



THE RELATIONSHIPS BETWEEN THE EFFECTIVENESS OF TEAM PLAY AND THE SPORTING LEVEL OF A TEAM

doi: 10.2478/v10038-012-0017-2

RYSZARD PANFIL, EDWARD SUPERLAK*

University School of Physical Education, Wrocław, Poland

ABSTRACT

Purpose. This study aimed at determining what relationships exist between the determinants of team play efficiency (cooperation) for creating scoring situations in volleyball and the sporting level of a team. These relationships take into consideration the number of players who cooperate within a team and the speed at which sets are performed. **Methods.** The study gathered observational data on how three leading male volleyball teams, namely Brazil, Russia and Serbia, played in the semi-finals of the 2010 World League, finishing first, second and fourth, respectively. The research tool was a self-made data registration sheet which included the description of the chosen variables, namely the type of plays used and how sets were formed, and the criteria for their quantification. The collected results were presented as tables and indexes. An interdisciplinary interpretation of the results was conducted, which included a qualitative identification of the dependencies that existed between the chosen variables. **Results.** The efficiency of team cooperation when solving situational problems in the offense was not significantly different in the analysed teams. The prevailing activities during the game were those performed in the 2nd tempo, i.e. team play requiring the coordination and synchronization of three players. Players' activity as well as the performance efficiency of the sets they performed in the 2nd tempo increased along with an increase in the sporting efficiency of the examined teams. In the case of sets performed in the 3rd tempo, activity and the efficiency of coordination declined along with the growth of sports efficiency. The suggested indexes of the employment and application of synergy enable us to determine its level within the teams which differ in regards to sports efficiency. A diagnostic value of the index of synergy usage, which is determined by the efficiency of sets in various paces, is higher than a diagnostic value of the index that is determined by the activity of team play. **Conclusions.** Nowadays, sport teams, especially those which play volleyball at the highest world level, are characterized by a high level of dynamic organization of players' activities, which is manifested in the game with the high efficiency of team play when solving situational problems in the offense, particularly with the use of two or three players conducted in the 1st and 2nd tempos.

Key words: team game, team play, sets, efficiency, synergy

Introduction

The factors determining sports efficiency or sporting level are established within the context of sporting skills by analysing the results obtained in qualified competition. In the case of team sports where the skills needed in competition are determined by pro-team, personality-related, intellectual and motor dispositions, an analysis of the determinants of sports efficiency is particularly complex [1–4].

A review of the numerous studies available on sports efficiency in team sports indicates that the factors that have had an effect on sporting level are interpreted in the Cartesian way and analysed separately. In some studies motor skills were determined as the most important factors, as in Spieszny and Żak [5], Latash [6], Stepiński et al. [7]. The role of fitness abilities were examined, among others, by Hoffman et al. [8], Bitttenham [9], Klocek and Żak [10]. Coordination abilities were regarded as particularly important by, among others, Ljach and Waśkiewicz [11]. To a broader extent,

other factors determining efficiency in team sports were considered, such as players' mental dispositions, both personality-related [12, 13] and intellectual [14, 15].

On the other hand, both in practice and in research, analysis on players' efficiency is restricted to individual assessments without any attempts to calculate the meaning of the team context. Such an approach is presented by, among others, Dembiński [16], Beal [17], Huciński and Tymiński [18]. Here, team efficiency is regarded as a set of individual aspects of efficiency rather than a set of mutually dependent individual efficiency levels. It is believed that assessments obtained in such a method are not entirely objective because they do not take into consideration the mutual interaction of the players, that is, the influences and relations which have an essential influence on efficiency, as far as team play is concerned.

A sports team is an sum exceeding its parts, one cannot perceive players in isolation from one other. An explanation of a sports team's actions requires an integral approach that treats the team of players as a dynamic system. Such a description is necessary in order to take into account the social and material-based relationships and influences, which can be better known as synergy, that occur in such a system [2, 19–22].

* Corresponding author.

For example, in sports competition, the football and volleyball teams representing Poland in international competitions were perceived by their coaches in such a synergic way (Kazimierz Górski for the football team and Hubert Wagner for the volleyball team). When time came to select players for the national teams these coaches selected the best two- or three-player groups they saw that worked effectively in local teams, not just single individuals, to be put on the roster. In this way the positive effects of two-person and three-person synergies were introduced to the new team. These relationships were further developed by their training and in their parent clubs. The teams later showed high sports efficiency, being that they treated the teams in a synergic way as systems of cooperating sub-subjects, i.e. as two-player and three-player groups. This was opposed to an individualized perception of players (which is unfortunately common), which treats the team as set of subjects with individual skills.

