

Exercise quantification in physical training by the computerized guidance of running tempos Cuantificarea efortului în pregătirea fizică, prin dirijarea computerizată a tempourilor de alergare

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Abstract

Physical training constitutes a real reference as one of the most important exigencies to obtain high performance. Accordingly, as the training moves forwards in order to achieve high performance, its design requirements must increase exponentially. This is because the evolution of individual results tends to flatten. It is a phenomenon acknowledged by most specialists, faced with a slower progress in athletes, sometimes followed by stagnation or a setback in performances. Therefore, our work presents an instrument that provides quantifiable and available information in the management of training exercise by directing the running tempos, followed by differentiated and individualized approaches of training methods. We wish to support coaches and physical trainers by presenting new criteria, several objective and valid reference scales in order to make the effort parameterization more efficient from two points of view: quantitative and qualitative.

Thus, we present a computational grid pattern of exercise intensity, assisted by a personal program, TEMPOSOF, which converts the running tempos to time units for several distances, between 20-800 m. This workout methodology is addressed to any coach and/or physical trainer, regardless of individual or team sports disciplines, in direct relation to the way in which the effort level is recorded and managed, using concrete and measurable time units.

Keywords: computerized guidance, effort compliance, physical training, timing grid, running tempos, split time.

Rezumat

Pregătirea fizică constituie o reală referință ca o importantă exigență în obținerea marii performanțe. Pe măsura înaintării în marea performanță, cerințele design-ului acesteia crește exponențial. Aceasta, din cauza faptului că evoluția rezultatelor individual tinde să se aplatizeze. Este un fenomen recunoscut de majoritatea specialiștilor, puși în fața unui progres mai lent al sportivilor, uneori urmat de stagnare sau regres al performanțelor. De aceea studiul nostru își propune să prezinte un instrument care oferă informații cuantificabile și disponibile în managementul efortului în antrenament, prin dirijarea tempourilor de alergare, urmate de abordări diferențiate și individualizate ale metodelor de antrenament. Dorim, astfel, să sprijinim antrenorii și preparatorii fizici, prezentându-le noi criterii, câteva referințe scalare, obiectivizate și valide, cu scopul parametrizării efortului, din două puncte de vedere: cantitativ și calitativ.

Astfel, prezentăm modele computerizate de scale ale intensității efortului, asistate de un program elaborat de noi, denumit TEMPOSOF, care transformă tempourile de alergare în unități de timp, pentru mai multe distanțe, cuprinse între 20-800 m. Această metodologie de lucru se adresează oricărui antrenor sau preparator fizic, cu referire la discipline sportive individuale sau de echipă, în relație directă cu modul în care se înregistrează și se dirijează nivelul efortului, utilizându-se unități concrete de măsurare a timpilor realizați.

Cuvinte cheie: asistență computerizată, complianță la efort, pregătire fizică, scală de timpi, tempou de alergare, timp intermediar.

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Introduction

Physical training, one of the fundamental components of the training process, is becoming more and more a real methodological benchmark, being one of the most important requirements to obtain high performance. Its effective management must be grounded as objectively as possible in the conduct of proceedings on a continuous monitoring and evaluation activity by those who manage it.

As it progresses on the upward spiral of achieving high performance, the design of the requirements, planning and organization of the training process increases exponentially (Fig. 1). This is because in the development of the athlete's career, the upward trajectory of his/her individual performance progress tends to flatten. It is a phenomenon observed and recognized by the majority of the specialists and sometimes stoically accepted by some of them, faced with a slow progress of the athletes' performances, followed by a temporary standstill and subsequently even a regression after a time period of marked progress (Neagu, 2010).

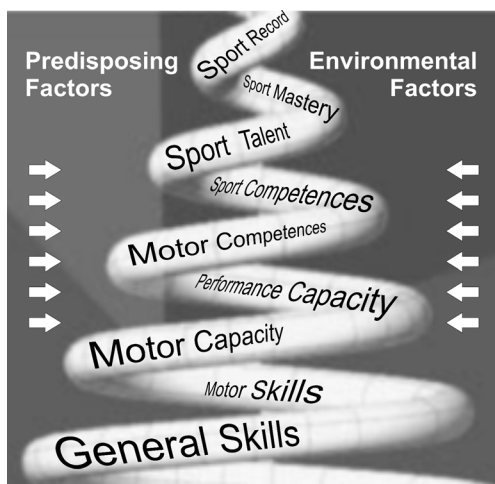


Fig. 1 – The upward spiral of achieving high sport performance under the influence of predisposing and environmental factors (Neagu, 2010).

