Haaga-Helia
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SM-League goal scoring analysis seasons 2013-2014 and 2016-2017 – Before and after blue line rule change

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Bachelor's Thesis
Degree Programme in sports coaching and management
2019

Haaga-Helia
University of Applied Sciences

Abstract

28.4.2019

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Degree programme
Degree program in sports coaching and management

Report/thesis title
SM-League goal scoring analysis seasons 2013-2014 and 2016-2017 – Before and after blue line rule change

Number of pages and appendix pages
37 + 5

This bachelor thesis is a research-orientated study of goal scoring in Finnish SM-League from season 2013-2014 and season 2016-2017. Objective is to find out how goal scoring has developed between the two season and, find out what kind of an effect IIHF's blue line rule change had in goal scoring.

This report includes theory part, with general information of game of ice hockey, analysing background of Finnish SM-League scoring and short introduction to Finnish SM-League and to International Ice Hockey Federations rule change of blue line placement. The practical section is made of introduction to the analysing tool, which has been used during this study and of data collection, how it was collected, who collected and why it was collected in first place. The analysing part includes answer to research questions and opening of all the data that was collected during season 2013-2014 and season 2016-2017.

Results answered to three research questions. How many goals were scored during season 2013-14 compared to 2016-2017 season in different scoring categories, what are the differences in scoring between the season 2013-14 and 2016-17 and what was the effect of the IIHF rule change in scoring between the seasons 2013-2014 and 2016-2017? It was found in results that scoring had changed almost in every analysing category, and the biggest differences was found in offensive end zone goal scoring with enormous increase of goal amounts and in turnover goal scoring with moderate decrease of goal amounts. Results showed that IIHF rule change influenced goal scoring in Finnish SM-League, not by increase of amounts of goals, but with larger number of goals scored after offensive end zone play.

Study provided an accurate data of a change of trend in scoring goals in Finnish SM-League. It was proven that the blue line rule change had its effects on change of goal scoring but not the way IIHF would have liked to. There is a possibility that everything in the change of goal scoring is not in direct effect of the rule change.

Keywords
Analysing tool, ice hockey, SM-League, goal scoring

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1 Introduction

This bachelor thesis is a research-orientated study of goal scoring in Finnish SM-League (from here after Finnish SM-League, SM-League, League, SM-Liiga, Liiga) from season 2013-2014 and season 2016-2017. Thesis covers theoretical part with general information of ice hockey, analyzing ice hockey, SM-League and of International Ice Hockey Federation (from here after IIHF). By going through all the theoretical part, it builds a base on the research part, where the data is opened to common language. This study has its focus on team development and team analysis, not so much in individual player analysis or development.

In ice hockey, game analysis is used as a training tool and as a game development tool. Game analysis can be used for individual player or team game development. When doing the analysis, it tries to find the strengths and weaknesses of our own and the opponent's game. Key themes in most of the analysis are how and where the goals are scored. By analyzing the game, it is possible to create accurate information on what has led to the goal. By clarifying the above-mentioned issues, the goal is to increase your team scoring and decrease opponent scoring.

The ice hockey's entertainment value is based on making goals and winning games. In July 2014, the IIHF outlined that the number of goals in the games should increase and at the same time rise the entertainment value of the game events. The change was made to the rules with way of moving the blue lines towards the central line by 1.5m. This gave more space to the offensive-zone in a hope of creating more goal scoring opportunities and making goal scoring easier.

Objective of the research-based study is to find out how goal scoring has developed between the season 2013-2014 and season 2016-2017 and, find out what kind of an effect IIHF’s blue line rule change had in goal scoring in Finnish SM-League.

2 Game of ice hockey

Ice hockey is a team sport played on ice. The game is played between two teams, consisting of five skaters and a goalie at the same time on the ice. A single game is won by the team that scores more goals. Therefore, the objectives of the game are to score goals and prevent the opponent from scoring against you. (Koho & Luukkainen 2012, 138.)

The division of the playing surface into two equal parts using the centre red line as the halfway point. The team that is closest to its own goal net is in the defending half while the team farthest from its own goal is in the attacking half. (IIHF Rule book 2018).

For an individual, the most essential tools for achieving the objectives of the game are his game playing skills, which include his technical skills and hockey sense. (Forsman & Lampinen 2008, 280.)