The characteristic feature of present-day sports teams, in particular those which play volleyball, is the high degree of organization needed in the dynamic play and actions taken by each of the players. Panfil [2], defining the game of sport, states that it is composed of both the surprising and anticipated plays and actions of a team cooperating with its offensive, counter-offensive and defensive elements. These elements are performed by the all of the participants of the game aimed at achieving a number of individual, common and opposing goals based on the accepted rules of the game (regulations and strategy). In the context of this study, the skills in resolving game situations are systems (sequences) of actions taken by the players with respect to goals of the game, that is, the deliberate sequences of actions in two-player and three-player groups and played at various tempos. In the case of volleyball, it is game rules that determine the dominant influence of the effects of team play between two or three players in offensive, counter-offensive or defensive systems on the achieved results.

The organizational relations of a sports team are determined by spatial dependencies, that is, by the type of coordinated actions taken by its team members, and time dependencies, as the degree of synchronization of these actions. Team play carried out at the highest level of synchronization and coordination introduces new qualities to the team, allowing for the effective realization of the goals in the game. The level of synchronization and coordination of team play in the game depends on selecting the time, place and method of play of a given player with respect to the time, place and method of play of his/her teammates [22].

Therefore, the logical basis for analysing the efficiency of team play would be a five-factor calculation of the performed actions which are absolutely dependent on each other, these factors (marked by the symbols g, p, c, s and w) are:

- g – the cooperating players identified in two-player or three-player sets
- p – the space available to effectively play, defined by situational factors
- c – the goal of coordinating team play
- s – the way of executing the sets
- w – the result of coordinated team play

On the basis of this predicate, we can define the two-player and three-player sets used by the offense of a volleyball team, and find:

- g – stands for the type of sets executed in the game
- p – are factors determining the space available to play in, including organizational and infra-structural factors
- c – the goal is to create scoring situations by the offense
- s – is the way of synchronizing and coordinating team play
- w – the result, which points to the level of team play efficiency

Identifying the synergy level in the two-player and three-player offense sets was also carried out on the basis of the following different factors:

- a) the number of players participating directly in the sets
 - from 2 to 3
- b) the goal of the play, i.e. creating scoring situations
- c) the type of synchronization in the sets:
 - advancing (active),
 - following (reactive),
- d) the type of coordination that takes advantage of the available space in the sets:
 - gaining (changing) the position of the players,
 - maintaining the same position by the players,
- e) the type of pass used in the play:
 - short (fast, underhand),
 - long (slow, overhead).

All of the presented determinants differentiate the levels of synergy in the sets used in creating scoring situations in volleyball [21].

A high level of synergy in the sets creates a new value and known sometimes as the so-called winning and fast sets, characterized by: the participation of three players, gained game space, changes in the occupied position, performing fast passes and is considered an advancing (active) set. Examples of these sets in volleyball are: fast sets performed in the “second tempo”, e.g. the shifted short, short from the back (the so-called pipe). An average level of synergy in sets (creating an added value quality) are groups of sets characterized by the participation of two players who change positions by the player who is the hitter and making short advancing passes. The examples of the sets in volleyball are playing the ball in the so-called “first tempo” in the attacking line. A low level of synergy is shown in the so-called maintaining, “slow” sets. These sets are

characterized by the participation of two players, they maintain their occupied positions, they perform a long, high pass and is synchronized sequentially. Examples of these sets in volleyball are a high pass to a player in zones II or IV in the so-called “third tempo”.

Based on the presented circumstances, the objective of this study were formulated and research questions postulated to better analyse the problem. The goal of the study was to define the relationships between the determinants of team play efficiency in creating scoring situations in volleyball and the sporting level, considered within the context of the number of teammates and “tempo” at which they performed the sets.

1. Are there any differences in team play efficiency for teams presenting high but differentiated sports efficiency?
2. To what extent is the activity of team play in the two-player and three-player sets connected with team efficiency in volleyball?
3. Did the studied teams differ with respect to the use of offense sets played in the first, second and third tempo?
4. To what extent does the level of synergy in two-player and three-player sets differentiate team efficiency in volleyball?

