3.7.3
3.6.9. prepare a specification in the form of diagrams of selected training effects and jump to 3.7.4
3.6.10. prepare a specification in the form of diagrams of competition results and jump to 3.7.4
3.6.11. save in a file or print and jump to 3.

3.7. Have all the functions been performed? If not, jump to 3.

3.8. If so, jump to 4.

4. Save the operations performed and, possibly, make selected printouts.

5. Log out and exit the program.

At any moment of the program operation, it is possible to stop its work, save the data and exit the program.

5. Final remarks – use of the computer-aided system

The program should be structured in such a way as to ensure that it can be installed on an average class computer, with the basic hardware and software set-up. It has been designed with a view to being user-friendly. The program is started by clicking on the program icon on the desktop. The program should not require the installation of any other paid software. During its use, the program should "suggest" successive steps to the user and contain a "library" of basic terms, names and concepts necessary for the designing of time structures, loads or control system or the recording of training loads.

The program described above could be used as a supporting tool by coaches, athletes and managers of sports clubs. So far such actions have made it necessary for coaches and athletes to fill in many documents (projects, training documentation, training logs, etc.). The graph and table generating function included in the program could be used for educational purposes.

The authors are pursuing a joint research project which covers the strategic level of a club's operation, as well as its operational level, i.e. the sports training management system. Both these levels will have a common core referred to as "IT-communications platform of the club and sports training management systems", which the authors will attempt to discuss in the second part of the description of their research results in the field of Business Informatics.

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KOMPUTEROWE WSPOMAGANIE PROJEKTOWANIA TRENINGU JAKO CZYNNIK KIEROWANIA PROCESEM TRENINGU SPORTOWEGO

Streszczenie: W pracy przedstawiono proces projektowania systemów treningowych jako element systemu kierowania. Wskazano na istotne cechy procesu projektowania. Projektowanie treningu polega na wykonaniu kolejnych czynności, których efektem jest zbiór danych tworzących projekt cyklu treningowego. Zawiera on zestaw założeń, uwarunkowań, celów oraz środków, które prowadzą do realizacji celów. Projekt powinien być utworzony dla konkretnego zawodnika, a nie dla grupy treningowej, a tym bardziej dla dyscypliny sportowej. Projekt nie powinien zawierać rozwiązań szczegółowych, przede wszystkim w zakresie doboru środków treningowych. W dalszej części pracy zaprezentowano 7-krokowy algorytm procesu projektowania systemów treningowych. Ostatni rozdział pracy stanowi uproszczony algorytm samego programu oraz uwagi dotyczące jego eksploatacji.

Słowa kluczowe: projektowanie, proces treningowy, system informatyczny.