Hockey game analysis is about evaluating different game situations. Game analysis is based on a sport analysis, which explains all the things that affect the game. These include: rules, conditions, history and hockey development. Game analysis is used to provide information to players and coaches about the game. For a successful coach, game analysis is one of the most important tools for team and individual development. The game situations are assessed using videos, as well as statistics (including shots, turnovers). Depending on the situation, there are three to six players on the field (goalkeeper + 5 players). Different game situations can be analyzed through one player or the whole sextet. Attacking and defending gaming are considered to be the evaluation of sextet. The role of an individual player can also be easily emphasized when evaluating the gameplay of the whole sextet. An offensive game can be used to evaluate direct attacks, where an opposed defense is organized, or turnovers attacked against unorganized defense. You can also evaluate the performance of the six springs through different zones (offensive, neutral or defensive). (Savolainen. 2016, 564-565)

> "When analyzing the performance of an individual player, his skill in playing is a key feature. It combines the player's ability to understand the environment and game situation and technical skills such as skating and stick handling. A player with good game sense is able to react and act in the best way to the benefit of his own team. Playing skills are also influenced by the physical (including speed, strength, endurance), psychological (eg courage, creativity, determination) and social (co-operative) conditions of the player." (Savolainen 2016, 565)

In Finland, the main focus in training was on the individual sport training methods. The coaching focused a lot on physics coaching and for that reason the game development

was not very fast. Since the beginning of the 90s, the Finnish Ice Hockey Federation started the analysis of the game. The game analysis focused on things that helped in winning, as well as in development of a player and team. The table below shows you all the features of game analysis that can be explored. (Westerlund. 2997 530)

The chart shows different needs in different age groups. The lowest boxes are for children's coaching. The middle row focuses on coaching and developing young players. The top of the chart illustrates player relationships and the ability to collaborate within the team. These features are designed to produce the best possible result for team play. The biggest goal at the top of the coaching is to get individuals to play together as well as possible. Ice hockey requires many different features from a player. If coaching focuses on only one development target, the overall development is slowing down. (Westerlund. 1997, 530-531)

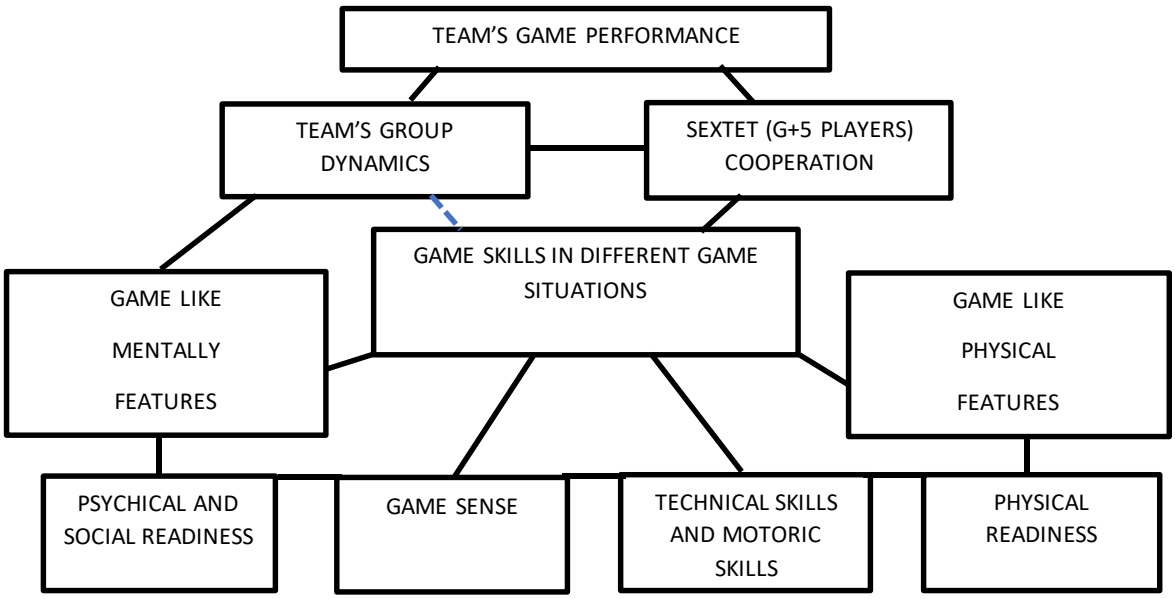


Figure 1. Figure of player and team development (Westerlund. 1997, 531)

2.1 Offensive play

A team is on offence when it has or is about to gain possession of the puck. To advance the puck into the offensive zone and to create high percentage scoring opportunities. This can be accomplished by the players on offense using a number of tactics to create time and space. (IIHF coach development program Level 1)

A goal is scored when a team has shot or directed the puck into the goal net and entirely over the plane of the goal line between the posts during game action and is deemed legal by the referee and/or video-goal judge. A goal is scored when the puck is put between the goal posts below the crossbar and entirely across the plane of the goal line. A goal is scored when the puck is shot, kicked, directed, or put into the goal net in any way by a defending player. (IIHF Official Rule Book 2018-2022)

A team with the puck in ice hockey is always an offensive team in the match. The purpose of the attack is to get the puck to the opponent's goal. Only one player can be the puck carrier at the time. The rest of the team is looking for space where the puck carrier can pass the puck. Another important role for a non-puck carrier player in an attack is to make space for a player. Attacking can begin in the defensive area, neutral zone, or attacking zone. Except for the faceoff, the attack always starts with a defensive situation where the team's goal is to get the puck for opponent team.

