

EXPERT MODELLING OF SPORT PERFORMANCE OF HIGH ELITE ATHLETES**Bojan Jošt and Milan Čoh***Faculty of Sport, University of Ljubljana, Slovenia**Review paper***Abstract**

The basic goal of organisation of sports lies in the elevation of the organisational culture of sports. This culture reveals in the various visible and invisible constituents. The invisible constituents are those which attract people to sport. The visible ones are a system of values and the level of development of the elementary factors involved in the organisational culture of sport (competition rules, execution of competitions, response to sports competitions, staff engaged in sport, technology of sports, transformation processes, sports events, etc.). Managing sports organisations must be directed towards the development of the constituents of the organisational culture of sport. Management is a mental, intuitive, sensational activity of people in an organisational system. This is a key subsystem in sports organisations as it connects and directs all other subsystems towards the achievement of the desired quality or performance level.

Key words: *modelling, sport, management*

Introduction

Athletes who are oriented towards competition, achievements and top-level sport must, in order to be able to attain top-level achievements, prepare regularly, systematically and continuously several years. This period is characterised by intensive growth of sports performance and represents as such the most complex and responsible stage of their sports life. In today's competitive, achievement-oriented and top-level sport, success is not possible without a high level of knowledge, technological support, financial support, appropriate organisation and successful management. A multitude of factors which affect the achievement in sports requires in itself that a corresponding treatment should be based on a permanent cybernetic systems approach. When we look for an answer to the question "How to succeed in sport?" we should first ask ourselves "What does the term successful performance mean?", and "What do we want to achieve?". Successful performance in sport is today much more than just a result achieved by the athlete (Marcell Bolle de Bal, 1990), it is culture in the sociological and anthropological sense as it reflects its basic values and achievements.

At every moment in history, culture of success, as a constituent of civilisational development of a given society and its members, depends on a system of symbols (Allaire & Firsrot, 1985) which are expressed in myths, ideologies, rules, values, paragons and other various cultural artefacts (rituals, customs, special vocabulary, metaphors, acronyms, stories, legends, tradition, architecture, etc.). Organisational and management aspects of sports deal with the organisation of sports and the characteristics of management of sports organisations and their members. The basic goal of organisation of sports lies in the elevation of the organisational culture of sports. This culture reveals in the various visible and invisible constituents. The invisible constituents are those which attract people to sport.

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Management

Management as a science is based, from the aspect of its contents, on the theory of sports and above all on the theory of performance, while from the methodological aspect, it is based on modelling and cybernetics as a science dealing with the management of complex dynamic systems. In management of sports, we have to do - knowingly or unknowingly - with expert modelling within the space of the theory of performance in sports whenever we think, make a decision, describe phenomena, people around us; whenever we are involved in concrete practice, in the formation of a certain notion (=model of thought) about objects; whenever we carry out simple thought simulations of the behaviour of models, think about proper management decisions and similar.

The most important realisation for management is that in its management practice there exists the external world which is independent of us and which is outside our observation. In order to represent it, we set up simplified verbal, descriptive, physical, pictorial, mathematical models.

Theory of performance in sport studies above all the contents-related standards and criteria of performance and the manner of management which will enable to attain the set target criteria on individual performance standards. Theory of performance can be studied only by means of analysis of a set of a variety of variables which, in the relationship of cause and effect, influence the criterion states on individual performance standards. Tackling of the problems of this kind in the theory of performance requires top-level contents-related and methodological support. The contents-related support is based on the theory of sports, while the methodological one is recently more and more based on expert systems as a method of artificial intelligence (Blahuš et al., 1988).

Modelling

At the Faculty of Sports in Ljubljana we have started with the formulation of an expert system called Sport Expert - SPEX whose application will enable to reach more efficient decisions in the management of the various sources involved in performance in sports. The quality of the expert system is above all the function of the scope and quality of its knowledge base (Harmon, King, 1995), which in turn is based on the knowledge acquired within the framework of sports science or theory of performance in sport. In modelling knowledge we meet with smaller and larger problems. Larger problems occur in the study of complex fields, phenomena, objects, processes, events, whose inside is more or less inaccessible to us. We have only access to the observation of external behaviour. We can draw conclusions about internal mechanisms, properties, characteristics only by means of external indicators. In most cases, however, we are not able - due to a large number of variables and their mutual interactions - to describe all of them and to place them into a coherent functional cause-and-effect whole. From the systems cybernetic aspect of the theory of performance in sport it is thus first necessary to formulate the standards and criteria of performance and to determine on the basis of them the target criterion states and functions. In the theory of performance, standards of performance represent basic axioms by means of which we assess the achievements in the field of sport. In sport, the axioms according to which sports competitions take place are well known, they are laid down in advance in the form of competition rules and are also strictly supervised during competition. Violation of the rules of competition unavoidably results in disqualification and reduction of the performance rate of the athlete. However, for high achievements in sport it is necessary to define first the relations between the final achievements and the subcriterion standards which are in a functional logical connection with these achievements. From formal logical or strictly functional point, penetration into the depth of these subcriterion variables of performance soon comes to an end due to the fact