The factorial rank of physical training as a component of sport training

Physical training, along with other two components, *technical and tactical training*, which are in our view the foundation of the high performance process, are supported by other components, all with different factorial ranks: *theoretical and biological training for competition, psychological, artistic training and the restoration period* (Fig. 2).

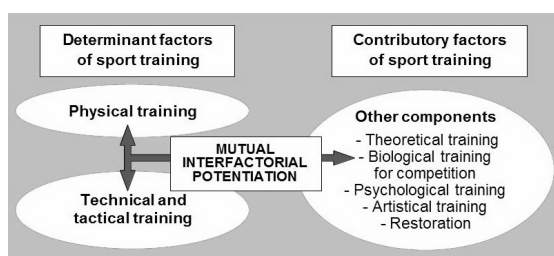


Fig. 2 – The factorial rank and interrelationships between the sport training components (Neagu, 2012).

The factorial rank of each component influence has a special variability, controlled by the coach in relation with several references: the training period of the annual cycle (i.e. preparatory, pre-competitive and competitive periods); the athlete's peculiarities configuration; the competition timetable; the proposed objectives, means and methodology; other resources etc.

In the design of the macro-cycle training program (i.e. annual cycle) or the meso-cycle training program (i.e. pre-competitive period or a particular stage etc.), one of the references is represented by the athlete's current level of training. More specifically, we are talking about the development level of motor qualities, correlative to some sports discipline or sport events specificities that will determine or influence the technical and tactical individual training level.

Only the achievement of some rank relationships between the components of the training process imparts its optimal functionality, which generates real and high yield efficiency. We emphasize that in our view not all training components have the same rank factorial influence. Consequently, we discuss about a particular hierarchy of these components, depending on their factorial rank, determinant or contributory (Fig. 3).

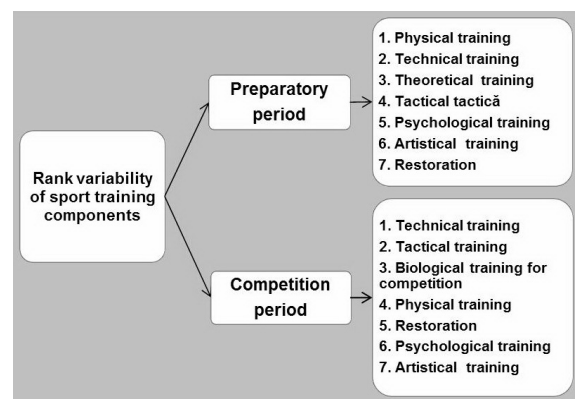


Fig. 3 – Factorial rank variability related to the objectives of training periods in the annual cycle (Neagu, 2012).

We must mention that this hierarchy is not a static one. It has a certain dynamics and variability in relation to the preparatory period of the annual cycle. The most eloquent example is the high rank of the *recovery component* within the transition period related to its position in other training periods. Another example is the changing of the principal role of *physical training* from the preparatory period to a secondary or tertiary place during the competition period, a rank exchanged with the *technical and tactical training components*.

To enable action by conducting the sport training process in the high-level development of the physical training indicator, general or specific, a more precise and rigorous substantiation of the main parameters of applied effort: *volume, intensity and density* is required.

From our point of view, this highly effective approach can be reached only through the configuration of a specific toolbox of the coach portfolio which would make the available elements as clear as possible, quantifiable and accessible in the management of exercise training, related

to its orientation and guiding, based on the momentary peak performance of the athlete. The effort quantification, the pauses between the exercise sets, followed by a differentiated and individualized approach of training (targeting its content, strategy and methodology) will become real instruments, continuous generators of high performance in sports training.

This supports the postulate that we found in a series of studies on the role and position of physical training within the sports training components, according to which “any sport technique is subject to physical means that it entails” (Aubert, 2002; Aubert 2003; Aubert 2004).

Regardless of the rank of physical training, especially specific physical training, this should not be interrupted in any annual training period, even in the competition period. The maintaining of high levels of “dynamic topokinetic parameters” and of technical element execution - “morphokinetic parameters” - can be sustained only in the context of continuous physical training (Neagu, 2010; Neagu, 2012).

The synchronous dynamics of physical training and the athlete's compliance to training requests

Taking a number of conceptual elements of *Dynamic Systems Theories* (DST) from mathematics (Gréhaigne & Paul, 2014), the design and the planning of physical training result from the manner in which it engages and interacts with the different periods of the training process. The internal dynamics of the process, the algorithmic succession of its periods determines distinctive management approaches for each of them (Fig. 4).