The Transition game means the readiness to start an attack every time your team succeeds in making the turnout. The Transition game works in both directions, losing the puck starts defending. Each team has their own tactical solutions for different situations. The key to tactical details is where the puck is lost or deprived. (Savolainen. 2016, 532)

1 GOAL SCORING

When the puck is on the scoring zone, primary task is goal scoring

2 WINNING SPACE TOWARD SCORING ZONE

When the puck is not in the scoring area, the goal of the team is to reach the goal area, and win space towards the opponent's goal

3 KEEP THE PUCK WITH YOUR TEAM

When the team is unable to immediately win the space ahead, the goal is to make room for the puck carrier and keep the puck on their own team.

4 DEFENCE READINESS

During the offensive play, the team must also be prepared to protect its own goal, ie be immediately ready to play the defense when the puck is lost to the opponent. When the opponent gets the puck, the attacked team must be ready to move quickly from the attack game to the defense game

Figure 2. Players target in the offensive play (Westerlund. 1997, 533)

2.2 Defensive play

Defense play is a large concept in hockey. There are always two named defenders on the rink, but the defense is for all players. The central idea of defending is to prevent an opponent from getting into the scoring chances. Defense always begins with the loss of the puck. For this reason, each team has its own tactical requirements for defense in the defensive-neutral and offensive-zone. Defense in all areas can be divided into small parts. In each defense system, all players know the roles of all players and, if necessary, roles need to be changed. The most common reason for the change of role is the position of the puck in the defensive area. Reaction is therefore also a key part of defense game.

1 PREVENT OPPONENT GOAL SCORING (GOALIES)
When opponent team has the puck on the scoring zone, the target is to protect your own goal
2 TAKE THE PUCK FROM OPPONENT
In game another goal in defense game is to take the puck away from the opponent.
3 PREVENT SPACE ON SCORING ZONE
When opponent team is not on the scoring zone, defensive team goal is to keep opponent team out of it.

Figure 3. Players targets in the defensive play (Westerlund. 1997, 533-534)

2.3 Offensive and defensive skills

> "Winning the game situations is often based on a faster action than the opponent. Since the game situations change very fast, the player reacts base on the game situation. In order for players to collaborate, they must have common goals in different game situations. "(Westerlund. 1997, 532)

Offensive skills are divided into scoring-time and space winning- and the puck keeping skills. Defense skills are again divided into the elimination of scoring and getting off time and space. Another defense skill is getting the puck from opponent team. The player's readiness to move from attack to defense is also a game skill and is a way to measure the player's readiness to play. For player, game readiness is one of the most important skill. The game is really fast and the reactions must be fast in the game situation. Reacting fast to situations increases the chance of moving from defense to attack. Fast translation of the game is able to create attacks when the defense is unorganized. A quick reaction to the defense also makes attacking difficult for the offensive team to play. (Savolainen. 2016, 565)

