

## DIFFERENCES BETWEEN THREE TYPES OF BASKETBALL PLAYERS ON THE BASIS OF SITUATION-RELATED EFFICIENCY

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### Abstract

The goal of this research is to identify and explain the difference between elite junior guards, forwards, and centers based on descriptive statistics, correlative analysis and latent structure of the 13 standard parameters of situation-related efficiency. The sample consisted of a 108 examinees who are elite junior basketball players, who played an average of 8 minutes per game and more than 3 games, and were selected out of 11 teams that played 46 games in the European Junior Championship in Zadar, in 2000. For the purpose of latent structure analysis, we applied the confirmatory strategy of factor analysis. In doing so, the process was limited to extracting two significant factors by a method of main components with orthogonal varimax normalized rotation of the structure of manifest variables for assessment of situation-related efficiency. The results of the mentioned analysis show that the parameters of situation-related efficiency differentiate players by positions, and indirectly determine tasks and assignments in the game that are apparent in the indicators of situation efficiency in the game.

**Key words:** basketball game, type of players, situation-related efficiency, elite juniors, latent structure

### Introduction

Basketball is a dynamic, atypical and the most changeable of all games (Nikolić, 1993; Trninić, 1996) in which all five players continuously and relevantly change places assisting each other in order to be efficient in the individual, as well as in the team game (Trninić, 2006). In sports games theory, player types can be defined as groups of players with mostly similar abilities and characteristics that enable them to play at a position where they can complete different tasks within the game roles (Dežman, 1988; 2000). During the development of basketball from the three original positions, or the three basic player types (guard, forward and centre), who differ from one another by certain characteristics (Semaško, 1976; Dežman, 1988; Trninić, Dizdar & Jaklinović-Fressl, 1999), developed five player types: 1 – *point guard*, 2 – *shooting guard*, 3 – *small forward*, 4 – *power forward*, and 5 – *centre*. These types of players differ by roles and tasks in the game that are in turn determined by abilities, personal characteristics, technical-tactical knowledge, skills and players' habits. But the roles change and considering player's emplacement on the court, and considering directions of movement in offense and defense, so the players should be able to react in accordance with their current position on the court, the ball position, and the position of all players on the court (Trninić, 2006). For successfully accomplishing assignments that play a role in the game in every position, here we require adequate systems of defense, offense and communication, a high level of fitness, a high level of automatization of technical-tactical skills and principles of an organized game, and an understanding of the game. All these are preconditions for an optimal reach of total potential of individual players and of the team as a whole. This means that the efficiency in performing concrete tasks in the game depends primarily on the motor and psychological skills and habits, morphological characteristics, motor - functional

abilities, personality traits and cognitive abilities of the players that, on the other hand, directly define the game tactics model (Trninić, 1995; 1996; 2000; 2006). Latest research on basketball affirms the opinion of basketball experts that each position in the game demands special skills, habits and knowledge, and indirectly determines assignments in the game that manifest themselves as indicators of player efficiency (Trninić, Perica & Dizdar, 1999). In accordance with the mentioned approach, the differences between player types affect a formation of a specific process of the whole sports preparation, and directly for assessment of specifics of a player's performance. The most detailed parallel analysis of players by their mentioned positions in a basketball game was given in the research of Trninić & Dizdar (2000) and Trninić, Dizdar & Dežman (2000), by describing similarities and differences between particular positions in the game's defense and offense on the basis of determined coefficients of importance of the 19 criteria for real basketball player quality assessment.

### Research goals

The goal of this research is to identify the difference between basketball players who predominantly play positions 1 and 2 (guards), 3 (forwards), and 4 and 5 (centers) based on descriptive statistics, correlative analysis and latent structure of the 13 standard parameters of situation-related efficiency.

### Previous researches

Based on a three-year research on American university basketball players, Swalgin (1994) established norms for evaluating situation-related efficiency of players at a basketball match according to their positions and time spent in the game.

He formed a computer program for evaluating each player's performance at a basketball match, which can evaluate situation-related efficiency of players depending on their position in the game. Furthermore, based on the above-mentioned system for evaluating player performance, Swalgin (1998) studied the connection of non-ponderated and ponderated systems to player efficiency assessments given by basketball experts. The results have shown that both methods are highly related to the coach's evaluation criterion. In addition, one can see from the results that the four indicators of situation-related efficiency particularly distinguish game positions: defensive and offensive rebounds and block shots mostly distinguish centers from guards and forwards, and assists significantly distinguish guards from forwards and centers, while shots from beyond the three-point line distinguish guards and forwards from centers. For evaluating shot success, the author took into account the percent of throws, as opposed to the number of successful and unsuccessful shots, which eliminated the influence of time spent in the game, and simultaneously injured players who had an equal or similar percentage of successfulness, but higher absolute values, as well. Dizdar, Trninić & Milanović (1997) used the hierarchical cluster analysis (Ward's method based on Euclidean metric) on 70 basketball players (from 8 teams that made it to the finals of the Croatian Basketball Championship in 1994, and who averagely played more than 10 minutes per game) in the space of 13 standard indicators of situation-related efficiency, and got four homogenous groups that were defined, based on the results of discriminatory analysis, as: group A – *outside players*, group B – *specialist players*, group C – *polyvalent players* and group D – *inside players*. The gained classification is in accordance with the functional model of player division that exists in elite basketball practice. Trninić, Dizdar & Jaklinović-Fressl (1999) analyzed the differences between guards, forwards and centers based on the standard indicators of situation-related efficiency. They determined that: 1) The players who play positions 1 and 2 (guards), and whose primary role is game organization in the offense stage, have the most assists and most often shoot from beyond the three-point line. As opposed to forwards and centers, they shoot significantly less for two points. They draw less personal fouls primarily because they play further from the basket, in the low player-density zone, and also because they do not run inside as much. They are the most successful in free throw shots. They have better assist and turnover ratios than forwards, and especially centers. Their primary task is the hold the regular defense position between the ball and the basket, so they have less irregular contacts; 2) The players on the position number 3 (forwards) basically connect the front and back line of offense (the position in front of the free-throw line enables them an optimal angle for passing inside). So, these players are generally considered to be co-creating the game because they connect the front and back line of offense, take semi distance and long distance shots (although they shoot less three-point goals than guards), greatly contribute in passing the ball to co-players (the number of assists puts them behind the guards), and they are the second or third rebounders on the team. By connecting the front and back line of defense, they prevent the co-operation of offense players on the line of guard-forward and center – forward, as well as help the guard and center in the