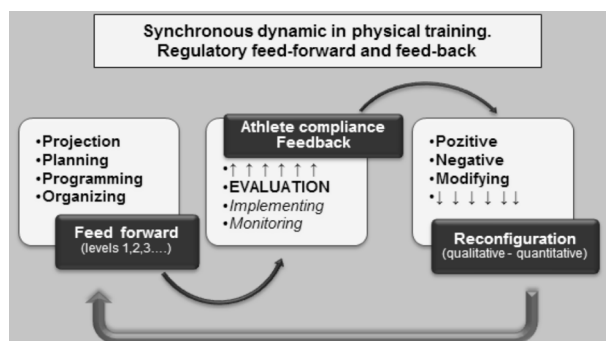


Fig. 4 – Synchronous dynamics of physical training. Regulatory compliance (Neagu, 2012)

The proposed objectives and tasks which must be performed allow some important changes in the evolution of a macro-cycle and/or meso-cycle of the training process. Obviously, the internal dynamics of the training process should be accompanied by a “synchronous dynamics” resulting from the operationalization of the objectives and tasks of each sequence (Neagu, 2012).

The design of the content of each stage followed by the planning and conducting of the training program involves beyond the predictive forwarding of the coach's qualities, the prediction of “the athlete's compliance” to induce multiple effects upon the athlete which was anticipated by the coach design (A/N). “The coach activity as feed forward type will not have the expected results in the lack

of regulatory feedback (quantitative and qualitative) of the original interventions designed by himself, respectively, named as *dynamic feedback, wholly integrated* during the monitoring and evaluating of the training process (positive and/or negative feedback, often even modifier feedback” (Neagu, 2012).

The proposed calculating program of running/locomotion tempos “TEMPOSOF”

One of the issues faced by coaches in general, and especially coaches who train athletes for sport disciplines or events involving locomotion-type movements, is related to the conversion of working time intensity related to different distances of running or displacement (other ways of locomotion). By studying the literature, we found limited references using optical measuring systems of the athlete's displacement timing, such as *Microgate Timing System, Optojump, Ergotest, IR-Mat* etc. (Bosquet et al., 2009; Casartelli et al., 2010; Glatthorn et al., 2011).

The book *The quantification physical preparation in sport training* (Neagu, 2012) presents several grids with time equivalents of work intensities provided on different levels, depending on the length of the covered distance (by running or by other means of locomotion). The proposed distances are: 20 m.; 30 m.; 40 m.; 50 m.; 60 m.; 80m.; 100 m.; 120 m.; 150 m.; 200 m.; 250 m.; 300 m.; 400 m.; 500 m.; 600 m. and 800 m. The amplitude between the minimum and maximum times for each distance is planned to be applied in several situations of locomotion and for different levels of the athletes. The range between times is 2 1/100 sec. for distances up to 100 m. and 5 1/100 sec. for longer distances. The steps of intensity are between 80-100%, depending on the distance length. The maximum time (100%) is the personal record achieved by an athlete and a basis for calculating the lower levels of intensity (98%, 96%, 94% etc.). We exemplify a grid for the 50 m distance (Table II).

The TEMPOSOF program solves many of the items above by:

- an exact measurement and record of the athletes' performed timings at a sensitivity of 1/100 sec. (using MGS);
- converting the exercise intensity from percent in nominal times, to be performed by an athlete in a training session;
- providing a concrete data base to the coach in real time, during training sessions, offering instant feedback;
- having functions such as a dynamic exercise regulator in relation to the physical shape of the athletes;
- performing timelines analysis of a race, identifying areas of acceleration / deceleration, stagnation of running or displacement speed.

The elaborated grids are, in our view, a very important guide; a real working tool for any teacher of physical education and sport, but especially for coaches and physical trainers interested in the objectification of the work tempos requested from an athlete. Personally, I have applied these grids since 1987 with very good results in guiding, monitoring and adjusting effort intensity in athletics training sessions (Neagu, 2010).

One particularly important aspect which we underline is the role of these grids in the detection of deceleration

intervals throughout the entire length of running or of other specific locomotion forms. This allowed us to customize and set up the training program in the exact intervals of the running race where we found problems (i.e. deceleration or slowdown). Another significant element is related to the determination of correlations between control tests and competition events. Similarly to highlighted issues above, for the correlation of 10 m. time intervals from the total distance we have found disparities in the timing correlation and we intervened upon the athlete's training program by differentiated (individualized) training.