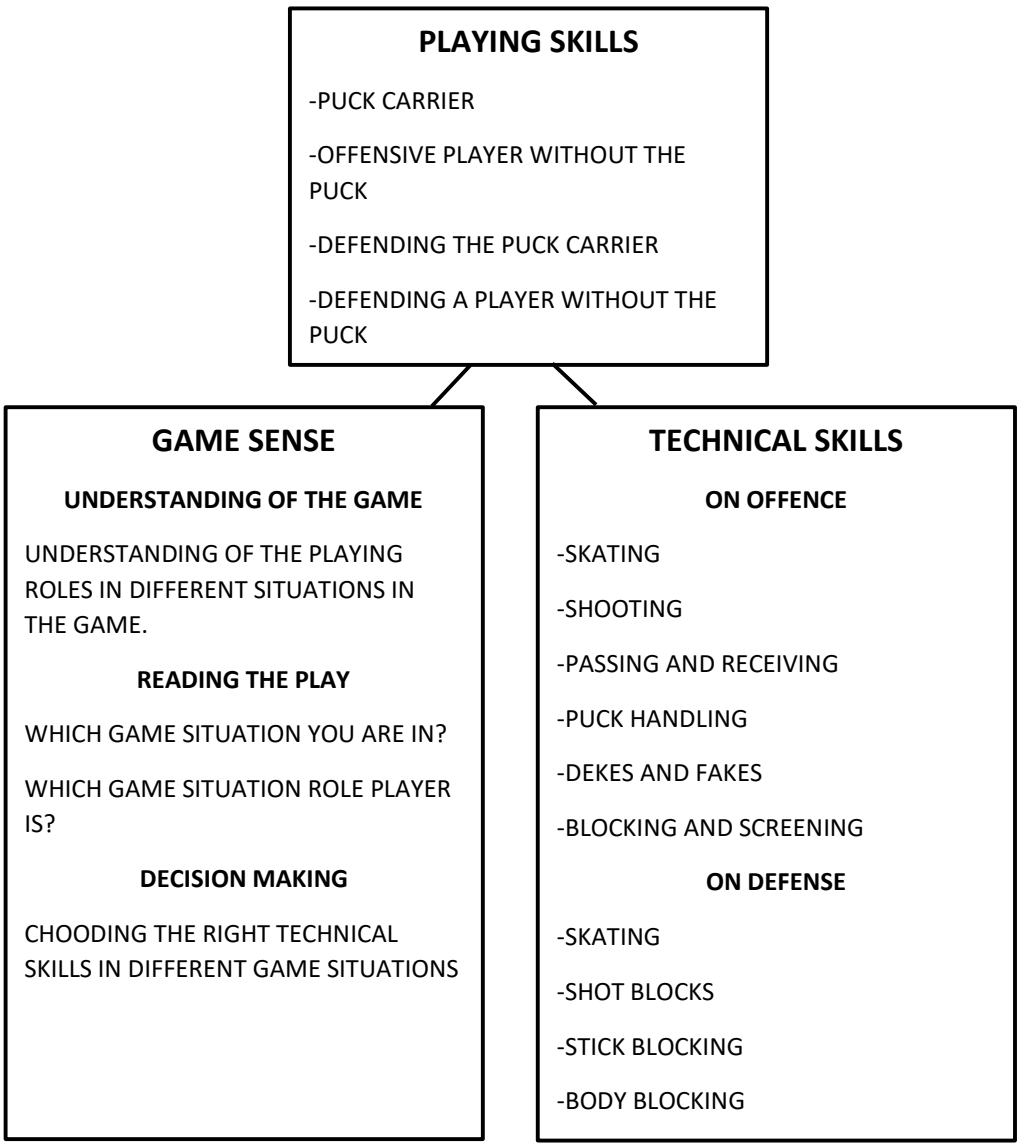


Figure 4. Playing skill division (Westerlund. 1997, 536)

Offensive skills can be divided into scoring skill, time and space winning skill and puck keeping skills, while defence skills include the ability to block scoring chances, removal of time and space and stealing the puck. The player's ability to react to a changing situation from the role of attack to the defence role is also a matter of playing skills and tells his readiness to play. This is one of the most remarkable game skills in today's hockey for solving gaming situations, because as the skill elements of the players evolve all the time the game speeds up and the time for solutions is less and less. A good react allows attacking an unorganized defence in offensive play and a quick organization of defence in the defence play gives the opponent less chance of implementing an attack. Only one of the players on the rink in the offensive play can keep the puck at a time. All other players act in non-puck carrier role in offensive game. In the defence game, the tasks are divided into defensive tasks of puck carrier and non-puck carrier players. (Savolainen. 2016, 565)

When player is attacking one-on-one against an opponent player there is many different offensive skills players should know (IIHF coach development program Level 1).

Change of pace is one effective way to beat opponent. The puck carrier, by varying the speed of attack through a change of page (e.g., slowdown, accelerate), may be able to deceive or force a defender to adjust speed and position very quickly.
Outside-In is another way to beat the opponent. A player skating on a wide (outside) course forces the defender to adjust wide. When just outside the checking range, the puck carrier makes a quick lateral move to the inside and accelerates past the defender to a scoring position (IIHF coach development program Level 1).

Inside-Out is a opposite to the outside-In. The puck carrier skates in a direction which forces the defender to adjust to an inside position, then skates and moves the puck quickly and laterally to the outside and accelerates past the defender (IIHF coach development program Level 1).

Body fakes may include movement of the head, upper body, or lower body in a deceptive movement designed to force the defender to adjust position or lean in the wrong direction. When this occurs, the puck carrier accelerates quickly in the opposite direction before the defender has time to recover. These fakes are normally initiated just outside the checking range of the opponent. This allows the puck to be moved through the defensive triangle which is formed by the skates and stick of the defender (IIHF coach development program Level 1).

Fake shot is a move where the attacker, by initiating a shooting action, may force the defender to momentarily “freeze” in a shot blocking response. This allows the puck carrier to accelerate past the defender and attack the net (IIHF coach development program Level 1).

When speaking of driving to the net, an offensive player, with an initial outside position on a defender, uses strong crossover strides or leans heavily with an extended inside leg and arm in order to cut to the front of the net for a potential scoring opportunity. The attacker attempts to drive to the far post and maintains one’s body position between the puck and the defender to protect the puck (IIHF coach development program Level 1).