defense stage; 3) The players that play positions 4 and 5 (centers) are the best in the rebound part of the game, both in defense and offense, they are the best shot blockers, above average at two-point shots (they shoot mostly from the key – the high shot percentage zone), they draw a lot of free throws (because they primarily score inside shots), but relatively less efficiently than guards and forwards, they lose the possession of the ball more often than they gain it, they make a lot of personal fouls because they primarily control the key from inside running and dribble penetration. The players on the position number 5 less often shoot from beyond the three-point line, as opposed to the players on position 4. In the defense stage, their basic task is defensive rebound and key control (team aspect of defense), while in offense they primarily play under the opposing team's basket and make a lot of inside shots. Playing 1 on 1 and 1 on 2 with their backs to the basket, they score and draw opponent's personal fouls. They have less assists than guards and forwards, although they are at the position of centers by their role inside players, and at the high post-position outside players. This group of players has a worse ratio of assists and turnovers than forwards and guards; 5) Trninić, Dizdar & Dežman (2005) did a research based on the standard indicators of situation-related efficiency, with the intention of establishing differences between players according to their positions, and they described these differences in detail.

The authors established the following: 1) The player who primarily plays on the position number 1 – point guard, mostly differs from other players by more *assists*, *turnovers* and *steals*. It is in accordance with their primary role in offense transition and set offense, which is manifested as immediate control of the game and it involves ball control, timely and accurate passing to the co-players that are in the most promising position to score, control of changing the tempo and rhythm of the game, balancing the game and other. In defense transition and set defense the point guard directly determines the level of pressure. In addition, these players *shoot three point shots* significantly more than centers (positions 4 and 5) and slightly less than players on positions 2 and 3, which mean that the first guard must have a scoring mentality. Players on the position number 1 make significantly less *two-point shots* and *personal fouls* than centers (positions 4 and 5), because in defense they play primarily on outside positions, where they make less personal fouls. They are responsible for defense balance, stopping the ball and closing the opposing team's fast break in depth and width after the shot, and therefore have the least opportunity for an offensive rebound. Besides their position on the court, their anthropomorphic features (they are the shortest) are also responsible for the fact that the players on this position have the least *rebounds* and *blocked shots*. Therefore, the overall situation-related efficiency of players on the position number 1 is determined by the level of pressure in defense, which is displayed in more turnovers, stopping offense transition and preventing depth penetration. Their role in the game is manifested in organizing and creating offensive team plays against various defenses, to realize the scoring abilities of their co-players. On the account of being primarily in charge of controlling the ball, their tasks in offense are the most risky ones, so players on that position have the most turnovers.

Traditional approach, which requires from players on position number 1 exclusively to organize and control the game in the stage of offense and pressure in the front line of defense is not appropriate to the contemporary notions of the role of the player on that position. Modern basketball demands from this player, aside from organizational abilities (playmaker), the ability to individually create his own shot, as well as depth penetration (creation of open shots for co-players) and leadership abilities. Therefore, the contemporary first guard, with a great responsibility assigned to him in all game phases, should be a creator and all-round player who must have the best understanding of the game of basketball. The point guard primarily carries the ball and organizes the game under the continuing pressure of the opposing team, which causes him to have the most turnovers.

However, with regard to the players on positions 2, 3, 4 and 5, the point guard has a better ratio of assists and turnovers; 2) The players who primarily play on the position number 2 – shooting guard, are similar to players who primarily play on position 3, but opposed to them, they have somewhat more *three-point shots*, and less *defensive* and *offensive rebounds*, as well as *blocked shots*. Compared to the players on position 1, they have somewhat more *three-point shots*, *defensive* and *offensive rebounds*, but significantly less *assists*, *steals* and *turnovers*. They are significantly different from centers (positions 4 and 5) by more *three-point shots* and less *defensive rebounds*, *offensive rebounds* and *blocked shots*. The results gained show that the high level of shooting abilities is the most important factor demanded from players who play on the position number 2. Their level of success in ball control and passing ability (second in the number of assists) is also important. In the defense phase, the player on position 2 is mostly in charge of controlling the opposing team's best shooter, which results in a higher situation-related efficiency from the player on position 1 in the rebound part of the game for two reasons: the player controlled by the shooting guard often does the *post-up* play and shoots more frequently, so in this position the shooting guard has a bigger responsibility, but also more chances to catch rebounding balls. Therefore, coaches select this player from the best shooters and ball handlers on their team (Krause, 1991; Krause, Meyer and Meyer, 1999); 3) The players who primarily play on position number 3 – small forward are in almost all variables between guards (positions 1 and 2) and centers (position 4 and 5), other than the fact that they have the least *turnovers*. Compared to the guards they have an almost equal number of *three-point shots*, but somewhat more *defensive* and *offensive rebounds*, as well as *blocked shots*. This position between guards and centers is understandable because players on this position change their position on the court between inside and outside positions, i.e. they play with both their faces and backs to the basket, which gives them opportunities to shoot from inside, as well as outside positions. So, these players' score from actions under the basket more often than players on position 2, but also make semi-distance and long distance shots. They participate significantly in the rebound part of the game, so they are usually also the most valuable players on the team (Trninić, 1995). Therefore, a small forward is expected to have all-around skill, ability and all-around play, so he can successfully play defense and offense on inside and outside positions.