Material and methods

The inspirations for the development of this method stemmed from both practical and methodological circumstances. From a practical point of view, there is no method of objectively identifying exceptional cases (phenomena, processes, conditions) that take into consideration a number of pragmatic issues. The inspiration for the methodological influence came from the scientific method used in economic, social psychology or pedagogical science known as the case study, or the analysis of an individual case.

Therefore, the proposed method is an original research procedure taking into account the situational and system-based dimensions of the study, a pragmatic perception of the research and in particular the obtained results, and their interdisciplinary dimension. This method allows for the analysis of complex entities (subjects) which can be the subject of interest in any number of applied sciences, e.g. medicine, economy, pedagogy or sport, and regarded as exceptional, that is, distinguished by unique progression or regression or regarded as unique in the sense of being ideal or regressive. The uniqueness of the examined object may have a quantifiable dimension, e.g. a uniqueness in size, speed, stability or changeability, as well an effective dimension or a quality dimension, e.g. uniqueness of organization, skills, competence or attractiveness.

The structure of the research procedure

1. Justification for the uniqueness of the selected case studies (a complex subject or object)
 - 1.1. Research instruments:
 - choosing a unique object by experts and justifying the choice
 - fulfilling the objective criteria of uniqueness
2. Choosing and describing hypothetic (variable) factors allowing the identification of the uniqueness of the examined phenomenon:
 - a) choosing and describing the variables, e.g. actions, behaviours, dispositions,
 - b) choosing and describing the criteria for analysing the variables, e.g. skills, efficiency
 - 2.1. Research instruments:
 - choosing the variables and criteria by experts
 - choosing the variables and criteria by brainstorming
 - describing the chosen variables and criteria allowing their quantification
3. Quantitative identification of the variables based on the accepted criteria
 - 3.1. Research instruments:
 - observing the factors, e.g. use of a recording sheet
 - basic statistical calculations
 - formalisations of the results, e.g. in the form of tables, figures or indices
4. The interdisciplinary interpretation of the results, based on the knowledge, imagination and intuition of the researchers by the qualitative identification of the dependencies between the variables and the uniqueness of the similarities and differences with respect to the accepted criteria (by taking into consideration average or unique cases)
 - 4.1. Research instruments:
 - interdisciplinary interpretation
 - formalisation of dependencies or relationships
5. Formulating practical directives which allow for the:
 - rationalization of the actions of the unique object under examination and those similar to it
 - systematic ordering of the knowledge about this unique phenomena

For this study, the data collected for analysis came from the three leading men’s volleyball teams, namely: Brazil, Russia and Serbia. The players from these teams competed with each other in the semi-finals of the 2010 World League, taking 1st, 2nd and 4th place, respectively (see Tab. 1).

Quantification of the observed differences of the teams’ sporting level included their direct competition

Table 1. The differences in the sporting level of the studied teams

National team	Brazil	Russia	Serbia
Number of points scores in direct competition	5	3	1
Set ratio (won : lost)	6 : 3	4 : 3	2 : 6
Place and points in FIVB ranking in 2010 [23]	1 st place 247.5 points	2 nd place 185 points	4 th place 167.75 points

and world ranking, which confirmed the primacy of the team from Brazil.

Based on the number of players, it was found that the majority of plays were composed of two-player sets – with the playmaker and the central player, and three-player sets – the playmaker, central player (simulating an attacking action) and the hitter actually hitting the ball from a specific position on the court – left attack, right attack, right defence or central defence. Selinger [24] proposed a classification of the methods of creating sets by use of a time basis, which is defined by using the term “offense tempo”, namely:

- the first offense tempo, a low set, in which the height of the ball is set from 30 to 60 cm
- the second offense tempo, a middle set, in which the height of the ball is set from 60 to 120 cm
- the third offense tempo, a high set, which allows any number of actions by the hitter

Taking into consideration the number of players, the tempo of carrying out the attack sets and the spatial organization of the players in comparison to one other, a classification of the most frequently sets used in the men’s world volleyball was conducted (see Tab. 2).

The criteria which took into account the specific features of two-player and three-player sets and created a scoring situation were used in the analysis and interpretation of the obtained results. These criteria include: the activity, its efficiency and the reliability of team play as described by Panfil [2].