Walkouts is done when player is in possession of the puck in the offensive zone (behind the goal line or along the side boards), a player should take advantage of any gap or lane

to attack the net. The puck carrier fakes a pass to force the defender to adjust position and then accelerates through the open lane to a potential scoring position. In the same way, a player receiving a pass should “fire” through an open lane created by a defender who fails to adjust position quickly enough (IIHF coach development program Level 1).

Protecting the puck, in tight checking situations, it is necessary for the offensive player to protect the puck. This involves the use of the skates and stick to maintain possession of the puck while using the body to establish position, thereby keeping the defender away from the puck. If unable to break loose from the checker, the attacker may attempt to hold off the defender until a teammate moves in to provide support. In some cases, it may be necessary to freeze the puck to force a stoppage in play (IIHF coach development program Level 1).

Screening (also referred to as picking or blocking) is the tactic of skating under control to a position on the ice that will force a defender to go around the screen on an indirect course in pursuit of the puck carrier or another teammate. Players executing a screen should also be prepared for a possible pass, depending on the reaction of the defenders. This also legitimizes the movement of the player to that position on the ice (IIHF coach development program Level 1).

When players are supporting in offensive situation, players away from the puck make themselves available as a passing option in the attack. Players away from the puck are active by positioning themselves in a manner which restricts options. (IIHF coach development program Level 1).

3 Analysing team play in ice hockey

3.1 Former studies in goal scoring in SM-League

Ice hockey is a goal scoring game, so in that reason, in sport of ice hockey, goal scoring is the most analysed and studied aspect of the sport.
One of the longest goal scoring analysis of SM-League has been made by Kari Savolainen and his supervised students from Degree program of sports and leisure management and Degree program of sport coaching and management.
In research, where all the goals scored in SM-league are analysed from six seasons (2007-2014), it was noticed, that straight attack goals cover approximately 20%, turnover goals cover 20% and offensive zone play goals cover 20% of all the goals that has been scored during the research time. Powerplay goals cover approximately 30% of all the goals scored. Last 10% of the goals came from different type of special situations. The percentage coverage has changed a little between the seasons, probably because of different aspect of reading the scoring rules. (Savolainen. 2016, 567)

Jukka Kontsas and Juha Lehtola made a research study 2010 of goal scoring on goaltender perspective which worked as base for their thesis, Goalie and scoring analysis: MOL, Mestis and Liiga. From their 2010 study they found that in ten analysed games from the NHL, there were 157 more shots taken, and 20 more goals scored compared to ten game analysed games from SM-Liiga. In the NHL there were over twice as many so called “dangerous” scoring situations compared to SM-Liiga.
One significant difference was in regular shots. The number of goals scored with a regular shot in the NHL was significantly higher than in SM-Liiga: NHL, 11 goals, SM-Liiga, 4 goals. (Kontas & Lehtola. 2014)

2015 Miika Elomo and Tuukka Poikonen made a research on SM-League scoring during 2011-2012 season. They made a research-oriented study of Analyzing reasons behind the goals in ice-hockey. The research-oriented thesis analysed and presened methods why and how goals were scored in SM-Liiga season 2011-2012

> In 420 games the averages goals scored was 3,2 even strength goals and 1,5 power play goals per game. Research shows that main categories do not give answer what is the best way to score except between even strength and power play. When looking inside the three even strength categories and power play the categories shows clearly which is the most effective way to score. Number one is turning the puck in a offensive zone. Turning the puck there leads to a goal in 20% chance.
> (Elomo & Poikonen 2015, 31)

4 Finnish SM-League (Liiga)

Finnish SM-League, known as just Liiga since 2013, is the top professional ice hockey league in Finland. Finnish SM-League was founded 1975, when it replaced former SM-sarja format. SM-sarja was an amateur level sporting league, and when it was changed to SM-League, it started to conform to a professional sporting league. Liiga is not overseen by Finnish Ice Hockey Association (FIHA), but they have an agreement with the association to cooperate in certain level. When SM-League was found, it separated from Finnish Ice Hockey Association with agreement of SM-League takes care of top-level ice hockey in Finland and FIHA take care of all the other hockey levels, including national team operations.

4.1 Organization

Liiga is a corporation who has a responsibility of organize and run the top-level ice hockey league in Finland. Liiga schedules games and organizes the match calendar in cooperation with FIHA. Liiga is in responsibility to provide officials to each event under their corporation. Also, they have the responsibility to take care of such a thing like, discipline matters, statistics and documentation. Liiga runs its own marketing as a Liiga corporation, but every team who takes part in Liiga are individual corporations and in that manner, they are responsible on their marketing and money withdraw. (Saarenpää 2014)

4.2 Competition format during season 2013-2014 and 2016-2017

Competition format during season 2013-2014 and 2016-2017 has stayed the same in amount of games and playing system.