that we reach the limit where we cannot anymore draw any conclusions about the subcriterion functions of performance in a direct manner, i.e. such conclusions can be drawn only indirectly by means of stochastic and probability relations. To set up an appropriate system of the factors involved in performance in sports is not an easy task, especially if we also want to penetrate into the depth of this system. The construction and supplementing of the system of performance factors is especially productive if it carried out by modelling. However, here we can very quickly be confronted with the dangers and traps of modelling. Models are and will also always reflect the views of their authors. Yet, without suitable model support, based on the knowledge of the sports science, we also cannot expect progress in sport. Thus, modelling within the space of theory and its application to practice is necessary. Our efforts have resulted in the construction of one of the possible models of performance in sports, which is based on the philosophical empirical hypothetical systems approach.

Potential performance model

As the performance model is future-oriented, we have called it a potential performance model. Performance models can be observed and studied on three basic levels (=macro, mezzo, and micro level). The micro level represents the smallest complete system which is based on a single person as an individual. The mezzo level represents a symbiosis of the systems defined on the micro level. The macro level represents a symbiosis of the systems on the mezzo level. The mezzo and macro level represent systems of higher order. Performance in sports depends on a balanced development of all three levels of the performance systems. As on all levels there are concerned systems which are based on real life, the factors of environment are permanently affecting the behaviour and functioning of these systems. These factors can have an extremely important and sometimes even a decisive role in the functioning of the systems. The modelling of the knowledge base from the aspect of the athlete's performance takes place by means of the model facts (=constituents of the knowledge base) and rules with which we define the relations between the criterion of performance and individual constituents of the knowledge base relative to their importance. The knowledge base thus contains two types of knowledge (Mallach, 1994): 1) Model facts: for their definition it is necessary to determine the contents, method of acquisition of knowledge, reference relationship to other model facts and basic characteristics which justify their scientific source; 2) Heuristic, i.e. the expert rules of conclusion-drawing and decision-making. The construction of the knowledge base takes place by means of a formalism, which - taking into account the target criterion functions of the knowledge base - formulates this knowledge base in such a way that it can be used on a computer.

The domain dealing with the drawing of knowledge and its conversion into the selected formalism is called the technology of knowledge. The formalism of the selected knowledge base must in general enable recording of the knowledge concerning the domain of application, i.e. the statements about the properties of objects, systems, models, about the relations between them, about general principles of the domain, but also about the methods for the resolution of the problems associated with the domain (Lavrač & Bratko, 1982). The formulation of the formalism of the knowledge base must be such that it enables the best possible answers to the following questions (graphic representation 14): 1) On what factors does successful performance depend (=cause-and-effect relationship)? Important is the content by which individual factors can be described; 2) By means of what measuring instruments and in what way can performance factors be measured and what is their value from the aspect of scientific realisation? (=recognisability of the contents of the measuring procedure, the type and objectivity of the method used to measure the respective factor (=intuition, logic deduction, mechanical measurement, estimate on the basis of tradition, estimate on the basis of experiences, experiment, inquiry, examination of filed documents, interview, study of the individual, etc.); coding system in terms of the coding of the structure of knowledge, capacity for numerical or attributive manipulation, determination relative to rank, association with normal distribution, objectivity, reliability, validity (qualitative, functional logical, real-correlational), sensitivity, homogeneity, invariance (=invariability in time), capacity for transformation and development.

Main questions: 1) What are the interrelations between the factors of the performance model? Concerned is the definition of the reference relationship between the factors of the performance model both on the level of elementary and on the level of derived model constituents and viewed according to the principle of inter- and intra-reference; 2) What is the nature of association between the performance factors and the final performance criterion? It is necessary to establish the form of association which can manifest itself in linear or in non-linear functions. Since the final achievements in sports are always linear, it is necessary to linearise all non-linear relations between the factors of the performance model and the final criterion. The procedures for linearisation can be mathematical analytical or heuristic; 3) What is the importance of the factors of the model from the aspect of target criterion functions (what is their functional and real stochastic validity)? In this part we want to model the so-called dimension configuration of the factors of the performance model. First we do this on the level of elementary factors, and then also on the level of derived model constituents. In carrying it out, we draw conclusions about the relations between the individual factors and the final performance criterion, or the relations

between performance factors and all those performance subcriteria which are in a formal logical, mathematical functional or a very high stochastic (=correlation association) connection with the final criterion; 4) What is the state or position of an individual on the selected performance factor? Here we determine the so-called positional configuration of the factors of the performance model which shows in the current state of individuals on model variables. The assessment of an individual on a defined model variable takes place by means of the so-called normalisers. Normalisers represent the defined quality categories on the basis of which we assess the values of the variables as excellent, very good, good, satisfactory or unsatisfactory; 5) What are the optimal means, methods and loads by means of which we can elevate the positional configuration of the performance factors separately for each individual?