Compared to the first and second guard, the small forward is closer to the basket in more situations (*post-up* plays), and frequently has the best position for an offensive rebound, which enables him a better rebound efficiency than the guards. Therefore, the role of the small forward for the organization of offensive and defensive rebound is more important than the ones of the first and second guard. From the point of view of ball possession, the small forward handles the ball in offense phase less than the first and second guard, but helps them in many situations to transfer the ball or set offense (*point forward* – for example in NBA, Scotty Pippen or Toni Kukoč). In the game geometry in offense on outside positions, the goal of the small forward is to receive the ball at an angle of 45° to the basket (the post line), which enables him high-quality co-operation with the center and guard. Compared to positions 1 and 2, small forwards have the least turnovers, which is probably the result of their position in the game geometry and offensive tasks, as well as a shorter period of ball possession; 4) The players who primarily play on positions 4 – power forward and 5 – center have significantly more *defensive* and *offensive rebounds*, *blocked shots*, *personal fouls* and *two-point shots* than players on other positions. Centers have a pivotal role in team defense (key and rebound control). With regard to this role, they make more personal fouls (than guards and small forwards), frequently while attempting to block a shot in the key, positioning in the front for an offensive or defensive rebound, risky interception of passing lines and positioning on the line of movement of an opposing player with or without the ball in defense. In the offense phase, centers (C) play under the opposing team's basket, where their basic task is to gain the front (or first) position for receiving the ball in 1 on 1 game with their backs to the basket in order to score and draw a personal foul. Players on position 5 are the team's most successful defense players (considering their position in the back line of defense) because they have to stop the opposing team, and not just "their" player. This results with more blocked shots and defensive and offensive rebounds, than outside players. Players on position number 4 differ greatly from players on position 5 when it comes to the *three-point shot* variable. That is, players on position 4, unlike classical centers (position 5) who are firstly scorers on the low post position, have a bigger movement radius (between the wing and the low and high post) and they make semi-distance and long distance shots, penetrate with their faces to the basket and more frequently open out to receive the ball. All of this makes them key players for opening the space for inside game, penetration and back side offensive rebound. As excellent shooters, this kind of players ensures that the defense will spread, guarantee movement dynamics in the offense and unlock every defense. Such an open offensive game geometry is ensured by the power forwards, who operate in a wider zone than players on position 5 (center), participating not only in scoring, but also in developing plays that open the key area and complicates every modality of the defense's rotational systems. In the phase of defense, the players on position 4 have to be able to successfully defend the outside players when it comes to switching. That is why players on position 4 have to have a genuine overall quality structure that meets the criteria for both small forward and center positions in transitional and positional game.

**Research methods**

*Sample of entities*

The research was carried out on a sample of 108 elite junior basketball players, participants of 19 European Championship in Zadar in 2000, who averagely played more than 8 minutes per game for 3 or more matches, and were chosen from 11 teams that played 46 matches of the European Championship (Table 1). According to the records from the official registration forms, the players were divided into three groups based on the position that they played: 42 players who dominantly play on positions 1 and 2 (guards), 26 on position 3 (small forwards) and 40 players on positions 4 and 5 (power forwards and centers).

Table 1. Examinees example

National team	Examinees	Final ranking
France	12	1
Croatia	10	2
Israel	8	10
Slovenia	10	9
Greece	8	3
Lithuania	11	7
Bulgaria	9	12
Russia	11	6
Italy	10	4
Latvia	8	8
Spain	11	11

The average age of the basketball players was 17,8 years ( $\pm 0,7\sigma$ ). All respondents (apart from the players of the Yugoslavian team) have consented to participate in the study, based on a permit issued by FIBA. It is a representative sample of the best junior basketball players in Europe.

