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**Väravalöömisvõimaluste analüüs kõrgel tasemel rahvusvahelise  
jalgpalli näitel**

**Analysis of scoring opportunities in high-level of international soccer**

**Master thesis**

Physical Education and Sport

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TARTU 2015

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## **Töö lühiülevaade**

**Eesmärk:** Antud töö eesmärgiks on analüüsida stabiilsuse piiripealseid olukordi, jälgides ühte FIFA tabeli keskmisel positsioonil asuvat meeste rahvuskoondist ning sama riigi U19 koondist ja määrata kaitse- ja ründemängu erinevusi. Lisaks sellel proov see töö selgitada, kas ainult stabiilsuse piiripealsete olukordade jälgimine on piisav, et hinnata erinevusi meeksondade vahel.

**Metoodika:** Selleks analüüsitakse mõlema võistkonna 10 mägu ja kõik stabiilsuse piiripealsed olukorrad nii kaitstes kui ründes kogutakse. Stabiilsuse piiripealseid olukordi hinnatakse mängu põhimomentide, mängu stiili ja tulemuste järgi.

**Tulemused:** Analüüsitud A rahvuskoondis tegi keskmiselt 5 (SD = 3,4) stabiilsuse piiripealset olukorda, võrreldes vastastega, kes tegid keskmiselt 9 (SD = 4,4) stabiilsuse piiripealset olukorda mängus. U19 koondise vastavad näitajad olid keskmiselt 4 (SD = 2,6) ja vastastel keskmiselt 10 (SD = 5,3).

**Kokkuvõte:** Antud töö tulemustest saab järeldada, et läbi stabiilsuse piiripealsete olukordade hindamise on võimalik leida, kuidas võitkond mängib ning millised on antud võistkonna tugevused ja nõrkused.

**Märksõnad:** stabiilsuse piiripealne olukord, tulemus, soorituse analüüs

## **Abstract**

**Aim:** The aim of this study is to analyse perturbations, looking at one mid-ranked FIFA men's national team and U19 national team from same Football Federation, and determine differences of offensive and defensive actions of two teams. Addition to that this study attempts to examine if perturbations alone are enough to determine differences between teams.

**Methods:** For that 10 matches from each team are analysed and all perturbation moments will be collected. Both attacking and defensive perturbations are looked at. Different moments of the game, styles of playing, outcomes of attacking moments and the success of perturbations are looked at.

**Results:** Analysed A national team made (mean = 5, SD = 3,4) perturbations per game compared to opposition (mean = 9, SD = 4,4) per game. U19 national team's corresponding numbers are (mean = 4, SD = 2,6) and opposition (mean = 10, SD = 5,3).

**Conclusions:** From the results of this study it can be concluded that through analysing perturbations it is possible to profile the team and see the differences of how the team plays and which are the weaknesses and strengths of the team.

**Keywords:** Perturbation, outcome, performance analysis

## **1. Literature review**

### **1.1. Performance analysis in applied field**

Performance analysis specifically in team sports originated in the United States with American football and basketball, analysing competitive performance using coded notes in the 1960's. However, the past three decades have seen the growth in the use of Performance analysis (PA), the development of PA systems, and PA research specifically for soccer. PA is firmly positioned as integral part of the coaching process and there has been a significant increase in the volume of PA in research and applied field (Mackenzie & Cushion, 2013). A study carried out by (Wright et. al., 2012) found that the majority of the elite coaches surveyed receives a video, DVD or edited clips of the game to review either the same day or the following day of the game. Of the coaches, 46% felt that the PA and the services a performance analyst can provide were essential, while 34% valued it as being very important. In the study by Butterworth et. al. (2012), the majority of coaches praised the usefulness of the performance profiles as part of the wider coaching process, citing the ability to compare objective data to the performers own perceptions as particularly valuable. In this study the possible use of PA in badminton was mostly well received by coaches, and this implicates it as a potentially key component in improving coach and athlete performance in an evolving coaching process. Same time study by Bampouras et. al., 2012, found that there can be little doubt that PA is demonstrably used as part of the process of improving performance meaning that coaches value the information they receive but they also act as gatekeepers and do not include athlete in the process itself. While, at the elite level in particular, this instrumentality is the concern, it might be contended that the "locking-out" of the athlete from the process itself reflects a short-term, ends oriented technical rationality. The study by Smith (2005) suggests PA technology can be used as an effective tool to monitor the coaching environment. However, care must be taken when setting up the operational definitions and training an independent operator to use the system in order to obtain objective, reliable data. Dawson (2007) argues that although the use of performance monitoring systems in soccer is now widespread at the top levels, the systems employed are often complex, expensive and immobile. In addition, while such systems can provide information that can be fed back to coaches, there is often some delay between the capture

of match data and the presentation of useful information – usually after the match has ended and when it is too late for coaches to make reasonable adjustments for players or to team formation. With the development, of the programs to measure performance Di Salvo et. al., (2006) looked if the new program at the time that addition to collecting technical and tactical information from the match also measured the movement of the players was valid and actually gave information that it was programmed to. They wanted to know if this program actually gave valid information about movement of players. They found that the program represents a valid motion analysis system for analysing movement patterns of soccer players on a soccer pitch.