During regular season all teams play 60 matches, every team plays four matches against every other team, plus two extra matches against two defined local opponents depending team’s geographic location. Playoffs formats the following way, the six best teams at the end of regular season proceed directly to quarter-finals. Teams placed between seventh and tenth will play preliminary play-offs – the two winners take the last two slots to quarter-finals. Rest of the teams, eleventh and lower ends their season by end of the regular season. (Wikipedia, 2019)

Number of the teams changed between season 2013-2014 and 2016-2017. During season 2013-2014 in Liiga there played total of 14 teams.

#	Team	GP	W	T	L	GF	GA	OTW	P	P/GP	PP%	PK%
1.	Kärpät	60	36	15	9	190	106	8	**131**	2,18	0,00%	0,00%
2.	Tappara	60	31	15	14	168	128	8	**116**	1,93	0,00%	0,00%
3.	Lukko	60	30	7	23	153	138	4	**101**	1,68	0,00%	0,00%
4.	SaiPa	60	26	13	21	160	134	9	**100**	1,67	0,00%	0,00%
5.	JYP	60	26	13	21	154	149	7	**98**	1,63	0,00%	0,00%
6.	Blues	60	28	6	26	137	146	3	**93**	1,55	0,00%	0,00%
7.	Jokerit	60	25	13	22	156	145	5	**93**	1,55	0,00%	0,00%
8.	Pelicans	60	25	11	24	156	156	6	**92**	1,53	0,00%	0,00%
9.	HIFK	60	25	9	26	147	145	4	**88**	1,47	0,00%	0,00%
10.	HPK	60	22	12	26	140	136	9	**87**	1,45	0,00%	0,00%
11.	Ilves	60	24	9	27	144	146	3	**84**	1,40	0,00%	0,00%
12.	Ässät	60	16	12	32	134	177	7	**67**	1,12	0,00%	0,00%
13.	TPS	60	12	17	31	135	197	6	**59**	0,98	0,00%	0,00%
14.	KalPa	60	12	12	36	101	172	3	**51**	0,85	0,00%	0,00%

Figure 5. Liiga standings 2013-2014 at the end of regular season.

Between season 2013-2014 and 2016-2017 several team changes happened. Two teams, Jokerit and Blues left Liiga. Jokerit moved to the KHL (Kontinental Hockey League) after 2013-2014 season and Blues was bankrupt by end of the 2015-2016. To replace these two teams Liiga corporation promoted three teams from Finland II league, Mestis. Sport from Vaasa was promoted after Jokerit left, for season 2014-2015, KooKoo from Kouvola was promoted for season 2015-2016 and Jukurit from Mikkeli was promoted for season 2016-2017.

#	Team	GP	W	T	L	GF	GA	OTW	P	P/GP	PP%	PK%
1.	Tappara	60	34	15	11	185	129	10	**127**	2,12	28,80%	80,45%
2.	TPS	60	30	16	14	167	123	8	**114**	1,90	16,59%	81,63%
3.	KalPa	60	28	19	13	168	140	9	**112**	1,87	19,51%	83,08%
4.	JYP	60	28	18	14	160	123	9	**111**	1,85	24,06%	86,43%
5.	HPK	60	23	17	20	153	136	12	**98**	1,63	15,69%	80,58%
6.	Pelicans	60	23	16	21	157	150	8	**93**	1,55	14,73%	80,47%
7.	Ässät	60	24	11	25	128	142	7	**90**	1,50	12,87%	85,78%
8.	Kärpät	60	22	15	23	147	136	9	**90**	1,50	21,11%	83,85%
9.	HIFK	60	22	13	25	138	140	8	**87**	1,45	12,57%	81,22%
10.	Ilves	60	21	13	26	143	146	6	**82**	1,37	16,67%	84,29%
11.	Jukurit	60	20	12	28	128	141	4	**76**	1,27	17,99%	79,10%
12.	Lukko	60	17	14	29	151	177	6	**71**	1,18	20,49%	80,57%
13.	KooKoo	60	15	18	27	137	173	7	**70**	1,17	18,78%	81,19%
14.	Sport	60	16	16	28	128	169	5	**69**	1,15	15,03%	80,29%
15.	SaiPa	60	14	13	33	116	181	5	**60**	1,00	14,22%	80,91%

Figure 6. Liiga standings 2016-2017 at the end of regular season

There was no other resource available for SM-League competing format except Wikipedia.

5 IIHF Rule change in 2014

SM-League follows the general rules of ice hockey, which IIHF rules on every fourth year. Latest rules are ruled 2018, and they are valid till end of 2022 competition season. Competition season start every year in July and ends in June.