To facilitate the use of grids, we developed a software program easy to use by any coach, which we called TEMPOSOFT. This is an interactive executable program through which the coach or the physical trainer introduces the running distance of interest, the set time point (the momentary maximum performance of the athlete) and the effort intensity level to work at in a given training session (Table I).

Table I

The manner to use the TEMPOSOFT application for 100 m distance. A sequence from the executable program.

Time	Speed	Levels of intensity - tempos				
		96%	92%	88%	84%	80%
11.67	8.57	12.16	12.68	13.26	13.89	14.59
11.69	8.55	12.18	12.71	13.28	13.92	14.61
11.71	8.54	12.20	12.73	13.31	13.94	14.64
11.73	8.53	12.22	12.75	13.33	13.96	14.66
11.75	8.51	12.24	12.77	13.35	13.99	14.69
11.77	8.50	12.26	12.79	13.37	14.01	14.71
11.79	8.48	12.28	12.82	13.40	14.04	14.74
11.81	8.47	12.30	12.84	13.42	14.06	14.76
11.83	8.45	12.32	12.86	13.44	14.08	14.79
11.85	8.54	12.34	12.88	13.47	14.11	14.81

TEMPOSOFT Computing

Calculating distance (m.)	100
Time benchmark (sec.)	11.67
Increment (1/100 sec.)	0.02
UM=second (excel)	1.15741E-05
Minimal time (baseline)	0.000694444

Table II

Grid illustration of effort intensity computing at 50 m. Range: 04 "40-06" 76 (calculated TEMPOSOFT by the program).