Hughes and Franks (2004) suggest that notational analysis is primarily concerned with the analysis of movement, technical and tactical evaluation and statistical compilation. Thus notational analysis is a technique for analysing different aspects of performance through a process which involves producing a permanent record of the events (James, 2006). The field of PA in general has expanded and progressed greatly over the last 20 years. As with most things, technology and research have led the way in terms of development, particularly in notation analysis systems.

## **1.2. Performance Indicators**

A performance indicator is a selection, or combination, of action variables that aims to define some or all aspects of a performance. Clearly, to be useful, performance indicators should relate to successful performance or outcome (Hughes & Bartlett, 2002).

Performance analysis research, like research in many other disciplines of sports science, seeks to answer some research question of interest. Once a research topic has been identified, operationalised performance variables should be introduced for defining independent and dependent variables. Performance indicators are summary variables for performances derived from the data recorded during match observation. There may be hundreds of events characterised by nominal action variables within a performance. These are used in the calculation of performance indicator values (O'Donoghue et. al. 2012).

Tenga et. al., (2009) tried to develop a new system for match analysis in soccer. A new method, representing a potentially valuable tool for more valid assessment of team match performance, has been developed as a reliable method for most variables used. There are a wide variety of purposes for observational systems in game sports: Measuring individual performance, physical loads, tactical solutions for special situations, studies of

the interactions between and within the teams, discover talents, decision making of coaches or theoretical interest in the structure of games. In order to support top-level teams, two purposes are dominant: preparation against an opponent and gaining information to support one's own training process. An analysis of these tasks reveals that in order to become practically relevant a multi-step process has to be passed, which relies to a great extent on the quality of conclusions drawn (Lames, 2001). Creating new systems for match analysis has the purpose of getting the advantage with knowledge of what is that area in the game that could help to win the match.

Lames & McGarry (2007) present the argument that the performance traits, as measured, are inherently unstable and that the performance indicators are therefore necessarily unreliable (or unstable). In this light, the ongoing search for reliable (or stable) measures of sports performance indicators is questioned. Instead, alternative approaches for PA are offered that recognise the dynamic interactions that characterise game sports as key features of sport performance. Even though Lames & McGarry (2007) suggest that performance indicators are unstable and should not be looked at, Jones et. al., (2004) found that there is link to length of possession and success in English soccer. Successful teams were found to have significantly longer possessions than unsuccessful teams irrespective of match status i.e. winning ( $p < 0.01$ ), losing ( $p < 0.05$ ) and drawing ( $p < 0.01$ ). They also consider that team having longer possession in the games might be down to skill level of the players rather than team tactics. That means choosing to necessarily keep possession does not award the win.

In order to identify performance indicators it is essential to have clear operational definitions. Being recognised as important in the reliability of data, operational definitions need to be clear and replicable. The creation of operational definitions both within academia and a professional context plays an important role in the analysis of performance within the sport (Williams, 2012). The operational definition of the action and outcomes enables you, and others, to consistently interpret events in the same way (Hughes & Franks, 2004). In his work O'Donoghue (2007) challenges beliefs, arguing that the presence of precise operational definitions does not guarantee good reliability nor does their absence guarantee poor reliability. Limited reliability can introduce variability into data that reduces the chance of finding a significant difference. Reliability is at least as important when PA is used in coaching and judging contexts as when it is used for academic research. There is a trade-off

between reliability and the precision of measurement. In his work he proposes 7 steps that should be considered when developing new systems for data collection in order to ensure reliability.

In addition to operational definitions O'Donoghue & Cullinane, (2011) suggest that due to the fact that sports performance variables are unstable with opposition quality being the main source of player of variability. Therefore, performance indicators should be evaluated addressing quality of opposition. This idea has been extended to address the relative strengths and weaknesses of particular opponents rather than applying the same model to all players.

The problem with finding reliable performance indicators is also down to a fact that soccer is multidimensional sport and there are many different variables that can affect the result of the game. James et. al. (2002) looked into the team tactics of different tournaments and found that teams play different whether they play in international games or national league. The correct tactic to play may also depend on the weather, the size of the field, the tactic of opposition, and many other variables that cannot be controlled. Either it is logical to consider all of these things that coach or anyone else cannot control or it would be best to ignore and look for these performance indicators that can predict the result in no matter what conditions.

### **1.3. Performance analysis in soccer**

As one of the most popular sports in the world soccer can be considered as the most studied discipline also in the field of PA. As Jones et. al., (2004) found in their study that there is a link between possession and success, a lot of studies has concentrated not directly on possession, but on one of the most important technical skill of keeping it – passing. There is a considerable amount of work done on this. For example, Scoulding et. al., (2004) looked at the passes made in World Cup 2002 in Japan and South Korea. They based their study on 6 matches, 3 from successful team and 3 from unsuccessful team. 4000 passes were made in these matches. They analysed the distance, whether it was passed into the zone or to teammate's foot and whether it was made with one touch or after dribble. They also analysed the outcome of the pass. The only difference they found between teams based on success was the fact that unsuccessful team made more passes. They suggested that either teams looked at were at similar level and other factors determined the outcome or criteria used were not sensitive enough. In this study those about 4000 passes analysed seems to be a