*Sample of variables*

The sample of manifest variables is consisted of 13 standard indicators of situation-related efficiency in the game of basketball that are standard registered for every team in the match. They are: 1) free throw (1,2 and 3) – made (FT-SU) – the number of successful goals behind the free throws line, 2) free throw (1,2 and 3) – missed (FT-UN) – the number of unsuccessful goals behind the free throws line, 3) two-point field goals – successfully (FG2-SU) – the number of successful goals within 6.25m line), 4) two-point field goal – unsuccessfully (FG2-UN) – the number of unsuccessful goals within 6.25m line, 5) three-point field goal – successfully (FG3-SU) – the number of successful goals beyond 6.25m line, 6) three-point field goal – unsuccessfully (FG3-UN) – the number of unsuccessful goals beyond 6.25m line, 7) offensive rebound (OR) – the number of ball caught (rebounds off the rim or backboard) on the rebound in the phase of offense, 8) defensive rebound (DR) – the number of ball caught (rebounds off the rim or backboard) on the rebound in the phase of defense, 9) assists (A) – the number of balls passed to the "open" (undefended) player enabling a successful throw into the basket, 10) personal foul (PF) – the number of fouls; it implies a prohibited, irregular body contact with the opponent, no matter whether the ball is in play or it is a tie ball; fouls regarding the infringement of the rules of conduct (technical fouls), 11) turnover (TO) – the number of turnovers in the offense stage as a result of inaccurate assist, bad catch, bad ball dribbling and infringement of the rules (foot faults, intentional kicking of the ball, the ball out-of-bounds, double dribbling, carrying the ball, rule 3,5,10 and 30 seconds and the ball returned into the backcourt), 12) steal (ST) – the number of steals during the stage of transition or set defense following the team foul during the transition or set offense. Stealing ball during dribbling or cutting off passed balls are some of the ways for defense players to gain possession of the ball, 13) blocked shot (BL) – the number of blocked

shots during the stage of transition or set defense. The collected data are the official results that are recorded at every match according to the rules of the technical commission of FIBA. The data regarding the basketball results in the computer programs has been registered by persons specially trained for the job.

*Data processing methods*

In view with the goal of this work, for each mentioned group of basketball players (guards, forwards and centers) the basic statistical parameters were calculated: arithmetic mean ( $\bar{X}$ ), standard deviation ( $\sigma$ ), minimal result (Min), maximal result (Max), skewness ( $\alpha_3$ ), kurtosis ( $\alpha_4$ ) and the correlation matrix of 13 standard situation-related variables. Furthermore, the differences between basketball players who prevalently play on positions 1 and 2 (guards), 3 (small forwards), 4 (power forwards) and 5 (centers) in the latent space of 13 situation-related variables, were determined using confirmatory strategy of factor analysis of two main components extraction with orthogonal varimax normalized rotation. For every variable it was derived: Explained variance by single factor (Expl. Var), The percentage of total explained variance of an applied variable system (Prop. totl), Communalities for manifest variables ( $h^2$ ), Determination coefficient of multiple correlation of each variable with the others in the set (SMC) and Parallel projection matrix for manifest variables with calculated factors.

**Results and discussion**

The descriptive statistical parameters of situation-related efficiency for the sample of guards, small forwards, power forwards and centers are presented in tables 2a, 2b and 2c. The results in Tables 2a, 2b and 2c show that the guards are marked in variables FG3-SU, FG3-UN, A, ST and TO. The question is – why do the guards have the most turnovers, even though they have the best individual technique and passing tactics.

Table 2a. The descriptive parameters for variables of situation-related efficiency – guards sample

	$\bar{X}$	Min	Max	$\sigma$	$\alpha_3$	$\alpha_4$
FT-SU	12,55	1,0	34,0	9,57	0,78	-0,52
FT-UN	4,64	0,0	22,0	4,28	1,85	5,46
FG2-SU	12,67	1,0	44,0	10,34	1,25	1,04
FG2-UN	13,60	0,0	51,0	10,88	1,29	2,03
FG3-SU	4,81	0,0	16,0	4,11	1,28	1,14
FG3-UN	11,10	1,0	36,0	8,17	1,22	1,39
OR	1,39	0,0	4,5	0,92	1,33	2,13
DR	0,40	0,0	1,6	0,41	1,20	1,11
A	1,41	0,1	5,1	1,04	1,73	3,97
ST	1,52	0,0	4,2	1,00	1,18	0,90
TO	1,74	0,0	4,7	1,07	0,67	0,28
PF	1,93	0,2	3,6	0,75	0,14	0,17
BL	0,06	0,0	0,5	0,11	2,39	5,84

Legend: N – the number of respondents,  $\bar{X}$  – arithmetic mean, Min – minimal result, Max – maximal result,  $\sigma$  – standard deviation,  $\alpha_3$  – skewness,  $\alpha_4$  – kurtosis

The reasons behind this are that precisely players on positions 1 and 2 are under pressure from the defense, that they handle the ball the longest and that they have overall the highest number of passings and assists in transition and position game during a match. They also make fewer personal fouls because in defense they play on outside positions (away from the basket, where player density is lower).

Table 2b. The descriptive parameters for variables of situation-related efficiency – forwards sample

	$\bar{x}$	Min	Max	$\sigma$	$a_3$	$a_4$
FT-SU	10,00	0,0	34,0	8,35	1,37	1,70
FT-UN	5,08	0,0	19,0	4,89	1,38	1,53
FG2-SU	15,08	2,0	47,0	11,06	1,35	-2,04
FG2-UN	15,00	1,0	36,0	9,60	0,54	-0,25
FG3-SU	3,92	0,0	12,0	3,39	0,84	-0,03
FG3-UN	9,19	0,0	28,0	7,12	0,97	0,76
OR	1,73	0,0	5,0	1,14	0,92	1,26
DR	0,83	0,0	2,4	0,58	0,79	0,97
A	0,65	0,0	1,8	0,49	0,76	-0,13
ST	1,18	0,2	2,8	0,78	1,03	-0,21
TO	1,46	0,4	2,9	0,65	0,17	-0,24
PF	1,97	0,8	3,6	0,88	0,50	-1,04
BL	0,33	0,0	1,4	0,41	1,41	1,25