> The IIHF consists of member nations which, when they join, recognize the need to participate under a codified system of rules based on sportsmanship, regardless of level of play or location of game
> (IIHF, 2018)

International Ice Hockey Federation made major rule changes to their rule book during summer 2014 which came in to effect for start of the season 2014-2015. One of the major changes were a blue line rule change. IIHF decided to move blueline in ice rink towards the middle line, to make more room in to the zone area. Blue lines were moved approximately 1,5meters from 21.33meters to 22.86meters, counting from the end line.

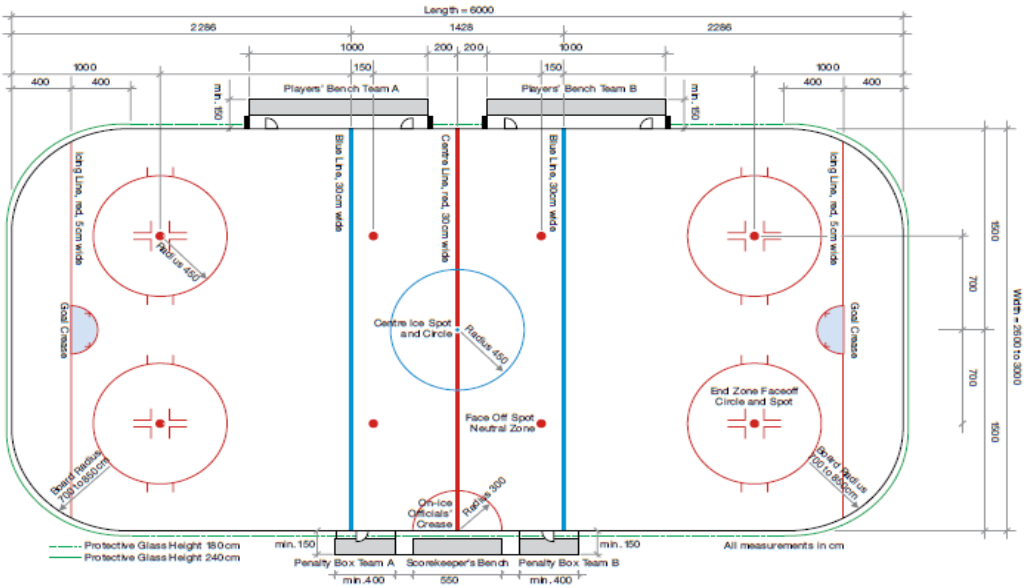


Figure 7. Rink size after August 2014 (IIHF Rulebook 2018)

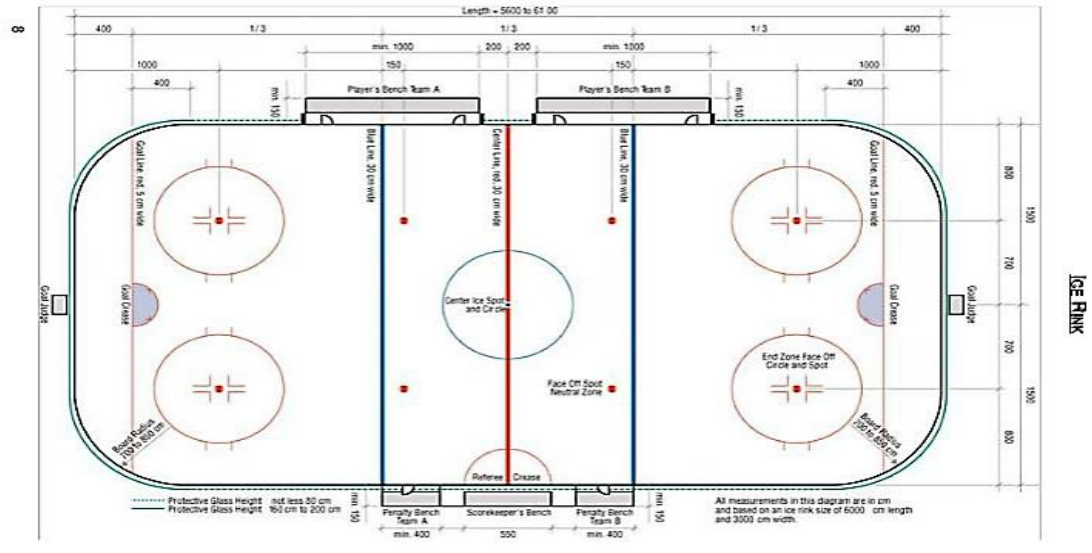


Figure 8. Rink size before August 2014 (IIHF Rulebook 2014)

Before the season 2014-2015, the blue line rule was a one third of the total length of the ice rink sizes between goal line and goal line. Rink side was allowed to be, before season 2014-2015, from 56 to 61 metres long, so the zone areas were variable based to the rink's total length. (IIHF, 2010)

After the rule change for season 2014-2015 the zone areas in ice rink are standard and only neutral zone is variable. From 2014 towards the rink sizes is allowed to be between 58-60 meters long. (IIHF, 2014)

6 Research aims and questions

IIHF made a rule change for blue lines, to aim for more goals by allowing more room for offensive team to work with. That way their aim was to increase entertainment value of each ice hockey game event. (Savolainen 1 April 2019.)