considerable amount, but they were analysing only 2 teams. It might be suggested that more teams should be looked at to find the difference in level of passing. Study by Adams et. al., (2013) found that successful English Premier League teams utilise defender's skills to build up the game from the back. In a study by Hughes & Franks (2005), the study published by Benjamin and Reep in 1968 was the base and passing sequences leading to shots and goals in soccer were looked at. Reep & Benjamin (1968) found in their study, which can be considered the cornerstone of modern PA that short passing sequences with 3 or less passes are more successful leading to 80% of the goals in soccer. Hughes & Franks (2005) looked into these results more deeply and suggested that the study by Reep and Benjamin led to only partial understanding of the phenomenon. In their study Hughes & Franks (2005) found that the results conform to that of previous research, but when these data were normalized with respect to the frequency of the respective lengths of passing sequences, there were more goals scored from longer passing sequences than from shorter passing sequences. The teams produced significantly more shots per possession from the longer passing sequences, but the strike ratio of goals from shots is better for "direct play" than for "possession play". They also found that for successful teams, longer passing sequences produced more goals per possession than shorter passing sequences. For unsuccessful teams, neither tactic had a clear advantage. Contrary to their study Wright et. al., (2011) found that in the English Premier League out of 169 goals 85% were scored from short, less than 4 pass sequences. When looked at passing from another angle. Ridgewell (2011) found that 5 minutes before and 5 minutes after the goal is scored are crucial minutes for the teams. He analysed 121 goals from FIFA World Cup in 2010 and found that 5 minutes before a goal is scored the scoring team has significantly more possession in the middle and attacking third than average of the halftime. In contrast to that team who conceded has more possession in the middle and attacking third 5 minutes after conceding. In this study it must be looked at the time parameters set for the data collection. Even though Redwood-Brown (2012) has already used this time parameter before, it should be considered whether the teams who had more possession than average during these periods measured had more possession sometimes longer than 5 minutes and sometimes less than five minutes. There can be just 1 minute of full domination and it still creates higher than average scores for a full 5 minutes. To look at the time factors Siegle & Lames (2012) in their study found that the average time in a soccer game that ball is in play is 50-55 minutes per game. Although soccer is the game where high intensity actions alternate with low intensity actions. Forwards spend greater time running

faster than 14 km/h when a team is leading, compared to when level and defenders on the contrary when a team is trailing compared to when level. (Redwood-Brown et. al., 2012). These findings show that the workloads or even ethics of the players change depending on the score of the game. Also, it could be assumed that in those matches where defenders were analysed the leading team was so dominant that the defenders had to work harder in order to help the team. These findings could give suggestions to coaches to look at the player's performance in different states of the game.

The variables that discriminate between winning, drawing and losing, were the total shots, shots on goal, crosses, crosses against, ball possession and venue. (Lago-Peñas et. al., 2010). Lago (2007), found that in the group phases of major tournaments like the World Cup the first match played by a team plays a significant role in further success. Which might be obvious as it builds momentum, but also with only 3 games in the group stage every point is crucial. As scoring being the most important in soccer, Wright et. al., (2011) looked for the factors that associate with goal scoring. They found that in the English Premier League, out of 169 goals 63% were scored from transition moments and 87% of all goals were scored from inside the penalty area. Supporting these findings Tenga et. al., (2010) found that 52% of the goals in Norwegian Professional soccer come from counter attacks. The biggest limitation with both of these studies is that neither of them gives an operational definition for the transition moment or counter attack. There might be two options: either they define these moments by time limitations or maximum number of passes. That makes it hard to use these findings in applied environment.

#### **1.4. Perturbation**

Perturbation can be defined as an incident that changes the rhythmic flow of attacking and defending in soccer. It could be identified as a penetrating pass, a dribble, a change of pace, or any skill that creates a disruption in the defence that might enable an attacker a shooting opportunity (Hughes et. al. 2001; Hughes & Reed, 2005). It exists in an open system where the usual stability is disturbed and results in a critical incident which in soccer can be counted as an attempt on goal. Perturbations do not always end with critical incidents and can be smoothed out (Hughes et. al. 2001). Smoothing out which can either be caused by bad skill execution by attackers or good effort by defenders, means that the defending team

has prevented the opposition from creating attempt on target. Perturbations have been studied by Hughes & Reed (2005) to find whether they can be used to profile team's strengths and weaknesses. It was found that there are certain characteristics that can help to identify team's tactics. Although it cannot be used to predict team's performance in the next games, it is due to the fact that a change in tactics causes the data to show high significant ( $p < .05$ ) variability. It means that using results from opposition last match cannot show exactly how they play and cannot allow to prepare only based on these results. There is an existing research on this topic and also a number of limitations generally in this specific area of research which must be considered.