Maximal time	Speed (m/sec)	Effort intensity					Maximal time	Speed (m/ sec)	Effort intensity				
		Running time equivalents (sec.)							Running time equivalents (sec.)				
		98%	96%	94%	92%	90%			98%	96%	94%	92%	90%
100%							100%						
04"40	11.36	04"49	04"58	04"68	04"78	04"89	05"68	8.80	05"80	05"92	06"04	06"17	06"31
04"42	11.31	04"51	04"60	04"70	04"80	04"91	05"70	8.77	05"82	05"94	06"06	06"20	06"33
04"44	11.26	04"53	04"63	04"72	04"83	04"93	05"72	8.74	05"84	05"96	06"09	06"22	06"36
04"46	11.21	04"55	04"65	04"74	04"85	04"96	05"74	8.71	05"86	05"98	06"11	06"24	06"38
04"48	11.16	04"57	04"67	04"77	04"87	04"98	05"76	8.68	05"88	06"00	06"13	06"26	06"40
04"50	11.11	04"59	04"69	04"79	04"89	05"00	05"78	8.65	05"90	06"02	06"15	06"28	06"42
04"52	11.06	04"61	04"71	04"81	04"91	05"02	05"80	8.62	05"92	06"04	06"17	06"30	06"44
04"54	11.01	04"63	04"73	04"83	04"93	05"04	05"82	8.59	05"94	06"06	06"19	06"33	06"47
04"56	10.96	04"65	04"75	04"85	04"96	05"07	05"84	8.56	05"96	06"08	06"21	06"35	06"49
04"58	10.92	04"67	04"77	04"87	04"98	05"09	05"86	8.53	05"98	06"10	06"23	06"37	06"51
04"60	10.87	04"69	04"79	04"89	05"00	05"11	05"88	8.50	06"00	06"12	06"26	06"39	06"53
04"62	10.82	04"71	04"81	04"91	05"02	05"13	05"90	8.47	06"02	06"15	06"28	06"41	06"56
04"64	10.78	04"73	04"83	04"94	05"04	05"16	05"92	8.45	06"04	06"17	06"30	06"43	06"58
04"66	10.73	04"76	04"85	04"96	05"07	05"18	05"94	8.42	06"06	06"19	06"32	06"46	06"60
04"68	10.68	04"78	04"87	04"98	05"09	05"20	05"96	8.39	06"08	06"21	06"34	06"48	06"62
04"70	10.64	04"80	04"90	05"00	05"11	05"22	05"98	8.36	06"10	06"23	06"36	06"50	06"64
04"72	10.59	04"82	04"92	05"02	05"13	05"24	06"00	8.33	06"12	06"25	06"38	06"52	06"67
04"74	10.55	04"84	04"94	05"04	05"15	05"27	06"02	8.31	06"14	06"27	06"40	06"54	06"69
04"76	10.50	04"86	04"96	05"06	05"17	05"29	06"04	8.28	06"16	06"29	06"43	06"57	06"71
04"78	10.46	04"88	04"98	05"09	05"20	05"31	06"06	8.25	06"18	06"31	06"45	06"59	06"73
04"80	10.42	04"90	05"00	05"11	05"22	05"33	06"08	8.22	06"20	06"33	06"47	06"61	06"76
04"82	10.37	04"92	05"02	05"13	05"24	05"36	06"10	8.20	06"22	06"35	06"49	06"63	06"78
04"84	10.33	04"94	05"04	05"15	05"26	05"38	06"12	8.17	06"24	06"37	06"51	06"65	06"80
04"86	10.29	04"96	05"06	05"17	05"28	05"40	06"14	8.14	06"27	06"40	06"53	06"67	06"82
04"88	10.25	04"98	05"08	05"19	05"30	05"42	06"16	8.12	06"29	06"42	06"55	06"70	06"84
04"90	10.20	05"00	05"10	05"21	05"33	05"44	06"18	8.09	06"31	06"44	06"57	06"72	06"87
04"92	10.16	05"02	05"12	05"23	05"35	05"47	06"20	8.06	06"33	06"46	06"60	06"74	06"89
04"94	10.12	05"04	05"15	05"26	05"37	05"49	06"22	8.04	06"35	06"48	06"62	06"76	06"91
04"96	10.08	05"06	05"17	05"28	05"39	05"51	06"24	8.01	06"37	06"50	06"64	06"78	06"93
04"98	10.04	05"08	05"19	05"30	05"41	05"53	06"26	7.99	06"39	06"52	06"66	06"80	06"96
05"00	10.00	05"10	05"21	05"32	05"43	05"56	06"28	7.96	06"41	06"54	06"68	06"83	06"98
05"02	9.96	05"12	05"23	05"34	05"46	05"58	06"30	7.94	06"43	06"56	06"70	06"85	07"00
05"04	9.92	05"14	05"25	05"36	05"48	05"60	06"32	7.91	06"45	06"58	06"72	06"87	07"02
05"06	9.88	05"16	05"27	05"38	05"50	05"62	06"34	7.89	06"47	06"60	06"74	06"89	07"04
05"08	9.84	05"18	05"29	05"40	05"52	05"64	06"36	7.86	06"49	06"62	06"77	06"91	07"07
05"10	9.80	05"20	05"31	05"43	05"54	05"67	06"38	7.84	06"51	06"65	06"79	06"93	07"09
05"12	9.77	05"22	05"33	05"45	05"57	05"69	06"40	7.81	06"53	06"67	06"81	06"96	07"11
05"14	9.73	05"24	05"35	05"47	05"59	05"71	06"42	7.79	06"55	06"69	06"83	06"98	07"13
05"16	9.69	05"27	05"37	05"49	05"61	05"73	06"44	7.76	06"57	06"71	06"85	07"00	07"16
05"18	9.65	05"29	05"40	05"51	05"63	05"76	06"46	7.74	06"59	06"73	06"87	07"02	07"18
05"20	9.62	05"31	05"42	05"53	05"65	05"78	06"48	7.72	06"61	06"75	06"89	07"04	07"20
05"40	9.26	05"51	05"63	05"74	05"87	06"00	06"50	7.69	06"63	06"77	06"91	07"07	07"22
05"42	9.23	05"53	05"65	05"77	05"89	06"02	06"52	7.67	06"65	06"79	06"94	07"09	07"24
05"44	9.19	05"55	05"67	05"79	05"91	06"04	06"54	7.65	06"67	06"81	06"96	07"11	07"27
05"46	9.16	05"57	05"69	05"81	05"93	06"07	06"56	7.62	06"69	06"83	06"98	07"13	07"29
05"48	9.12	05"59	05"71	05"83	05"96	06"09	06"58	7.60	06"71	06"85	07"00	07"15	07"31
05"50	9.09	05"61	05"73	05"85	05"98	06"11	06"60	7.58	06"73	06"87	07"02	07"17	07"33
05"52	9.06	05"63	05"75	05"87	06"00	06"13	06"62	7.55	06"76	06"90	07"04	07"20	07"36
05"54	9.03	05"65	05"77	05"89	06"02	06"16	06"64	7.53	06"78	06"92	07"06	07"22	07"38
05"56	8.99	05"67	05"79	05"91	06"04	06"18	06"66	7.51	06"80	06"94	07"09	07"24	07"40
05"58	8.96	05"69	05"81	05"94	06"07	06"20	06"68	7.49	06"82	06"96	07"11	07"26	07"42
05"60	8.93	05"71	05"83	05"96	06"09	06"22	06"70	7.46	06"84	06"98	07"13	07"28	07"44
05"62	8.90	05"73	05"85	05"98	06"11	06"24	06"72	7.44	06"86	07"00	07"15	07"30	07"47
05"64	8.87	05"76	05"88	06"00	06"13	06"27	06"74	7.42	06"88	07"02	07"17	07"33	07"49
05"66	8.83	05"78	05"90	06"02	06"15	06"29	06"76	7.40	06"90	07"04	07"19	07"35	07"51