Thus the action in performing the sets was absolutely dependent on each other in order to create a scoring situation. It was determined based on the number of sets performed at various tempos by two or three players regardless of their result. On the other hand, efficiency was determined in a non-graded manner based on evaluating the conformity of the result with the executed goal. Hence, the determinant of team play efficiency was the number of sets which ended with a scoring a point by the team. Reliability was based on the index value calculated from the ratio of the number of effective sets to all executed sets, i.e. the sum of effective, ineffective and counter-effective sets.

By synthesizing the significance of team play efficiency in creating a scoring situation, two indices were constructed to assess the scope of the application

and the use of synergy in the sets, determined on the basis of the ratio of the number of individual types of actions.

Thus, the synergies application index was defined (W_{ss}), calculated on the basis of comparing the activities (A) of the groups in performing the various sets as the sum of the ratios of the number of completed sets with a lower level of complexity to the number of sets with a higher level of complexity, divided by 3:

$$W_{ss} = \left(\frac{\sum III \text{ tempo}}{\sum II \text{ tempo}} + \frac{\sum I \text{ tempo}}{\sum II \text{ tempo}} + \frac{\sum III \text{ tempo}}{\sum I \text{ tempo}} \right) : 3$$

The second index which defined the importance of synergies was the index of using synergies (W_{ws}), was based on the comparison of efficiency (S) of the teams in performing various sets as the sum of the ratios of the number of effectively completed sets with a lower level of complexity to the number of effective sets with a higher level of complexity, divided by 3.

$$W_{ws} = \left(\frac{\sum Effectiveness, III \text{ tempo}}{\sum Effectiveness, II \text{ tempo}} + \frac{\sum Effectiveness, I \text{ tempo}}{\sum Effectiveness, II \text{ tempo}} + \frac{\sum Effectiveness, III \text{ tempo}}{\sum Effectiveness, I \text{ tempo}} \right) : 3$$

Results

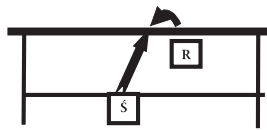
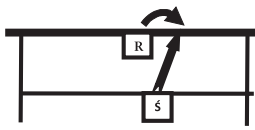
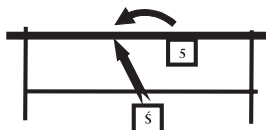


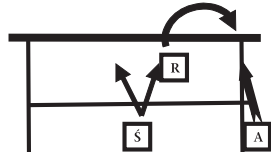
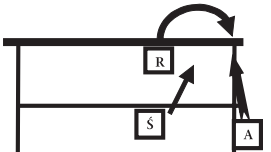
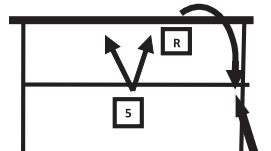
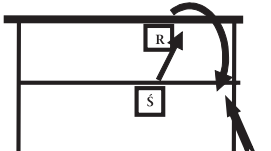
Analysis of the results began with comparing the examined teams with respect to their efficiency, including the activity, efficiency and reliability of coordinated team play in the performed sets. Then, the efficiency of the teams was compared to the coordinated team play tempo. As a result, a rational attempt to determine the significance of synergies for the efficiency of volleyball was created.

The results presented in Table 3 do not significantly differentiate the individual teams. The values and indices shown, illustrating the scope of performing the two-player and three-player sets performed at various tempos, could on the other hand constitute a model mapping high sports efficiency and may be a reference point for formulating new design models for volleyball teams.

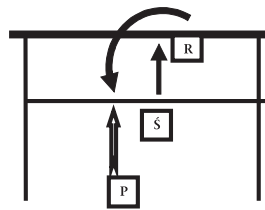
The results from the evaluation of efficiency are presented in Table 4, including the mean values of activity, efficiency and the reliability of sets performed at various tempos, and indicate a relationship between the accepted criteria and the efficiency of the examined teams, such as:

- the slower tempo, the lower reliability of the set, as the reliability of sets performed at the 3rd tempo was 0.32, in the 2nd tempo – 0.48, and in the 1st tempo – 0.61
- the ratio of the number of sets performed in each of the tempos was respectively: 1st tempo – 21%, 2nd tempo – 48% and 3rd tempo – 31%, and the ratio of the number of effective sets performed at