First of all, the main concern is that even if there is a clear definition of what perturbation is, the person collecting the data for the study might interpret the situation differently. It is defined that perturbation is a moment, in soccer context, when the defence is out of balance and attacker has a shooting opportunity. It is not always black and white and it is the first and foremost the biggest limitation that must be considered when looking at research on this topic. For example, there were an average of 78 perturbation attempts per game found by James et. al., (2012) which is a lot less than the average of 118.2 perturbations per game reported by Hughes et al. (2001). In these studies perturbation attempts from both teams are summed up which means we could see that almost every minute there are unorganized situations in defence. Different results in these studies can derive from different definitions of perturbation moment, which can be subjective. Creating own notational system might encourage that. It must also be considered that different level of soccer can produce different number of perturbations. For example, smaller number of perturbations were found in the lower level of soccer by James et. al., (2012) and bigger number at a higher level by Hughes et al. (2001). It would mean that more scoring chances and goals could be seen in top level. After comparing those two numbers, it came out that the percentage is even 25% bigger. It must be noted that data was collected during more than 10 years' time and the game might have changed by that time.

Secondly, Hughes & Reed (2005) found that perturbation can be used to profile a team, but also found that the change in tactics between the game states caused the data to show high variability. This is why results from studies looking how perturbation attempts were created must be looked with caution. If even a change in one team's tactics can create big variability in the data, then analysing two or more teams and generalizing the data to show how perturbation attempts are created might not be actual. Stronger teams who have

the best players and create more perturbations in the game will dominate in the data set. Therefore one can witness that a team which uses lots of crosses and is successful in that area sets the mark in the data set. It would be more reasonable to prevent generalizing all the full matches analysed, but to differentiate games by the venue, game state, opposition and time played in the game (Hughes & Reed, 2005). Hughes et. al., (2001) found that 55% of all perturbation attempts resulted from the pass, run, dribble and skill categories, which are all associated with positive, creative play. In contrast (James et. al., 2012) analysed only perturbations that originate from creative play and how they ended. They found that passes are used mostly to create perturbations, but the same time dribbling is most successful when creating perturbation. Previous studies have not mentioned set pieces as an opportunity to create perturbation attempts. Even though these should be counted as perturbation attempts and looked into more deeply. When analysing perturbations, no studies have mentioned if there are certain players or areas of the field where more perturbations are created from. On the one hand, it is certain that perturbation itself must occur in the penalty box for it to be successful and have an actual scoring chance. But on the other hand, it would be more important to see whether there are certain areas of the field where these perturbations originate from. It is clear when results from different studies say that most perturbations are attempted by passing. It has not yet been studied with which passes and from where.

In a study by Hughes et. al., 2000 where they looked for only perturbations which were smoothed out, it was found that perturbations are smoothed out equally by bad attacking or good defending and reasons for that are dominantly bad passing or intercepting passes. When looking at different studies where perturbations are analysed, we can see that the location of the pitch is not analysed in these studies. It might be important to see whether perturbations from certain team can be characterized by the location of the pitch where they create most of the perturbations. Also, whether there are differences between successful perturbations and unsuccessful perturbations. Although not studied in context of perturbation, significant differences were found in defender-to-ball distance between different positions on the pitch. Due to the fact that player dyads which is a relationship between two players and shows how one's actions affect others. It is a complicated topic and earlier perturbation studies have not sought an answer to the question if there are certain players who cooperate better - although that would be one possibility to see whether there are dyads of players in one team that create perturbations more effectively than others, Headrick et. al., (2012).

Redwood-Brown et. al., (2012) found that forwards spent greater percentage of time moving faster when their team was leading than when level while defenders spent a greater percentage of time moving faster when their team was trailing than when level. In addition Shafizadeh et. al., (2012) found that losing possession is most caused by skill execution speed, timing and parameterization under stress. It could mean that with higher tempo there would be more perturbations and different score of the game might indicate more perturbations are attempted. Previous studies analysing perturbations have not included the factor of score in them. It is reasonable to look whether teams losing are creating more or less perturbations than when winning or level. Same time it must be considered, that perturbation which means that the rhythm of the system for one team has collapsed and critical situation is created, that the fatigue might be also factor. However Lago-Peñas et. al., (2009) found that there are no significant differences in distance covered between two halves. Previous studies looking for perturbations have not looked into the time factor of perturbations. Due to the fact that perturbation in soccer is a not-so-much studied topic it is hard to find a study that would include the dimension of time or score which would give us an idea whether or not this factor influences the attempts to create perturbations.

(James et. al., 2012) studied perturbations by a team at the English soccer league third level and found that it is possible to differentiate when and how perturbations take place. To see whether this is something that can be found also by looking at teams at different level James et. al. (2012), suggested carrying out similar study at with the different standard team. As suggested this study is going to look perturbation attempts by mid-ranked team in FIFA World ranking.

One middle ranked national team and its U19 youth national team are analysed and looked whether there are differences between main moments of the game when creating perturbations. Whether there are styles of play in which team is most successful creating perturbations and if there are certain variables in the game which can discriminate between A national team and U19 national team. Addition to that this study attempts to examine if perturbations alone are enough to determine differences between teams. Factors of time, score, home advantage and importance of the game are not looked at in this study. This study takes perturbation and positive end to the possession as different outcomes. There are not always perturbations when an attempt on goal takes place.

## **2. Aims and tasks**

The aim of this study is to analyse perturbations, looking at one mid-ranked FIFA men's national team and U19 national team from same Football Federation, and determine differences of offensive and defensive actions of two teams.