Fig. 5 – Handheld Microgate Timing System used at UMF Tîrgu Mureş with three passing gates.

The program will instantly calculate the equivalent time requested by the coach. In order for the recorded data to be very objective, in addition to the minimum equipment (hand stopwatch and laptop or tablet with the installed executable program), it is advisable to have instrumentation with a photoelectric cell timer (i.e. *Microgate Timing System*). The minimal number of passing gates should be two (1, 2). The ideal number of passing gates depends on the number of required split times related to: sprint or long distance running, hurdling, long or triple jumping, swimming, other distances of displacement / locomotion, etc. (Fig. 5).

Domains, exemplifications and applicability of the TEMPOSOFT Program

a) *Applied sport disciplines and events*

Going through the literature, we noted an answer to the question: *Why does any athlete need a very good physical training in general, and a very good speed, in particular,*

regardless of the practiced sport discipline or sport event?

Thus, Letzterter quoted by Smirniotou argues that running speed over short distances is the fundamental quality because it provides any athlete with the ability “to quickly react (reaction rate), to be able to accelerate over a distance as long as possible (power), to reach a top-speed as high as possible (maximum velocity), to maintain it for as long as possible (maximum speed under resistance) and finally to minimize fatigue caused by the loss of velocity (speed under a submaximal resistance)” (Smirniotou et al., 2008). In addition, the effective management of speed training eliminates the occurrence of the phenomenon named “anaerobic energogenic substrate depletion” (McArdle et al., 2010). A top acceleration in running as high as possible can be achieved only with the activation of a considerable number of muscle motor units with maximum force executions “performed explosively and with the highest frequency” (Bompa & Carrera, 2006). A brief listing of sport disciplines and events that could be the beneficiaries of our proposed grids is presented in Table III.

b) *Determination of the individual rate of technicality (IRTh) in the hurdle race*

In hurdle running, the achieved time of the athlete is the result of his *topokinetic performances* (the individual reaction rate, the acceleration rate up to the first hurdle, the stepping rate for each hurdle, the lower limb strength impulse, the acceleration rate during the running range after the last hurdle up to finish line etc.). All these are supplemented by other individual *morphokinetic performances* (i.e. block starting technique, hurdle stepping technique, running technique up to the first hurdle and between hurdles, the overall rhythm of running

Table III
Illustrations of several sport disciplines and events as beneficiaries of grids utilization in running or other displacement computing tempos.

No.	Sport discipline	Targeted events or specific components of locomotion	Applicability and relevance in the context of specific requirements of the sport disciplines or events
1	Athletics	Speed running races Long distance running races Hurdle races (short and long distances) Long jump, triple jump, pole vault (the speed running approach) Javelin throw (the speed running approach)	Guiding the effort intensity on the development of running speed onset start and flying start sprint Identifying the deceleration areas throughout the entire running distance Setting up physical preparation in order to eliminate disturbing factors Developing the speed running approach in the context of the overall event requirements (speed acceleration, optimal speed on take-off phase, step running rhythm etc).
2	Rowing and kayak-canoeing	All competition events	Guiding the effort intensity for craft propulsion by setting of requested momentary times of displacement in relation to the objectives and requirements of the training period
3	Cycling	All competition events	Guiding the effort intensity in cycling by setting of requested momentary times of displacement in relation to the objectives and requirements of the training period
4	Swimming	All competition events	Guiding the effort intensity in swimming by setting of requested momentary times of displacement in relation to the objectives and requirements of the training period
5	Orientation in running	All competition events of orientation in running	Guiding the effort intensity in orientation in running by setting of requested momentary times of displacement in relation to the objectives and requirements of the training period
6	Speed skating	All competition events	Guiding the effort intensity in orientation in speed skating but also in off season physical training (running), by setting of requested momentary times of displacement in relation to the objectives and requirements of the training period
7	Nordic ski and biathlon	All competition events	Guiding the effort intensity in orientation in Nordic ski and biathlon but also in off season physical training (running), by setting of requested momentary times of displacement in relation to the objectives and requirements of the training period
8	Sport games	Especially physical training targeting the specific displacements on the playing field	Guiding the effort intensity in playing field displacement in technical and tactical context but also in non-specific physical training (i.e. sprints on short distances, uni- and multidirectional sprints, marker simulations and counterattack displacements etc.), by setting of requested momentary times of displacement in relation to the objectives and requirements of the training period