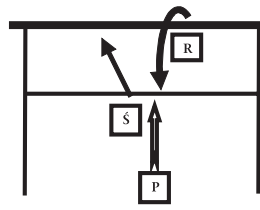
Table 2. The classification of sets used by professional men’s volleyball teams

Type of play	Description of the types of play		
Attack in two-player sets at the first tempo	 <p><i>short</i>, attack by the middle player in the first tempo situated approx. 1 m before the playmaker</p>	 <p><i>short from the back</i>, attack of the middle player at the first tempo situated approx. 1 m behind the playmaker</p>	 <p><i>hort shifted</i>, attack of the middle player at the first tempo situated approx. 3 m in front of the playmaker</p>
Attack in three-player sets at the second tempo – left attack	 <p><i>left attack – short</i>, execution of the attack from the left side of the attack field, the middle player pretends to hit a short attack, or</p> <p><i>left attack – short shifted</i>, execution of the attack from the left side of the attack field, the middle player simulates a short shifted attack</p>	 <p><i>left attack – short from the back</i>, execution of the attack from the left side of the attack field, the middle player pretends a short attack from the back</p>	
Attack in three-player sets at the second tempo – right attack	 <p><i>right attack – short</i>, execution of the attack from the right side of the attack field, the middle player pretends to hit a short attack, or</p> <p><i>right attack – short shifted</i>, execution of the attack from the right side of the attack field, the middle player pretends short attack</p>	 <p><i>right attack – short from the back</i>, execution of the attack from the right side of the attack field, the middle player pretends to hit short attack from the back</p>	
Attack in three-player sets at the second tempo – attack by the right defence	 <p><i>right defence attack – short</i>, execution of the attack from the right side of the defence field, the middle player pretends to hit a short attack or</p> <p><i>attack right defence – short shifted</i>, execution of the attack from the right side of the attack field, the middle player pretends to hit a short attack</p>	 <p><i>attack right defence – short from the back</i>, execution of the attack from the right side of the defence field, the middle player pretends to hit a short attack</p>	

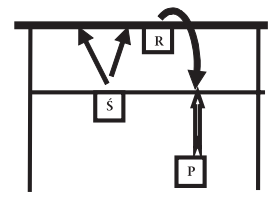
Attack in the three-player sets at the second tempo – attack by the defence middle player, the so-called pipe play



pipe in front of the playmaker – short, execution of the attack from the middle of the defence field on the left side of the middle player, the middle player pretends to hit short attack

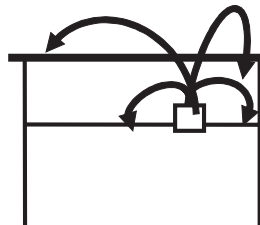


pipe in front of the playmaker – short shifted, execution of the attack from the middle of the defence field between the middle play and playmaker, the middle player pretends to hit short shifted attack



pipe behind the playmaker – short, execution of the attack from the middle of the defence field behind the playmaker, the middle player pretends short attack, or
pipe behind the playmaker – short shifted, execution of the attack from the middle of the defence field behind the playmaker, the middle player pretends to hit a short shifted attack

Attack after setting the ball at the third tempo in two-player team play



execution of the attack after setting of the ball by the playmaker or other player:
 – from the left side of the attack field, or
 – right side of the attack field, or
 – middle of the defence field, or
 – right side of the defence field

each tempo was, respectively: 1st tempo – 28%, 2nd tempo – 50% and 3rd tempo – 22%

- both the activity and the efficiency were dominated by the sets performed in the 2nd tempo, constituting 50% of all attempts
- the activity of the sets performed in the 3rd tempo was slightly higher than the number of the effective ones and was 31% to 22%, respectively

We then analysed the differences of the activity, efficiency and reliability of performing the two-player and three-player sets at various tempos by the volleyball teams. A comparison of the values presented in Table 5 illustrates the activity, efficiency, as well as the indices values of coordination reliability of sets played at various tempos allows us to define certain trends of actions determining sports efficiency in volleyball, including:

- the activity and efficiency of the sets in the 2nd tempo increased with the growth of efficiency of the examined teams
- however, for the sets performed in the 3rd tempo, we observe the contrary, where the activity and efficiency of team play decreased with an increase in efficiency

It is worth nothing that the Brazilian team, ranked as the most effective, played to the smallest extent in the in the 1st tempo and achieved a high reliability.