For that:

1. 10 games from both teams are analysed and ball possessions are collected.
2. From each ball possessions all perturbations are analysed.
3. Analysed teams are compared to by attacking perturbation and defensive perturbations.
4. Different offensive and defensive ball possessions are looked at.
5. Outcomes of the ball possessions and perturbations are compared

This study looks for perturbations in 10 matches from each team. Both attacking and defensive perturbations are looked at. Different moments of the game, styles of playing, outcomes of attacking moments and the success of perturbations are looked at.

### **3. Methods**

#### **3.1. Participants**

Mid ranked in the FIFA world ranking table – A national team’s qualifying games and U19 age group national team from the same country were analysed. Home and away games were both looked at. Matches were chosen by considering the players playing for analysed teams. Reason for that was to analyse only the matches where analysed teams played with the strongest line-up. For A national team 6 home and 4 away games out of which 6 games were qualifications matches and 4 friendlies. For U19 national team 1 home game 2 away games and 7 games from tournaments on neutral field, out of which 3 games were qualification matches and 7 friendly games. All the games from both teams were played in year 2013. Both attacking and defensive perturbations were studied. Home and away matches were not looked separately, friendly and qualification matches were not looked separately. A total of 3402 ball possessions were looked. 1553 from A national team matches and 1849 possessions from U19 national team.

In these games, teams used 20 players in the U19 team ranging from 17 to 18 and 18 players in the A national team ranging from 18 to 37, with the average age of 26 years.

#### **3.2. Procedure**

##### **3.2.1. Data collection**

All 10 A national team matches were broadcasted and televised. All 10 matches from U19 national team were filmed by one camera by the technical staff of the Football Federation. All the videos from 20 games were received from Football Federation of the analysed teams. All the data collection was done using Dartfish Connect Plus software version 7. A custom notational template was constructed in Dartfish. The raw data was processed and analysed using Microsoft Excel 2013 for Windows 7.

For each perturbation, the following information was recorded: Team, main moment, outcome, set-piece or not, build up style, pressing, perturbation or not.

Perturbation was collected when unbalance in defensive team formation was noted. The unbalance was determined when there was clear chance for attacker to shoot on goal while being in the penalty box or in some cases outside of the box. The attacking player can be unmarked or defender has lost the 1v1 duel. Added illustration of creation of perturbation moment.



Figure 1. Illustrating starting point.



Figure 2. Showing key moment.





Figure 3. Showing start of perturbation moment.



Figure 4. Showing clear perturbation moment added as annexes.

Operational definitions for collected events are listed in Table 1.

Table 1: Operational definitions for collected proceeding events.

1. Team	The team analysed or opposition.
2. Main moment	The build-up - Team has possession where they are trying to keep the possession and opposition defence is organized. Transition - Moment after winning the ball and team tries immediately to go to attack.
3. Outcome	Possession ends with an attempt, winning set piece or losing the ball Positive outcomes end with shot on, off goal or blocked.
4. Set piece	Set piece during the possession. Set pieces counted are: Throw in, Free kick, Corner, Penalty, Goal kick, Goal keeper restart – goalkeeper catches the ball in the game and restarts by throwing or kicking it.
5. Build-up style	Differentiated between short passing and long passing Short pass – on the ground, no longer than 20 meters. Long pass – on the ground or in the air, longer than 20 meters.
6. Perturbation	Unbalance in the defence during opposition attack.

All the action variables, main moments, opposition and analysed team were compared with a paired t-test to see whether there were significant differences between them. All the variables were analysed to find correlation between perturbations.

### 3.2.2. Data analysis

Data analysis included descriptive statistics, measuring means, standard deviations, correlation coefficient and student test were used.

For each perturbation, the following information was recorded: Team, main moment, outcome, set-piece or not, build up style, pressing, perturbation or not.

The correlation coefficient was measured only between perturbations other variables collected.

Student t-test were used to compare the different variables measured between the A national team and U19 national team and between team analysed and oppositions. Significance was counted at level of (.05).

### **3.3. Reliability**

For determining the reliability of collected data, 20% of all data were recollected and reliability was measured. The intra-observer test for comparing the data collected was used. The percentage of error was measured for perturbations after comparing two collected data sets between each other. Example, (Jones, James & Mellalieu, 2004). Low 69% of reliability was measured when determining whether or not perturbation occurred.

#### 4. Results

There were total of 277 perturbations in 20 games analysed in the study (mean = 14 per game, SD = 3,4). A total of 3402 ball possessions were collected, with 277 perturbations in total, on average perturbation happens in every 12 ball possessions. There is a small difference between A national team and U19 national team with on average perturbation taking place after every 13 possessions for men's team and 11 in youth.

Number of perturbations in A national team games is (mean = 14, SD = 3,3) per game. Analysed A national team made (mean = 5, SD = 3,4) perturbations per game in attack compared to perturbations in defence made by oppositions (mean = 9, SD = 4,4) per game. For U19 national team same numbers are (mean = 14, SD = 3,6) perturbations per game. U19 national team's made (mean = 4, SD = 2,6) attacking perturbations per game and (mean = 10, SD = 5,3) created by oppositions. In both cases there were negative correlation found between the number of perturbations made by the analysed team and oppositions. A national team ( $r = -.67$ ) and U19 national team ( $r = -.81$ ).

Table 2. Perturbations out of 100 ball possessions in A national team and in U19 national team.