etc.). The main difficulty consists in the determination of contributory factors which lead to progress (i.e. a better personal running time). This is a problem encountered by any hurdle coach. By calculating the individual rate of technicality (IRTh), the contributory factor in achieving individual performance can be accurately determined. The formula is:

$$\text{IRTh} = (\text{Thr} - \text{Tsr}) / \text{Nh}$$

IRTh = individual rate of technicality; Thr = hurdle race time
Tsr = speed running time; Nh = number of hurdles

Thus, the analysis of the split time of each interval between the hurdles or the equivalent interval of the running speed can identify the possible moments of acceleration or deceleration, the stagnation or regression which limit the performance or other causes that produce individual progress/regress: higher /low speed running, very good / bad hurdle stepping technique etc. We illustrate below two analyzed cases of the 60 m hurdle race, based on the TEMPOSOFIT data-program, measured by the *Microgate Timing System*.

1. 1st case (Fig. 6)

- 1st finding: the difference between the *hurdle running time* (Thr) and the *speed running time* (Tsr) is too large.
- 2nd finding: the *individual rate of technicality* (IRTh) is weak (low level - LL).
- priority target: substantial *optimization of the hurdle stepping technique*.
- secondary target: further development of overall individual running speed.

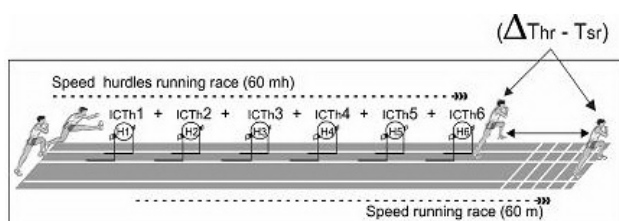


Fig. 6 – Low level of individual rate of technicality (LL-IRTh)
Note. This particular situation generates a large difference between the *speed running time* (Tsr) and the *hurdle race time* (Thr) with a modest performance in the hurdle race.

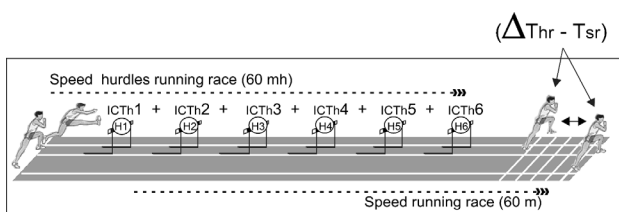


Fig. 7 – High level of individual rate of technicality (HL-IRTh).
Note. This particular situation generates a small difference between the *speed running time* (Tsr) and the *hurdle race time* (Thr) with a very good performance in the hurdle race.

2. 2nd case (Fig. 7)

- 1st finding: the difference between the *hurdle running time* (Thr) and the *speed running time* (Tsr) is small.
- 2nd finding: the *individual rate of technicality* (IRTh)

is at a high level (high level - HL).

- priority target: *maintaining and improving the hurdle stepping technique*.
- secondary target: *further development of overall individual running speed*.

c) The analysis of several race timelines in high performance athletes

By analyzing the recorded patterns of several race timelines in world class performers (3), we can calculate adapted timelines for our own athletes, assessed by the proposed new TEMPOSOFIT program. Therefore, the TEMPOSOFIT program can become an effective work tool for each coach (Figs. 8, 9, 10).

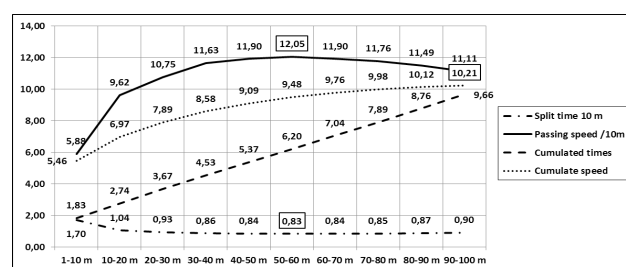


Fig. 8 – Ben Johnson timeline in the 100 m. running race - 1988 (Time = 9"79).

