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ORIGINAL RESEARCH

THE QUANTITATIVE MODEL OF THE FINALIZATIONS IN MEN'S COMPETITIVE HANDBALL AND THEIR EFFICIENCY

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Abstract

In the epistemic steps, we approach a competitive performance behavior model build after a quantitative analysis of certain data collected from the official International Handball Federation protocols on the performance of the first four teams of the World Men's Handball Championship - Croatia 2009, during semifinals and finals.

This model is a part of the integrative (global) model of the handball game, which will be gradually investigated during the following research.

I have started the construction of this model from the premise that the finalization represents the essence of the game.

The components of our model, in a prioritized order: shot at the goal from 9m- 15p; shot at the goal from 6m- 12p; shot at the goal from 7m- 12p; fast break shot at the goal - 11,5p; wing shot at the goal - 8,5p; penetration shot at the goal - 7p;

Introduction

Building a model of the handball game is a priority of the epistemological investigative work in our field, especially if we want a quicker come-back of handball in our country.

This is not the first attempt, several other models were made: Bota (1989) in handball; Colibaba- Bota (1998) in sportive games; Yiannakos A. and collaborators (2004) in handball; but they must be updated and adapted to the game's demands, tendencies and development directions, after each international competition.

The fact that handball has a lot of component elements as well as an infinity of relations between these elements, determines us to use in our research the method of modeling (Taborsky, F. – 2001, Pollany W. - 2001). Epuran M. (2005) says: "in order for a model to be correctly build and applied, it must fulfill certain conditions:
   a) the field of the model must be better known that the field of the original;
   b) the model must be an extrapolation of the original, without all its fields;
   c) the analogy between the model and the original must be qualified: performances, functions, the structure of the two systems."
   d) the model must allow the emphasis of certain dimensions referring to the original and that are not explicitly present in the initial data (P. Apostol 1970, p.165, quoted by Epuran 2005).

Bompa Tudor (2001) says that: "the elaboration of a model is not a short-term process. A model for the future must be based on preceding examples and to eliminate the errors, and that could take several years. It must be specific to the sport that it investigates".

The sportive game system is made up of subsystems (elements) that act in a synergic manner in order to accomplish well-determined performance finalizations (Colibaba- Bota 1998). There are several types of models:

- Integrative (global) game model;
- Orientation and selection model;
- Training model;
- Scientific research model.

The integrative (global) game model comprises series of subsystems such as:

- Team model;
- Player model;
- Fundamental game components model;
- Ambiance model;
- Performance behavior model (of the team and individual players);
- Absolute performance model.

The type of model investigated in this paper is the performance behavior model in the finalist teams at the World Men's Handball Championship - Croatia 2009, with certain connotations of an absolute performance model.

Research hypothesis

The investigation of certain elements in the competitive performance behavior of the teams in the World Men's Handball Championship finals could orient us toward the improvement of the existent model. The data comprised in the juniors' protocols could bring new parameters of competitive performance behavior.

Subjects and methods

The subjects were the teams in the first four places at the World Men's Handball Championship - Croatia 2009.

We researched the game protocols in the semifinals, small finals (places 3-4) and big finals (places 1-2) published by the International Handball Federation. These data were analyzed statistically and mathematically and then systematized in tables on specific issues.

Results

1. Regarding the frequency of shots at the goal

A team has an average shot at the goal of 42.75 times, a minimum being an average of 38.50 executions, and a maximum an average of 49.00 executions in (see Annex 1).

Shots at the goal and game situations   TABLE 1

Goal situation	No. of executions	% frequency	Position
6m throws (semicircle)	5.87	13.73%	II- III
Wing throws	5.87	13.73%	II – III
9m throws	19.5	45.66%	I
Fast break throws	5.25	12.81%	IV
7m throws	4.25	9.94%	V
Penetration throws	2.00	4.67%	VI
TOTAL	42.75	100%	

The repartition of shots at the goal and game situations (table 1) shows that the highest frequency is found at the 9m (distance) throws, with an average of 19.50 executions which represents a frequency percent of 45.66, followed by the 6m throws (semicircle) and the wing throws, both with an average of 5.87 executions and a percentage of 13.73%, and the fast break throws with an average of 5.25 executions, respectively a percent of 12.28. Next are the 7m throws, with an average of 4.25 executions and a percent of 1.94.

The situation regarding the frequency of shots at the goal in the first 4 teams at the World Men's Handball Championship - Croatia 2009 is as follows:

- POL = in average over 2 games, semifinal and small final = 49.0 executions, on third position;
- DEN = in average over 2 games, semifinal and small final = 44.50 executions, on fourth position;

- CRO = in average over 2 games, semifinal and big final = 39 executions, world vice-champion;
- FRA = in average over 2 games, semifinal and big final = 38.50 executions, world champion.