	A	U19
Average	.088	.076
SD	.283	.266
TTEST	.232	

In Table 2 with average showing similar result for A team and U19 team in occurrence of perturbations in 100 ball possessions from all the collected data with no significant difference between two teams ( $p = .23$ ). It shows that there is no significant difference between two national teams in terms of how often perturbations occur in the games.

Significant difference was found when analysed team is compared to the opposition ( $p < .001$ ). Only 5% of possessions ended with perturbations for analysed teams compared to the oppositions 12%. Similarly, significant differences ( $p < .001$ ) were found in every category looked at between analysed teams and oppositions. Only when A national team build-up is

compared to transitions moments, significance was smaller with ( $p < .05$ ) and when A national team transitions are compared to opposition team transitions ( $p = .17$ )

Table 3. Main moments in A national team and U19 team.

	A	U19
Average	0,5	0,5
SD	0,5	0,5
TTEST	0,95	

Table 3 showing significant similarity between ball possessions of two analysed national teams ( $p = .95$ ). Similarly, when only looking at possessions ending with an attempt at goal, no differences were found ( $p = .76$ ). For example looking at only possessions which ended with an attempt at goal 70% of the possessions for A national team included perturbations. Same number for U19 national team was 62%. No significant difference between two teams were found ( $p = .14$ ). In the analysed games of A national team, there was a moderate correlation ( $r = .66$ ) between perturbations and the result of the ball possession. Same result was found when looked younger team matches ( $r = .64$ ). When both analysed team's are compared to the oppositions there is a moderate correlation between perturbations and the outcome of the possession for analysed team ( $r = .59$ ) and slightly stronger correlation for oppositions ( $r = .69$ ). Strongest correlation between perturbations and the positive outcome of the possession was found when opposition is building up the game ( $r = .80$ ). Strong relationship was found in both cases at A national team level and U19 national team level.

There was no significant correlation between perturbation and other variables measured, when all data was put together or when only possession that ended with an attempt at goal were looked at. No significant correlation was found either when analysed teams are compared to the oppositions nor when main moments of the game are divided into groups of build up or transition.

There were no significant difference between two teams, A national team and U19 national team, in the outcomes of the ball possessions. ( $p > .69$ ; Table 4). However, there is a significant difference when an analysed team is compared to the opposition ( $p < .01$ ). With only 6% of possessions ending successfully for analysed team and 11% for oppositions.

Same result was found when U19 team is compared to the opposition ( $p < .001$ ). On the other hand, no significant differences were found in other categories like U19 team build-up compared to their transition ( $p = .88$ ) or U19 opposition same category ( $p = .94$ ). However, between A national team opposition's build-up and transitions significance is ( $p < .05$ ). It means that opposition build-up created more successful moments, on average 12% of build-up moments ending with shot compared to 8% from transition. Same level of significance ( $p < .05$ ) is found between U19 build-up compared to U19 opposition build-up. In defence, build-up created more successful moments for opposition, average 12% of moments ending with shot compared to transition 8%.

There were significant differences between the occurrence of set pieces in A team and U19 team ( $p < .001$ ). In U19 team matches every second ball possession included set piece. Similarly, when looking only at the possessions ending with shot, significant difference was found ( $p < .01$ ). Only 28% of possessions, included set piece in A national team games compared to 45% in U19 games. However, when the youth team analysed was compared to the opposition there was no significant difference between the occurrence of set pieces ( $p = .77$ ). Also, no significant differences were found in other categories analysed.

Table 4. Short passing build-up in A national team and U19 team matches.

	A	U19
Average	0,41	0,5
SD	0,49	0,5
TTEST	0,00	

In table 4 can be seen that more than 40% of all the build-ups were played with only short passing by A national team and with 50% by U19 national team. There is no significant difference between two teams ( $p > .05$ ). Similar to these findings, there is no difference in build-up style between A national team analysed and oppositions ( $p = .89$ ). Both teams using only short passing nearly half of the times when building up in the game. However, at youth level significant difference is found ( $p < .001$ ). Oppositions using 32% of the times only short passing compared to analysed team 39%. Also there was significant difference found between A national team and U19 national team ( $p < .05$ ) when success of the short passing

build-up is compared. 44% of the short passing build-up possession made by A national ended with attempt at goal compared to 32% in U19 games.