Legend: N – the number of respondents,  $\bar{x}$  – arithmetic mean, Min – minimal result, Max – maximal result,  $\sigma$  – standard deviation,  $a_3$  – skewness,  $a_4$  – kurtosis

The small number of irregular contacts made by guards is also a consequence of their task to hold the position of regular defense between the ball and the basket. Furthermore, the players who play on position 1 and 2 (guards) primarily have to organize the game in the phase of offense. Consequently, they have the highest number of assists and most often shoot from beyond the three-point line. As opposed to small forwards and centers, they shoot significantly less from the two-point area. They make less personal fouls than small forwards and centers because they play further from the basket (beyond the high shooting percentage zone), in the low player density zone, and have a significantly lower inside running number (running into the key). Guards are, as well as centers, very successful in free throws and they have a better ratio of assists and turnovers than small forwards and especially centers.

Table 2c. The descriptive parameters for variables of situation-related efficiency – centres sample

	$\bar{x}$	Min	Max	$\sigma$	$a_3$	$a_4$
FT-SU	13,52	1,0	44,0	10,27	1,20	1,29
FT-UN	6,80	1,0	31,0	5,96	2,40	7,27
FG2-SU	16,63	3,0	50,0	10,61	1,21	1,64
FG2-UN	16,17	2,0	45,0	10,06	0,86	0,38
FG3-SU	0,85	0,0	8,0	1,83	2,83	8,03
FG3-UN	2,37	0,0	23,0	4,54	3,05	10,92
OR	2,21	0,7	6,2	1,36	1,36	1,79
DR	1,32	0,1	3,2	0,78	0,41	-0,26
A	0,47	0,0	1,9	0,40	1,49	3,24
ST	0,82	0,2	2,0	0,47	0,92	0,26
TO	1,39	0,1	2,8	0,66	0,57	-0,28
PF	2,39	0,7	4,0	0,93	0,01	-1,08
BL	0,46	0,0	2,1	0,50	1,41	1,98

Legend: N – the number of respondents,  $\bar{x}$  – arithmetic mean, Min – minimal result, Max – maximal result,  $\sigma$  – standard deviation,  $a_3$  – skewness,  $a_4$  – kurtosis

With regard to their position, role and basic tasks in the game, and considering their anthropometric features (they are of the lowest height and body mass), they have the least offensive and defensive rebounds, as well as an irrelevant number of blocked shots. The players who play on position number 3 (small forwards) are in almost every variable between guards and centers, except that they have the lowest score in the FT-SU variable. Trninić (1995; 1996; 2006) states that players on position 3 basically connect the front and back lines of offense (their position below the free-throw line enables them an optimal angle for inside passes).

So, these players are generally considered to be the game creators because they connect the front and the back line of offense, shoot from semi-distance and long distance (although they score less three-point shots than guards), significantly contribute to passing the ball to co-players (the number of assists puts them behind guards), and they are the second rebounders in the team. By connecting the front and back line of defense, they prevent the co-operation of attackers on the guard-small forward and center-small forward lines, and they help defend the guard and center. Centers are the best rebounders both in defense and offense, the best shot blockers; in two-point shots (they shoot mostly from the key – high shooting percentage zone). Furthermore, since they draw a lot of free throws, they are the best at the free-throw variable, as well. They also make a lot of personal fouls because they primarily control the key from inside running and dribble penetration, and they have the most turnovers compared with their number of steals. Their three-point shot is significantly different from small forwards and guards. According to the stated facts, the basic task of centers is defensive rebound and key control. In the offense phase they primarily play under the opposing team's basket, so they make a lot of inside shots. In 1 on 1 and/or 2 game with their backs to the basket, they score and draw the personal fouls. They have a smaller number of assists than guards and small forwards, even though that the center position gives them the role of inside game creators, and the high post position makes them outside game creators. This group of players has a worse assists and turnovers ratio than small forwards and guards. A significant connection between analyzed variables for all three entity sets observed can be seen in the correlation matrices (Tables 3a, 3b, 3c). From a total of 78 correlation coefficients, as much as 53 (68%) are significant on the guards sample (ranging from 0,31 to 0,83), 51 (65%) on the small forwards sample (ranging from -0,51 to 0,87) and 44 (56%) on the centers sample (ranging from 0,32 to 0,84) at a level of significance of 0,05. When it comes to the guards, the highest number of statistically significant correlation coefficients (11) with other variables pertain to FT-SU, FG2-SU, FG2-UN and DR variables, while on the small forwards sample the highest number of statistically significant correlation coefficients (10) with other variables pertain to FG2-UN, DR, OR and A variables and they cause the largest part of covariability in the area of situation-related efficiency indicators in the game of basketball. Centers have as much as 6 variables that have 9 statistically significant correlation coefficients with other variables – FT-SU, FG2-SU, FG2-UN, DR, OR and TO. Trninić (1995) states in his empirical findings that out of the total number of attempts at scoring, two-point field goals account for 52, 13% of points scored, i.e. 55, 48 % of points scored. It is therefore understandable that the two-point field goal – successful/unsuccessful variable, along with the defensive rebound, is the most significant covariability generator in the overall situational area. Using factor analysis of variables for evaluating situation-related efficiency of players who play guards on the basis of the GK – criterion, two significant factors were extracted, and they explain a total of 60 % of the variance (Table 4a). The first significant factor shows marked correlations with FT-SU, FT-UN, FG2-SU, FG2-UN, DR, OR, ST, TO and PF variables.