Analysis of the importance of synergies in terms of the examined teams' sports efficiency

In order to summarise the results in terms of the efficiency of team play in creating a scoring situation in volleyball, the indices used to assess the use of synergies in sets were analysed. They were analysed by determining the basis of the ratio of the number of individual types of actions performed at various tempos by each team.

The index of applying synergies (W_{ss}) was calculated by comparing the activity (A) of the teams in performing the various sets, and was:

$$\text{Brazil } W_{ss} = \left(\frac{27}{61} + \frac{18}{61} + \frac{27}{18} \right) : 3 = 0.75$$

$$\text{Russia } W_{ss} = \left(\frac{30}{49} + \frac{26}{49} + \frac{30}{26} \right) : 3 = 0.76$$

Table 3. The efficiency of team play for the examined teams

Team name	Effectiveness criteria		
	team play activity (number)	team play efficiency (number)	team play reliability (index)
Brazil	106	48	0.45
Russia	105	53	0.50
Serbia	118	51	0.43
Mean value	109	50	0.46

Table 4. The efficiency of team play in sets performed at various attack tempos

Tempo of team play in the set	Effectiveness criteria				
	team play activity		team play efficiency		team play reliability
	number	%	number	%	index
1	23	21	14	28	0.61
2	52	48	25	50	0.48
3	34	31	11	22	0.32
S	109	100	50	100	-

Table 5. The efficiency of sets at various tempos performed by the teams

Team play tempo	Team name								
	Brazil			Russia			Serbia		
	activity	efficiency	reliability	activity	efficiency	reliability	activity	efficiency	reliability
1	18	11	0.65	26	16	0.63	26	15	0.65
2	61	31	0.52	49	27	0.57	47	18	0.43
3	27	6	0.24	30	10	0.35	45	18	0.31

$$\text{Serbia } W_{ss} = \left(\frac{45}{47} + \frac{26}{47} + \frac{45}{26} \right) : 3 = 1.08$$

The indices of using synergies (Wws) were determined by similar principles, by adding up the numbers of the effective sets performed at various tempos, finding:

$$\text{Brazil } Wws = \left(\frac{6}{31} + \frac{11}{31} + \frac{6}{11} \right) : 3 = 0.36$$

$$\text{Russia } Wws = \left(\frac{10}{27} + \frac{16}{27} + \frac{10}{16} \right) : 3 = 0.53$$

$$\text{Serbia } Wws = \left(\frac{18}{18} + \frac{15}{16} + \frac{18}{15} \right) : 3 = 1.01$$

Interpreting the indices values of the application (Wss) and utilization (Wws) of synergies finds that the increase in efficiency leads to an increase in the level of synergies used in creation scoring situations in volleyball. This is confirmed by the indices values of both activity and efficiency and the diagnostic ability of

the synergy utilization index, determined by the efficiency of the sets at various tempos, and is higher than the diagnostic ability of the application index determined using the activity of team play.

The fact that the values of both the synergy application (Wss) and utilization (Wws) indices approached zero indicates the ever greater application and use of three-player sets performed in the 2nd tempo within the game space. On the other side of the spectrum an opposite trend was found with the values approaching one or exceeding it by the teams with lower efficiency (see the Serbian team), which indicates the decreasing importance of less complex sets performed in the 1st tempo, and in particular in the 3rd tempo.

Discussion

By recognizing the results of other studies seeking to identify the efficiency of a sports team, understood as the components of efficiency by players that are relatively isolated from one other, a research procedure was proposed that took into consideration a number of aspects, such as the system-based and situational dimension of the game, a pragmatic perception of the

research, and in particular the obtained results and their interdisciplinary dimension. The scope and type of the research presented in this study takes an innovative approach with entirely different perception of team play than the one found in above-mentioned studies and produces an original research methodology.

A sports team is treated by Panfil [21] as an integral and dynamic system in which we can distinguish social and material influences and relationship which appear in various levels of synergy, all of which were different among each of the competing teams.

The dominant importance of synchronization and coordination forces the players to treat working together as a quality of its own, as it is not possible to identify the size of an individual's contribution to that of players cooperating together to achieve a common result. The action components are so interdependent that we can perceive the joint effort of the players as a separate entity. Therefore, looking for a higher efficiency of an action or, on the contrary, registering its low efficiency, the synchronization and coordination of actions should be analysed together rather than by their individual dimension. Thus, the efficiency of fast play depends to the same extent on the playmaker as well as the hitters. The perceived level of team play by synchronization and coordination facilitates analysis of team play in sets and its variants as the actual causes of skilful team play, which lie in the coordination or synchronizations of actions, rather than in the actions themselves.