## 5. Discussion

There were (mean=14) perturbations in analysed matches. This is lower than 60-100 per game as it was found by James et. al. (2012) in English Coca-Cola Championship or 118 per game suggested by Hughes et al. (2001) in FIFA World Cup. These results show that teams with different levels create different number of perturbations. It must be considered that previous works which were mentioned, looked for the perturbations attempts. Perturbations attempt is an action like pass, dribble or any other creative action by the attacking team, which, if successful, clearly creates unbalance in defence. Perturbations, which were looked at in this study, are moments where perturbation attempt has been successful and defence is out of balance after that. There is no pattern to bring out when comparing teams by the playing level from studies by James et. al. (2012) or by Hughes et al. (2001). Difference of more than 20 perturbation attempts per game found by James et. al. (2012) and by Hughes et al. (2001), could be explained that teams in one league level are more even at their playing level. However teams playing in FIFA World Cup are usually playing against teams with different playing levels, especially in the first rounds. When considering results from this study then lower number of perturbations created by analysed team compared to the opposition could be easily explained. It is clear when looking the logic of groups drawn at World Cup or European Championship qualification rounds. The main idea is that teams are divided by their rankings into the groups of 6 and in every group there is at least one team from absolute top, second from near the top of FIFA ranking and etc. Also, friendly matches are usually played against attractive and stronger teams to attract more spectators to come to the stadium. Additionally it must be considered that this study specially chose most important games so that the effect of different players playing would be as low as possible. When considering the difference between James et. al. (2012) and Hughes et al. (2001), it is reasonable to consider that the difference of defining the moment of perturbation is key in this case. Definition for perturbations and perturbation attempts is also very important factor which might cause the big difference between previous studies mentioned and also low reliability of the current study. At the moment the definition of perturbation allows to make subjective decisions when collecting data. Even intra-rater reliability used to register occurrence of perturbations in this study was relatively low, clearly showing the point in this matter. It must be considered whether perturbations are the key moments and should be collected or not. Also with lowest ( $r = .59$ ) correlation in this study between a successful



outcome of the possession and perturbation, the attempts at goal could be the key moments to look at. Lames & McGarry (2007) consider performance indicators to be unstable, which means that key moments in the game happen much less when playing against stronger opposition. They also suggest finding alternative approaches to recognise dynamic interactions. Supported by O'Donoghue (2007) who argues that even precise operational definitions are not the guarantee for strong reliability and vice versa. In the other work by (O'Donoghue & Cullinane, 2011) was suggested that performance indicators should be changed by the level of opposition. Both of his suggestions could help to change the way soccer is analysed. As in this study low reliability was found and it can be said that it is due to the fact that the clear operational definition is missing. Same time it must be considered that the perturbation in its nature is already very complicated event in the game. Different observers can see these moment differently. It comes down to the experience of the observer but also same time, knowledge of the sport and observational skills are crucial.

In a study by Dawson (2007) it was said that today's performance monitoring systems are complicated, expensive and take long time to get information out of which does not let it be used in the game situations. Hughes & Reed (2005) found that perturbation can be used to profile a team, but also found that a change in tactics between the game states caused the data to show high variability. In applied field, it could be thought about measuring the attempts for and against. It could help finding weaknesses, strengths and patterns from the opposition and own team. This kind of data collection could be done during the game if performance indicators and operational definitions are agreed. Also patterns of play and changes in tactics could be found. Addition to that, it could be collected live and would be a very quick way to get useful knowledge out of the game. It can be a problem if a low number of attempts are taken in the match. Also in academic works, it should be considered looking attempts and taking steps back from these situations to find significant performance indicators.

Addition to that, it must be considered that analysing perturbations in soccer is a new topic. With the game itself being dynamical, it can still be useful to determine whether perturbations are an effective way to evaluate the performance of the team. James et. al. (2002) suggested that teams play different tactics home and away or depending on weather. This study did not consider different fields or weather and it cannot be confirmed that these variables would have an effect on results. For example (Lago, 2009) found that match location had no influence on team possession. Playing home or away was not characterized

by an increase or decrease in team possession. However, there was an interaction between the variables of match location and quality of opposition. This interactive effect showed that playing away against strong opponent decreased team's possession when compared with playing at home. It could be explained that away teams adopt cautious and defensive approach and it contributes to the home advantage. Jacklin (2005), findings contradict against previous work and say that in this particular context, the extent of home advantage has diminished. It is due to the fact that the winner gets three points instead of one. Lago & Martin (2007) found that home teams have more possession than away teams, teams have more possession when they are losing the matches than when winning or drawing, and the identity of the opponent matters – the worse the opponent, the greater the possession of the ball

A surprising result from this study was that correlation between the positive end result and perturbations was not so strong, weakest ( $r = .59$ ) and strongest ( $r = .69$ ). It allows to assume that every mistake by defensive team that leads to a goal cannot be considered as perturbation. There are many different factors that must be taken to notice. For example, a shot from the distance is taking a chance and defence can be totally organized when the shot is made, which means that perturbation did not take place. With correlation coefficients showing different results, it was found that the strongest correlation between the positive outcome of possession and perturbation was when the opposition was building up. That was found both in A national team level and U19 national team level. It was biggest differences between analysed teams and opponents. A slightly stronger correlation of ( $r = .69$ ) between positive outcome and perturbation for opposing teams can indicate that they are causing more problems with their skills. It means that they can unbalance the defence of the analysed teams more easily and analysed teams must rely more on shots from longer distances and maybe even more on chance. Lames (2014) studied the chance in goal scoring and found that nearly 50% of the goals are scored with the help of luck. It was found that the luck increases with free kicks (exists in 55% of goals scored) and decreases with corners (45%) but it is 50.5% in open play. They did not find any differences between two top leagues in the world (English Premier League and German Bundesliga). Nor did they find any differences between the final positions of the teams in the league table.

There were negative correlation found between the number of perturbations made by the analysed team and oppositions. It allows to suggest that a soccer match is rarely an even competition and usually one team is better than another by creating chances. It does not mean

that creating perturbations immediately means that team making them more will win. The results showed that there is difference in youth and adult level (A national team ( $r = -.67$ ) and U19 national team ( $r = -.81$ ). There was no significant correlation between perturbations and any other variables looked at. Neither was there significant correlation between these variables when conditions were changed. For example, analysed team compared to the opposition or different main moments compared.