2. Regarding the efficiency of shots at the goal
Out of 42.75 average shot at the goal of a team, 24.75 goals are scored which emphasizes an efficiency of 57.89% with a minimum efficiency average of 50.55% and a maximum efficiency average of 66.23%.
Efficiency of goal situations   TABLE 2

Goal situation	No. of executions	No. of goals	% efficiency	Position
6m throws (semicircle)	5.87	3.87	66.26	IV
Wing throws	5.87	3.00	51.10	V
9m throws	19.5	8.75	44.35	VI
Fast break throws	4.25	3.75	88.23	I
7m throws	5.25	3.87	73.71	III
Penetration throws	2.00	1.5	75	II
TOTAL	42.75	24.75	5.89	

Regarding the goal situations, the most efficient were the 7m throws, followed by the penetration throws with an efficiency of 75%; the fast break throws with 73.71%; the 6m throws (semicircle) with 66.26%; the wing throws with 51.10% and the 9m throws with an efficiency of 44.35%.
The efficiency of shots at gate in the researched teams, calculated as an average over two games, is as follows:
- FRA= world champion 66.00%;
- CRO= world vice-champion 61.52%;
- POL = bronze medal 55.10%;
- DEN= 4th position 50.55%.

3. Regarding the contribution of game situations to scoring
This parameter was calculated also, in order for us to be able to give a correct evaluation of each situation's importance.

Contribution of goal situations for scoring   TABLE 3

Goal situation	No. of goals	%	Position
6m throws (semicircle)	3.87	15.63	II-III
Wing throws	3.00	12.12	V
9m throws	8.75	35.35	I
Fast break throws	3.75	15.11	IV
7m throws	3.87	15.63	II-III
Penetration throws	1.5	6.06	VI
TOTAL	24.75	100	

The largest contribution of goal situations for scoring had the 9m throws with a percent of 35.35, then the semicircle and fast break throws, with 15.63%; the 7m throws, with 15.11%; the wing throws, with 12.12% and the penetration throws, with 6.06%.
Cumulating the data from the tables 1, 2, and 3, we can build a correct model of the performance behavior in the most valuable teams at the World Men's Handball Championship - Croatia 2009.

4. Centralizing the percents for each game situation, according to tables 1, 2 and 3

Goal situation	Table 1 frequency		Table 2 efficiency		Table 3 Contrib. sit. scoring		Final	
	%	loc	%	loc	%	loc	% points	place
6m throws (semicircle)	13.73	II-III	66.26	IV	15.73	II-III	12.0	II-III
Wing throws	13.73	II-III	51.10	V	12.12	V	8.5	V
9m throws	45.66	I	44.35	VI	35.35	I	15.0	I
Fast break throws	12.28	IV	73.71	III	15.63	II-III	11.5	IV
7m throws	9.94	V	88.23	I	15.11	IV	12.0	II-III
Penetration throws	4.67	VI	75.00	II	6.06	VI	7.0	VI

Giving for the 1st place 7 points, 2nd place 5p, 3rd place 4p, 4th place 3p, 5th place 2p, 6th place 1p, we have obtained the following hierarchy of goal situations:
I. 9m throws with 15 p; II-III. 6m and 7m throws each with 12 p; IV. Fast break throws with 11.5 p. V. Wing throws with 8.5 p. VI. Penetration throws with 7 p.

Discussing and interpreting the results

The data of our model, regarding the frequency of shots at the goal, emphasizes an average of 42.75 executions- the minimum being of 38.50 executions and the maximum, of 49 executions and the data from the specialized literature (Bota 1984 and Colibaba and Bota 1998) is a difference of 3.50, respectively 4 extra executions. This difference is given by the increase of game dynamics following the changes in regulations regarding the continuation of the game after the scoring of the goal. Thus, the 1984 and 1998 models (which are identical) and considered prospective models, are obsolete. The newly built model becomes a current, ideal model, but not a prospective one. The paradigm of perspective will be build during following research.
In the scoring situations, the 9m (distance) throws have the highest frequency, with a team and match average of 45.66% executions, in comparison with other situations with percents between 13.73 and 4.67. The result is presumed to be determined by the distance from the defender, who acts less efficiently, and the height and strength of the players throwing from a 9m distance.
The ratio between the final position of the first four teams and the number of shots at the goal is not directly proportional:
- First place FRA- a game average of shots at the goal of 38.5
- Second place CRO- a game average of shots at the goal of 39.0
- Third place POL - a game average of shots at the goal of 49.0
- Fourth place DEN- a game average of shots at the goal of 44.5