Tablica 3a: Matrix of correlations of manifest variables – guards sample

	FT-SU	FT-UN	FG2-SU	FG2-UN	FG3-SU	FG3-UN	OR	DR	A	ST	TO	PF	BL
FT-SU	1,00												
FT-UN	<b>0,64</b>	1,00											
FG2-SU	<b>0,76</b>	<b>0,49</b>	1,00										
FG2-UN	<b>0,72</b>	<b>0,33</b>	<b>0,81</b>	1,00									
FG3-SU	<b>0,42</b>	<b>0,35</b>	<b>0,33</b>	<b>0,33</b>	1,00								
FG3-UN	<b>0,39</b>	0,21	<b>0,38</b>	<b>0,39</b>	<b>0,83</b>	1,00							
OR	<b>0,62</b>	0,28	<b>0,66</b>	<b>0,76</b>	<b>0,37</b>	<b>0,46</b>	1,00						
DR	<b>0,46</b>	0,16	<b>0,56</b>	<b>0,48</b>	0,11	0,21	<b>0,44</b>	1,00					
A	<b>0,52</b>	0,20	<b>0,50</b>	<b>0,56</b>	<b>0,49</b>	<b>0,63</b>	<b>0,62</b>	0,27	1,00				
ST	<b>0,53</b>	<b>0,49</b>	<b>0,41</b>	<b>0,56</b>	<b>0,31</b>	<b>0,38</b>	<b>0,56</b>	<b>0,41</b>	<b>0,55</b>	1,00			
TO	<b>0,61</b>	<b>0,42</b>	<b>0,46</b>	<b>0,52</b>	0,29	0,26	<b>0,60</b>	<b>0,48</b>	<b>0,60</b>	<b>0,60</b>	1,00		
PF	<b>0,56</b>	<b>0,47</b>	<b>0,46</b>	<b>0,38</b>	0,17	0,11	<b>0,36</b>	0,26	0,21	0,20	<b>0,46</b>	1,00	
BL	0,29	0,00	0,14	0,24	0,23	0,30	<b>0,49</b>	-0,04	0,25	0,09	<b>0,32</b>	0,22	1,00

Bold = significant coefficients for p<0.05

Tablica 3b: Matrix of correlations of manifest variables – forwards sample

	FT-SU	FT-UN	FG2-SU	FG2-UN	FG3-SU	FG3-UN	OR	DR	A	ST	TO	PF	BL
FT-SU	1,00												
FT-UN	<b>0,79</b>	1,00											
FG2-SU	<b>0,60</b>	<b>0,73</b>	1,00										
FG2-UN	<b>0,58</b>	<b>0,70</b>	<b>0,72</b>	1,00									
FG3-SU	0,18	-0,01	-0,13	0,11	1,00								
FG3-UN	0,23	0,26	0,14	0,37	<b>0,75</b>	1,00							
OR	<b>0,69</b>	<b>0,63</b>	<b>0,68</b>	<b>0,65</b>	-0,12	0,01	1,00						
DR	<b>0,59</b>	<b>0,61</b>	<b>0,61</b>	<b>0,61</b>	-0,19	-0,09	<b>0,87</b>	1,00					
A	0,25	<b>0,41</b>	<b>0,52</b>	<b>0,44</b>	<b>-0,51</b>	-0,17	<b>0,60</b>	<b>0,50</b>	1,00				
ST	<b>0,43</b>	<b>0,51</b>	0,37	<b>0,58</b>	-0,13	-0,02	<b>0,64</b>	<b>0,50</b>	<b>0,68</b>	1,00			
TO	<b>0,67</b>	<b>0,53</b>	<b>0,49</b>	<b>0,51</b>	-0,03	0,20	<b>0,66</b>	<b>0,45</b>	<b>0,41</b>	<b>0,39</b>	1,00		
PF	<b>0,41</b>	0,36	0,37	<b>0,55</b>	0,15	0,28	<b>0,46</b>	<b>0,42</b>	<b>0,49</b>	<b>0,57</b>	0,18	1,00	
BL	<b>0,51</b>	<b>0,51</b>	<b>0,52</b>	<b>0,40</b>	-0,11	0,04	<b>0,66</b>	<b>0,57</b>	<b>0,57</b>	<b>0,49</b>	0,34	<b>0,52</b>	1,00

Bold = significant coefficients for p<0.05

Tablica 3c: Matrix of correlations of manifest variables – centers sample

	FT-SU	FT-UN	FG2-SU	FG2-UN	FG3-SU	FG3-UN	OR	DR	A	ST	TO	PF	BL
FT-SU	1,00												
FT-UN	<b>0,71</b>	1,00											
FG2-SU	<b>0,77</b>	<b>0,75</b>	1,00										
FG2-UN	<b>0,65</b>	<b>0,51</b>	<b>0,68</b>	1,00									
FG3-SU	-0,03	-0,09	-0,21	-0,11	1,00								
FG3-UN	-0,06	-0,14	-0,25	0,03	<b>0,68</b>	1,00							
OR	<b>0,76</b>	<b>0,79</b>	<b>0,84</b>	<b>0,61</b>	-0,04	-0,03	1,00						
DR	<b>0,52</b>	<b>0,61</b>	<b>0,64</b>	<b>0,62</b>	-0,10	-0,09	<b>0,69</b>	1,00					
A	<b>0,48</b>	<b>0,57</b>	<b>0,44</b>	<b>0,32</b>	0,25	0,11	<b>0,59</b>	<b>0,32</b>	1,00				
ST	<b>0,37</b>	0,25	<b>0,47</b>	<b>0,65</b>	0,02	0,10	<b>0,34</b>	<b>0,36</b>	0,19	1,00			
TO	<b>0,59</b>	<b>0,43</b>	<b>0,56</b>	<b>0,68</b>	0,17	0,23	<b>0,58</b>	<b>0,60</b>	<b>0,47</b>	<b>0,47</b>	1,00		
PF	0,21	0,15	0,21	<b>0,35</b>	0,17	<b>0,32</b>	0,17	0,22	0,04	<b>0,47</b>	<b>0,33</b>	1,00	
BL	<b>0,32</b>	<b>0,55</b>	<b>0,46</b>	0,30	-0,14	-0,15	<b>0,48</b>	<b>0,49</b>	0,12	0,16	0,15	0,21	1,00