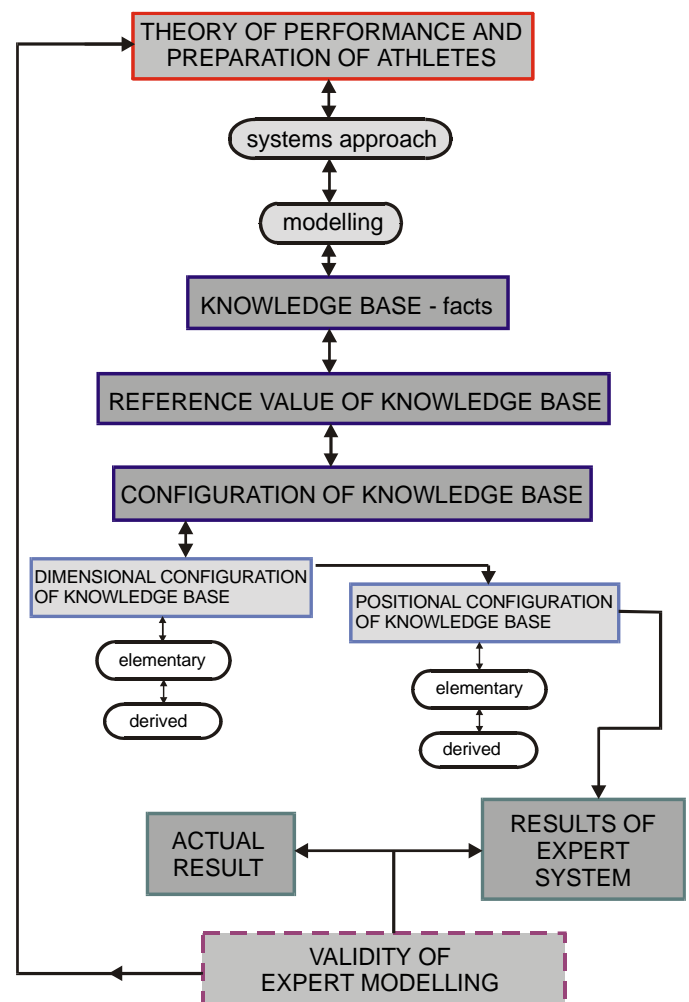


Figure 1. Origins for Creating Knowledge Basis on the Field of Successfulness Theory and Athletes Preparation.

Conclusion

The modelling of the knowledge base lies within the competence of experts who on the basis of knowledge of the properties, laws and principles governing the system, model this system.

The management part lies within the competence of the theory of system management which is, of course, inseparably connected with the knowledge of system models and the modelling itself. From the aspect of optimal management of sports it is necessary to define first a management system or its model: 1) The desired form of output quantities (=performance criteria); 2) A set of allowed management facts (=management system); 3) A selection of optimal management facts with the emphasis on the highest quality of the management process; 4) Criterion function or efficiency standard. In the field of management of athletes the doctrine of management is included in the functional structure of the expert system Sport

Expert. The results obtained so far are, regrettably, still limited to only some fields of the athletes' performance model. However, despite the narrowness of its contents, they can be in many ways useful to the manager in making management decisions. The results of expert systems are only an aid which can enable better management of people in terms of elevation of performance on the selected standards and criteria. In this way, the decisions will be based on more scientific grounds; the value of information will be higher, and the system itself will be permanently oriented towards the growth of the quality of the organisational culture of sports.

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EKSPERTNO MODELIRANJE SPORTSKOG POSTIGNUĆA ELITNIH SPORTAŠA

Sažetak

Temeljni cilj organizacije u sportu leži u podizanju organizacijske culture sporta. Ta kultura se otkriva u različitim vidljivim i nevidljivim sastavnicama. Nevidljive sastavnice su one koje ljude privlače sportu. Vidljive su pak, sustav vrijednosti i razina razvoja elementarnih čimbenika uključenih u organizacijsku kulturu sporta (natjecateljska pravila, odgovor na sportske kompetencije, osoblje uključeno u sport, sportska tehnologija, transformacijski procesi, sportski događaji, itd.). Upravljanje organizacijom sporta treba biti usmjereno prema razvoju sastavnica organizacijske culture sporta. Menadžment je mentalna, intuitivna, senzacionalna aktivnost ljudi u organiziranom sustavu. Ov o je ključni subsustav organizacije sporta jer povezuje i usmjerava sve ostale subsustave prema postizanju željenih kvalitetnih razina sportske izvedbe.

Ključne riječi: modeliranje, sport, menadžment

Received: April 14, 2013

Accepted: May 10, 2014

Correspondence to:

Prof. Milan Čoh, Ph.D.

Faculty of sport

University of Ljubljana

1000 Ljubljana, Gortanova 22, Slovenia

E-mail: milan.coh@fsp.uni-lj.si