In more effective teams, actions taken in the 2nd tempo that required the coordination and synchronizations of team play by three players, are central. On the other side, the number of sets performed in the 1st and 3rd tempos are similar, but their reliability is twice as high in the case of the 1st tempo (0.61 to 0.32). This implies a greater ability to effectively anticipate the actions performed in the 3rd tempo and a higher level of surprise of actions performed in the 1st tempo (a fast play with two-player sets).

The increasing trend of growth in the activity and efficiency for the sets in the 2nd tempo may indicate a decrease in the importance of the skills needed to play sets in the 3rd tempo because they are considered classic sets, commonly used and performed rather slowly by making high passes, which makes them easy to anticipate.

The synergic perception of team play efficiency, as accepted by the players, according to the opinion of Panfil [21], is favourable for creating added value in the team and by affecting team efficiency, i.e. task-focused coherence and, consequently, on emotional coherence. The players, accepting joint responsibility for team cooperation, improve their own and their teammates' sense and consciousness of the interdependence of the tasks of the game by a final team result, i.e. winning or losing. A sense of shared responsibility for the results

also develops and strengthens the emotional coherence and material group conflicts in the team, which stem from the so-called basic composition of the two-player and three-player sets.

It appears as if the proposed indices for evaluating synergies could become a diagnostic criterion for the differences of efficiency in team sports. In practicing sports, when assessing the efficiency of actions, players are usually treated as separate subjects. Even if any sets are differentiated when carrying out an assessment on the efficiency of executing these sets, each player is evaluated individually, ignoring the dependencies between their actions which form two-player or three-player wholes.

Ignoring the joint responsibility for the result achieved by a specific team play by pointing to only a select group of player, as well as evaluating their performance by a specific action on the efficiency of another player who could not have influenced its result, such as when one player assists another, only confuses the players, makes self-evaluation more difficult, and reduces motivation in general as well as in playing together. That is why an assessment on the efficiency of two-player and three-player cooperation should concern itself with the level of synergies, and, in particular, synchronization and coordination.

It should be noted that although the creation of a scoring situation is undoubtedly the most basic component of volleyball, others, such as serving, playing in a block and the mistakes made by opposing team are also important components of the game which can influence efficiency. Therefore, the formulation of clear conclusions could only be possible after analysing the above-mentioned game components.

Conclusions

The results obtained in the course of this analysis allow us to answer the formulated research questions on what specific determinants exist in playing volleyball at the championship level.

1. The efficiency of team play (i.e. activity, efficiency and reliability) in resolving offense plays, considered due to the scope of performing certain sets with two and three players, performed at various tempos, did not significantly differentiate in the studied teams.
2. Sets performed at the 2nd tempo were the most dominant in the more effective volleyball teams and were carried out by a group of three players. The highest reliability was observed in the interaction of two players who carried out sets at the 1st offense tempo. The activity of the players and the efficiency of using the sets performed at the 2nd tempo increased with an increase in the efficiency of the examined teams, while for sets performed at the 3rd tempo, the activity and effi-

ciency of team play decreased with an increase in the efficiency.

3. It was observed that the Brazilian team, at the top of the world ranking, is characterized by significant activity in three-player cooperation at the 2nd tempo, with the significantly lowest number of sets performed at the 1st tempo. On the other side, the team from Serbia, with the lowest sporting level among the competitors, performed mostly two-player attacks at the 3rd tempo. Currently, these types of sets in the game of volleyball are regarded as routine plays used more in critical situations, and hold only one team play variant and are not very surprising plays to their opponent.
4. The suggested indexes of applying and using synergy make it possible to determine the level of synergy of a team in regards to their sporting efficiency. Index values coming close to zero indicate the greater application and utilization of three-player sets performed at the 2nd tempo by more effective teams (the Brazilian team in this case). On the other hand, an opposing trend was found with values coming close to one or exceeding it by the teams with lower efficiency (the team from Serbia) and indicates the decreasing importance of less complex sets performed at the 1st tempo, and in particular at the 3rd tempo. The comparison of these two indices allows us to state that a diagnostic ability of the synergy utilization index, determining the efficiency of the plays performed at various tempos, is higher than the diagnostic ability of the play utilization index, which determines team cooperation.