Bold = significant coefficients for p<0.05

Table 4a. Factor analysis with varimax rotation – variables with factor rotation – guard sample, determination coefficient of multiple correlation of each variable with the others in the set (SMC) and communalities for manifest variables ( $h^2$ ), Expl. Var – particular factor variance; Prp. totl – percentage of explained total variance of applied variable system

	F1	F2	SMC	$h^2$
FT-SU	0,82	0,33	0,79	0,79
FT-UN	0,64	0,08	0,73	0,41
FG2-SU	0,81	0,27	0,83	0,72
FG2-UN	0,75	0,38	0,81	0,71
FG3-SU	0,12	0,83	0,76	0,70
FG3-UN	0,11	0,91	0,82	0,83
OR	0,64	0,53	0,74	0,69
DR	0,66	0,02	0,62	0,44
A	0,41	0,70	0,74	0,66
ST	0,61	0,36	0,67	0,50
TO	0,71	0,31	0,72	0,59
PF	0,66	-0,01	0,42	0,44
BL	0,09	0,51	0,52	0,27
Expl.Var	4,66	3,10		
Prp.Totl	0,36	0,24		

One can assume that there are guards who score high and low values in these variables. Hypothetically, there are guards who are not successful three-point shooters so their technical-tactical activities primarily

consist of dribble penetration and passing. In view with this, these players penetrate the defense and have a higher number of successful and unsuccessful two-point shots, as well as a high number of assists and turnovers. Penetrating the front and back line of defense draws a higher number of personal fouls, so guards have a higher number of successful and unsuccessful free throws. The above-mentioned technical-tactical activities create opportunities for catching rebounds in the area beyond the rebounding defensive triangle. In the transition and position defense phase, the guards' task is to retain disciplined pressure on the ball and passing lines.

Physical aggression in the front line of defense results in a higher number of personal fouls. This factor describes 36% of the total variance of applied variables system for evaluating situation-related efficiency. The other extracted factor highly correlates with FG3-SU, FG3-UN, A and BL. Indicators of situation-related efficiency show that guards are more focused on outside shot, beyond the 6, 25 line, by which they have a higher number of successful and unsuccessful three-point shots. This factor describes 24% of the total variance of the system. Two factors explain a total of 67% of the variance.

Table 4b. Factor analysis with varimax rotation – variables of situation-related efficiency – forwards sample, determination coefficient of multiple correlation of each variable with the others in the set (SMC) and communalities for manifest variables ( $h^2$ ), Expl. Var – particular factor variance; Prp. totl – percentage of explained total variance of applied variable system

	F1	F2	SMC	$h^2$
FT-SU	0,79	0,27	0,86	0,70
FT-UN	0,83	0,15	0,86	0,70
FG2-SU	0,80	-0,01	0,79	0,64
FG2-UN	0,82	0,23	0,79	0,73
FG3-SU	-0,06	0,92	0,82	0,86
FG3-UN	0,18	0,88	0,81	0,82
OR	0,90	-0,14	0,92	0,83
DR	0,80	-0,20	0,86	0,69
A	0,68	-0,51	0,82	0,72
ST	0,72	-0,19	0,79	0,55
TO	0,68	0,09	0,75	0,47
PF	0,63	0,14	0,67	0,41
BL	0,72	-0,15	0,60	0,53
Expl.Var	6,45	2,19		
Prp.Totl	0,50	0,17		

They were extracted using factor analysis of players who play small forwards on the basis of the GK – criterion. The first significant factor highly correlates with FT-SU, FT-UN, FG2-SU, FG2-UN, DR, OR, A, ST, TO, PF and BL variables. One can assume that pertains to small forwards, who have a significant number of inside running, which enables them two-point shots, offensive rebounds and personal fouls drawn. In the defense phase they make more personal fouls. Therefore, their movement radius from the outside to inside positions and vice versa creates more opportunities for inside shots, offensive rebounds and assists in the offense phase, and more opportunities for defensive rebounds and steals in the defense phase. This factor describes 50% of the total variance of the variable system for evaluating situation-related efficiency. The other extracted factor highly correlates with FG3-SU and FG3-UN variables. Assumably, certain players on the small forward position have a high shooting range. The factor describes 17% of the total variance of the variable system for evaluating situation-related efficiency. Two significant factors that explain a total of 62 % of variance were extracted using factor analysis of players playing on the position of center on the basis of the GK – criterion. The first significant factor highly correlates with FT-SU, FT-UN, FG2-SU, FG2-UN, DR, OR, TO and BL variables. High correlation coefficients with these variables point to the roles and tasks of centers that manifest in inside game, which reflects on a higher number of successful and unsuccessful two-point shots. The technical-tactical activities mentioned create opportunities for drawing a great number of personal fouls, which directly determines a higher number of successful and unsuccessful one-point shots and catching rebounds in both defense and offense. Their position and role in the game gives them greater possibilities for blocking shots. Trninić & Dizdar (2000) and Trninić (2006) state that blocked shots is exclusively a criterion of real quality of players who play on the position of center. On the other hand, Bird and Bischoff (1985) maintain that shot blocking is a spectacular defensive play. The players on the position of center also have a higher number of turnovers, which is probably a consequence of numerous double teams and triple teams on the low and middle post that result in ball handling errors and breaking the rules of the game.