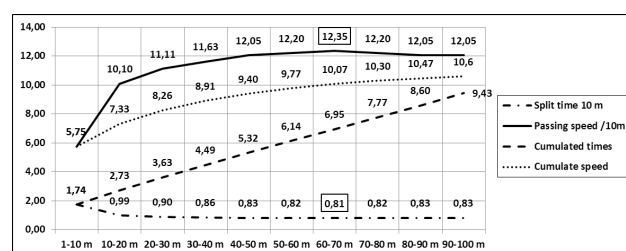


Fig. 9 – Usain Bolt timeline in the 100 m. running race - 2009 (Time = 9"58).

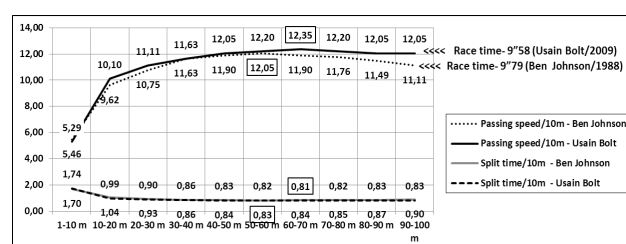


Fig. 10 – Comparative timelines between Ben Johnson (1988) and Usain Bolt (2009) in the 100 m. running race.

d) Creation of a weighted rank matrix of motor skills pattern / sport event

In the context of an objective contribution to the evaluation of each component of the ideal profile of an athlete related to a sport event requirement, we can develop a rank matrix pattern of skills, which can highlight only the valid and relevant score made by an athlete. Obviously, the contribution of the TEMPOSOFIT program is in sport disciplines or events involving displacement movements. We present such a matrix pattern, inspired by Colibaba & Bota (1998) (Figs. 11, 12).

Specific motor skills	Task / Test	Individual result	Nominal rating	Skills ranking ratio						Weighted rating
				6	5	4	3	2	1	
Reaction rate	Reaction rate / auditory stimulus test	0"218	10	●						10
Repetition rate	„Tapping” Test / 6 sec.	68 rep.	10	●						10
Sprint	50 m sprint	7"3	8	●						8
Body weight / Lower limb force	Squat kgs. / body weight	1,4	10			●				6,66
Lower limb force	Standing long jump	2,28 m	10		●					8,33
Crunch	Trunk lifting / 30 sec.	38 sec.	9				●			4,50
Lombar mobility	Orthostatic lombar mobility test	Up to 15 cm	10			●				6,66
Specific mobility hurdle stepping	Maintaining a specific unsteady position with five inter-segmental right angles	Up to 40"	8	●						8
Specific endurance	300 m race	67"	7					●		2,33
General endurance	800 m race	2 min. 30"	5						●	0,83
TOTAL SCORE			Rated 87	4	1	1	2	1	1	Weighted 65,31

Fig. 11 – Theoretical matrix pattern of motor skills related to event requirements (i.e. 60 m hurdle race).

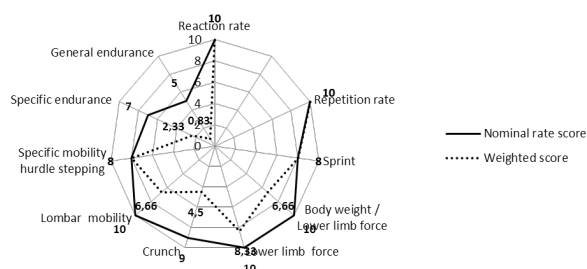


Fig. 12 – Graphical representation of the athlete's profile. The matrix pattern of motor skills related to hurdle race requirements – short distances.

Conclusions

1. The *individual coach* should be replaced by the so-called *coach team* (technical staff) - a comprehensive *team of specialists*: coach, physical trainer, physical therapist, nutritionist, psychotherapist, statistician (computer scientist), video operator, etc.

2. To have a well-founded and valid correlation with the athletes' momentary possibilities, a special exercise management based on a very accurate data base is required.

3. All these can be highlighted only using modern equipment and techniques, to quantify and evaluate in an extremely accurate manner the quantitative and qualitative exercise parameters - *volume, intensity and density*.

4. We propose and recommend the TEMPOSOFT program to be used in the training process in the case of more sports disciplines, but especially in those where the speed of movement (running or displacement) is a determinant or contributory factor of performance.

Conflicts of interest

Nothing to declare.

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Web sites

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