References

1. Naglak Z., Team sports game [in Polish]. AWF, Wrocław 1994, 94–112.
2. Panfil R., Praxeology of sports games [in Polish]. *Studia i Monografie AWF we Wrocławiu*, 2006, 82.
3. Superlak E., The structure of volleyball playing dispositions in players 14–15 candidates for the polish national team. *Hum Mov*, 2006, 7 (2), 118–129.
4. Superlak E., Personal dispositions and action skills in a team game [in Polish]. *Studia i Monografie AWF we Wrocławiu*, 2008, 89.
5. Spieszny M., Żak S., In search for a model of the champion in the youth handball. *J Hum Kinet*, 1999, 2, 137–150.
6. Latash M.L., Evolution of motor control: from reflexes and motor programs to the equilibrium-point hypothesis. *J Hum Kinet*, 2008, 19, 3–24.
7. Stępiński M., Zwierko T., Florkiewicz B., Dębicka J., The level of chosen motor abilities of 13 years old soccer players. *J Hum Kinet*, 2003, 9, 99–107.
8. Hoffman J.R., Fry A.C., Howard R., Maresh C.M., Kraemer W.J., Strength, speed and endurance changes during the course of Division I basketball season. *J Appl Sport Sci Res*, 1991, 5 (3), 144–149.
9. Bittenham G., Complete conditioning for basketball. Human Kinetics, Champaign 1998, 45–49.
10. Klocek T., Żak S., Structural and motor determinants of game efficiency of female volleyball players [in Polish]. *Antropomotoryka*, 2001, 22, 65–80.
11. Ljach W., Waśkiewicz Z., Diagnosis of footballers' coordination skills [in Polish]. AWF, Katowice 1998, 56.
12. Rychta T., Intentional behaviours and personality of sportsmen. In: Rychta T. (ed.), Intentional behaviours and personality of sportsmen [in Polish]. PTNKF, Warszawa 1998, 54–96.
13. Basiaga-Pasternak J., Analysis of personality types, level of fear and main components of sports motivation in juniors – football players [in Polish]. AWF, Kraków 2000.
14. Superlak E., Connection of specialist knowledge of players with a result in the game of volleyball. In: Chmura J., Superlak E. (eds.), Personal dispositions towards sports games [in Polish]. WTN, Wrocław 2003, 21–30.
15. Duda H., Intellectualisation of teaching to play football [in Polish]. *Studia i Monografie AWF w Krakowie*, 2004, 78.
16. Dembiński J., Modelling of actions of basketball players on the basis of assessment of their individual efficiency in the game. In: Dembiński J., Naglak Z. (eds.), Action efficiency of players in sports games [in Polish]. WTN, Wrocław 2003, 73–79.
17. Beal D., Seeking in a program – going for the gold. In: Shondell D., Reynaud C. (eds.), The volleyball coaching bible. Human Kinetics, Champaign 2002, 45–49.
18. Huciński T., Tymiński R., Efficiency of a player acting as a point guard in basketball [in Polish]. *Roczniki Naukowe AWF w Gdańsku*, 2001, 10, 39–54.
19. Pszczołowski T., Synergy and its place in the theory of organisation [in Polish]. *Prakseologia*, 1973, 3–4, 42–54.
20. Panfil R., Synergy in a team sports game [in Polish]. *Prakseologia*, 1992, 1–2, 73–86.
21. Panfil R., Synergism of absolutely dependent actions in a sports team (on the example of football and volleyball) [in Polish]. *Rozprawy Naukowe AWF we Wrocławiu*, 2011, 32, 20–32.
22. Panfil R., Effective coaching of task teams (on the example of sports teams) [in Polish]. *Studia i Monografie AWF we Wrocławiu*, 2008, 92.
23. www.fivb.com [accessed: 10.05.2010].
24. Selinger A., Arie Selinger's power volleyball. St. Martin's Press, New York 1986.

Paper received by the Editors: June 26, 2011

Paper accepted for publication: November 16, 2011

Correspondence address

Edward Superlak
Zakład Treningu w Grach Zespołowych
Akademia Wychowania Fizycznego
ul. Mickiewicza 58, bud. P5
51-612 Wrocław, Poland
e-mail: edward.superlak@awf.wroc.pl