Table 4c. Factor analysis with varimax rotation – variables of situation-related efficiency – centers sample, determination coefficient of multiple correlation of each variable with the others in the set (SMC) and communalities for manifest variables ( $h^2$ ), Expl. Var – particular factor variance; Prp. totl – percentage of explained total variance of applied variable system

	F1	F2	SMC	$H^2$
FT-SU	0,83	0,05	0,72	0,70
FT-UN	0,84	-0,11	0,75	0,72
FG2-SU	0,91	-0,14	0,85	0,85
FG2-UN	0,80	0,17	0,73	0,67
FG3-SU	-0,14	0,81	0,56	0,67
FG3-UN	-0,13	0,88	0,63	0,78
OR	0,90	0,01	0,85	0,81
DR	0,79	-0,01	0,66	0,62
A	0,56	0,26	0,56	0,38
ST	0,54	0,33	0,54	0,40
TO	0,70	0,43	0,67	0,68
PF	0,31	0,50	0,36	0,35
BL	0,55	-0,23	0,45	0,35
Expl.Var	5,82	2,15		
Prp.Totl	0,45	0,17		

The other extracted factor highly correlates with FG3-SU and FG3-UN variables. Assumably, the players concerned are the ones playing on the position number 4 (small forwards). It is important to mention that in modern basketball, players on positions 4, 2 and 3 comprise the main axis of offense that opens the key with outside shots. Power forwards have to be successful shooters from beyond the 6, 25 line. This factor describes 17% of the total variance system.

**Conclusion**

This research was conducted for determining differences between guards (42 players dominantly playing positions 1 and 2), forwards (26 in position 3) and centers (40 players in positions 4 and 5) based on the 13 standard parameters of situation-related efficiency. The sample consisted of players from 11 teams that played an average of 8 minutes per game and more than 3 games. Data was gathered from 46 games in the 19th European Junior Championship in Zadar, in 2000. In order to determine differences between the three basic types of players (guards, forwards and centers), we used descriptive statistics, correlative analysis and confirmatory strategy of factor analysis. In doing so, the process was limited to extracting two significant factors by a method of main components with orthogonal varimax normalized rotation of the structure of manifest variables for assessment of situation-related efficiency. The results of the mentioned analyses show that the parameters of situation-related efficiency differentiate players by positions, and thus indirectly determine assignments and tasks in the game. Here obtained is a significant difference between the three basic types of players. Players in *guard* positions are dominant in variables FG3-SU, FG3-UN, A and ST, and this mainly regarding the centers. Players in *forward* positions are dominant in comparison to the centers in variable A, and centers are in comparison to forwards much more dominant in the BL variable. Although guards score most lost balls, they have a better rate of assistances and lost balls than the centers do. Forwards are set in between centers and guards in all observed variables. The centers are best shot blockers, and they obtain most jumps in offense and defense. Also, they do most shots from the two-point area and a minimal number of three-points shots.

They enforce and make most personal faults. The results greatly match the research conducted so far that show that the four indicators of player efficiency differentiate game positions. The SO and the OR variables, and BL mostly differentiate centers from

guards and forwards, while A variable significantly differentiates guards from centers and forwards, and variables FG3-SU and FG3-UN differentiate guards and forwards from centers.

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## RAZLIKE IZMEĐU JUNIORSKIH ELITNIH KOŠARKAŠKIH BEKOVA, KRILA I CENTARA NA TEMELJU PARAMETARA SITUACIJSKE UČINKOVITOSTI

### Sažetak

Cilj ovog istraživanja je utvrditi i objasniti razliku između juniorskih elitnih bekova, krila i centara na temelju deskriptivne statistike, korelacijske analize i latentne strukture situacijske učinkovitosti. Uzorak ispitanika sastojao se od 108 vrhunskih juniorskih košarkaša, koji su prosječno odigrali minimalno 8 minuta po utakmici i više od 3 utakmice, a odabrani su iz 11 momčadi koje su odigrale 46 utakmica evropskog juniorskog prvenstva Europe u Zadru 2000. godine. U svrhu analize latentne strukture, primijenjena je konfirmatorna strategija faktorske analize. Pritom se ograničilo na ekstrakciju 2 značajna faktora metodom glavnih komponenata uz ortogonalnu varimax normalizirani rotaciju strukture manifestnih varijabli za procjenu situacijske učinkovitosti. Rezultati navedenih analiza pokazuju da parametri situacijske učinkovitosti razlikuju igrače po pozicijama, te time posredno određuje zaduženja i poslove u igri koji se očituju u pokazateljima situacijske učinkovitosti u igri.

**Ključne riječi:** košarkaška igra, tipovi igrača, situacijska učinkovitost, vrhunski juniori, latentna struktura

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