Yiannakos & Armatas, (2006) found that goals which were achieved through organized offence presented higher frequency (44.1%) following goals after a set play (35.6%) and counter-attacks (20.3%). Hughes and Franks (2005) found that there were significantly more shots per possession at longer passing sequences than there were at shorter passing sequences for successful teams in 1990 and 1994 World Cups. Contrary to that, the conversion ratio of shots to goals is better for direct play than for possession play. Organised offence or possession play means build-up play in this study, even though it is not defined how the cited studies define organized offence and counter attacks. Results in this study indicate that significantly more, perturbations are created through build-up than transition moments. Both A national team ( $p < .05$ ) and U19 team ( $p < .001$ ). These are results of build-up by analysed teams. When looking at defensive play, which shows how perturbations are created against the teams analysed, it can be seen that against both teams perturbations are created more through build up play than transitions. Even though these results are supported by previous studies, the results are surprising. When comparing these two main moments with each other, it should be easier to create perturbations and also to score from transition moment. Build-up moments are the ones where defence is organized, usually with most of the players near the defensive team's penalty box. It should be harder to unbalance the team when players are closer to each other and ready to defend. Compared to transition moment which means the attacking team lost the ball and has to react quickly to defend their goal. In this situation players are further away from each other and usually also far away from their own goal. Mainly with 4-5 players between the ball and an own goal. As results from earlier works indicate, nearly 80% of goals are scored from moments when defence is organized. For example, it could be considered that analysed teams are not good enough and always play against stronger opponents that have many opportunities and good quality when they build-up, making it more reasonable that build-up moments create more perturbations against analysed teams. The result that analysed teams created significantly more perturbations from attacking build-up play disproves these suggestions. The study also found that opposition

teams created significantly more perturbations. It was both in youth and A national team level and in every type of ball possession. There was no significant difference in transition moments for A national team. When two analysed teams were compared, there were no differences found in terms of number of perturbations. As this study was not looking at results of the games analysed it cannot be said if the balance between winning and losing was negative for the analysed teams. This is why it could be helpful to add the result level in future studies to see if more perturbations in the game also means more goals.

In addition to perturbations, in this study it was also analysed if there are differences in analysed teams in any other variables besides perturbations. This study found no significant difference and correlation between perturbation and a positive outcome is similar. Finding no differences is surprising. It is because there is relatively small group of players available for youth national teams from smaller countries. Compared to A national team where there are more players available to choose from (almost 15 different age groups) which should make the difference in playing level compared to bigger countries much smaller. For example, in both cases, opposition created the same amount of successful outcomes from their possessions against both of the analysed teams. Also, analysed teams created same amount of positive outcomes from their attacking possessions. Similarities in two teams were also found when only build-up play was analysed. In studies by Waldron & Worsfold (2010) and Shafizadeh (2008), was found that there were differences when two groups with different age were compared to each other. It must be acknowledged that different groups and also different variables were measured in both of the studies, but the clear indication is that in soccer when two groups with different experience were studied, differences were found. It could be suggested that similarities between two teams are a positive finding in this study, as players from youth team are being prepared to play in the A national team. It can be concluded that different analysis should be carried out for finding differences between the analysed teams. More games should be used to find differences between youth and A national teams. Also, it must be concluded that these results are not transferable to any other teams.

It must be considered that one of the limitations of this study is that only one team in each age group is analysed and therefore generalizations for other teams are not possible. 20 matches are analysed and opposition is always different, ranking from top teams of the world to some weaker teams. The analysed matches were played over a long period of time,

compared with club soccer where a total of 10 matches might be played in 2 months. That causes the problem that some of the players and also the team's style of playing might have changed, that's why it makes it harder to gather data from national team games.

The biggest limitation in this study is the reliability of defining perturbation. In addition to that, other studies analysing perturbation attempts have differences in number of perturbations per game which comes from the subjective opinion that the person collecting the data has to determine perturbation. For the reason of only moderate correlation between positive outcome and perturbation with lowest ( $r = .59$ ). All the attempts on and off the goal in attack or defence should be collected and looked how and why they happen. Future studies should define perturbation attempt before collecting data to make sure that it keeps in line with previous studies.

## 6. Conclusions

From the results of this study it can be concluded that through analysing perturbations it is possible to profile the team and see how the team plays. Also, it can be considered that even though U19 national team players are considerably younger than A national team players, the strengths and weaknesses of some federation national teams are similar and games can be approached similar way.

1. Scoring opportunities in high-level of international soccer take place typically after every 12 ball possessions for analysed teams.
2. There were no significant differences between youth national team and A national team in the amount of perturbation occurrences.
3. There is significant difference ( $p < .01$ ) in efficiency of reaching positive outcome in the end of the possession for analysed teams and oppositions.
4. Positive outcome of the possession does not mean that perturbation took place ( $r = .59$ ).
5. Low reliability shows that occurrence of perturbation can be seen different when collected again.
6. Low reliability in collecting the perturbations and low correlation between positive outcome and perturbation suggest, that it would not be the best way to collect information about the teams.

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