This result can be integrated in the game conception of the respective teams, in their way of applying tactics that determined a longer training time for each situation of shots at the goal, from each of the studied teams.
- regarding the efficiency of shots at the goal realized in this world championship we can see that it is directly proportional with the final position: 1st place FRA = 66.23%; 2nd place CRO = 61.52%; 3rd place POL = 55.10% and 4th place DEN = 50.55%. This result leads us to believe that the paradigm of efficiency that we presented is confirmed by the practical reality.
The efficiency of shots at the goal model that we have built, of 57.89% can be compared with the prospective models from 1984 and 1998 regarding certain components:
- regarding the 9m throws- the prospective model foresees an efficiency of 50%;
- the real 2009 model is of 44.35%.
From here we can see that the prospective model from the years 1984 and 1998 did not have a very rigorous epistemological basis:
- regarding the 7m throws- the prospective model is of 90%;
- the real 2009 model is of 88.23%.
As a part of tactics, the fast break has a specific particularity regarding the dynamics of efficiency during various international competitions: at the World Men's Handball Championship - Croatia 2009 the efficiency was of 73.71%; in other competitions the situation was very different: Yiannakos A., (2004) presents the following situation: European Championship Croatia = 60% (Czerwinski,1998); European Championship

Italy = 75% (Czerwinski, 1998); World Championship Egypt = 62.8% (Seco, 1999); European Championship Sweden = 75% (Mocsai, 2002) - quoted by Yiannakos A. and collaborators (2004).

We have also built the model of the contribution of every situation for scoring, in order to give a correct interpretation of the final hierarchy. Showing just the connection between frequency and efficiency does not ensure a correct emphasis of the way the model reflects the original.

Conclusions

The world championships, like other international competitions, constitute the main sources for scientific models of the competitive game.

The performance behavior model regarding the frequency and efficiency of finalizations represents an important guide for the work of teachers and coaches that deal with competitive sports.

The components of the performance behavior model regarding the finalization in handball are presented in table 4, detailed in annex 1 and objectified in tables 1, 2, 3, whereas the hierarchic order of these components is this:

1. 9m throws = 15p;
2. 6m throws (semicircle) = 12p;
3. 7m throws = 12p;
4. Fast break throws = 11.5p;
5. Wing throws = 8.5p;
6. Penetration throws = 7p.

The order of the goal situations determines the tendencies and development directions of handball, with implications in the process of training process and application during competitions of game tactics.

Our final model has enough epistemological justification to be considered an ideal one.

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ANNEX 1.

Distribution of the shots at the goal and scoring over games, teams and goals

Teams	TOTAL		Throws/goals during game situations						Results			Scored goal/goal received in a game	Dif
	G/S	%	6m	W.	9m	7m	FB	Pen	RI	RII	Final		
FRA/CRO	24/36	67	4/6	1/4	8/14	7/7	4/5	0/0	11/12	13/7	24/19		
FRA/DEN	27/41	66	6/8	4/6	9/16	4/6	2/3	2/2	16/11	11/11	27/22		
FRA/TOTAL	51/77	66.23	10/14	5/10	17/30	11/13	6/8	2/2	27/23	24/18	51/41	25.5/20.5	+5
CRO/FRA	19/36	53	3/4	3/6	7/18	4/	2/4	0/0	12/11	7/13	19/24		
CRO/POL	29/42	69	6/7	3/5	9/18	6/6	4/5	1/1	14/13	15/10	29/23		
CRO/TOTAL	48/78	61.52	9/11	6/11	16/36	10/10	6/9	1/1	26/24	23/23	48/47	24.00/23.5	+0.5
POL/DEN	31/50	62	3/5	4/6	13/25	0/0	7/7	4/7	14/11	17/12	31/23		
POL/CRO	23/48	48	3/7	1/7	6/18	4/5	4/6	5/5	13/14	10/15	23/29		
POL/TOTAL	54/98	55.10	6/12	5/13	19/43	4/5	11/13	9/12	27/25	27/27	54/52	27.00/26.00	+1
DEN/POL	23/49	47	1/3	5/6	8/26	4/5	5/9	0/0	11/14	12/17	23/31		
DEN/FRA	22/40	55	5/7	3/7	10/21	1/1	3/3	0/1	11/16	11/11	22/27		
DEN/TOTAL	45/89	5055	6/10	8/13	18/47	5/6	8/12	0/1	22/30	23/28	45/58	22.5/29.00	-6.5
TOTAL OVER 4 GAMES	198/342	57.92	31/47	24/47	70/158	30/34	31/42	12/16	102/102	96/96	198/197		
TEAM AVERAGE	24.75/42.75	57.89	3.87/5.87	3.0/5.87	8.75/19.50	3.75/4.25	3.87/3.87	1.5/2.0	25.55/25.55	24.00/24.00	24.75/24.75	24.75/24.75	