This research main aim is to view the amount of goals and ways of scoring in ice hockey league Liiga, in seasons 2013-2014 and 2016-2017. Also, one of the aims is to compare the two seasons and see if there is a difference and what kind of difference there is. By viewing the differences aim is to see did the IIHF blue line rule change effect and if so, how it affected the amounts of goals and ways of goal scoring.
This research aims to find an answer to these following questions:

1. How many goals were scored during season 2013-14 compared to season 2016-2017 in different scoring categories?
2. What are the differences in scoring styles between the seasons 2013-14 and 2016-17?
3. What was the effect of the IIHF rule change in scoring between the seasons 2013-2014 and 2016-2017?

7 Research methods

Idea of this research study came from our teacher, Kari Savolainen, who has done SM-League goal scoring analysis research for more than 10 years in cooperation with students from Degree program in sports and leisure management and Degree program in sports coaching and management – students in Vierumäki, Finland.
We started the project of goal analysis in September 2016 with group of four students, Simo Korpela, Tero Sainio, Niki Tuomela and Eeri Pulkkinen. We divided the all the 450 Liiga games to four and all four of us analysed total 112 or 113 games.
After the analysing project was done and presented, was decision made to write thesis based on the goal analysis research.

7.1 Definition of current research

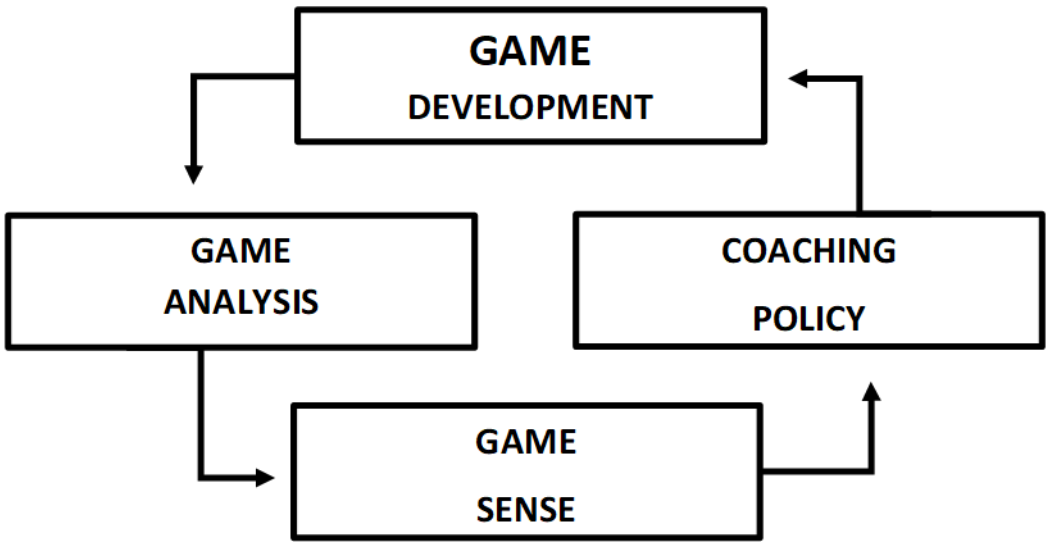


Figure 9. Figure of coaching cycle. Use of analysing tool -> Understanding of games trend "game sense" -> Updating coaching policy to new trends of game -> Developing game to new trends -> Analysing game.

Coaches use different type of analysing tools to analyse their team's performance. Figure 9. shows the basic idea of usage of analysing tool. Coach uses analysing tool to analyse the game and where it stands now, and where it is headed in the future. Then coach needs to tear down the data, which is collected with the analysing tool and understand the trend of the game. After that coach will think what is important to focus on and update coaching policy to the level where needed. That way coach can move on to develop

teams' game to de-manded level at the moment. Coaching tools can be made from single practice or exercise needs to long-term season/s lasting tools.
With analysing tools coaches want to measure many different factors of the game. Most use is tool for analysing goals scored. Within all the sports, where the measurement of winning the match is the most goals/points scored, the biggest focus in analysing will be in scoring. In case of ice hockey, which is the considered sport in this thesis work, the most use analysing tools are created for goal scoring analysing. How many goals were scored and where they were scored and the same way of all the goals scored against. This thesis data is collected with one analysing tool. Many coaches create their own tools work analysing and for their own needs.

This thesis study is based on a season long goal scoring analysis, with main purpose of compare of two seasons from separate time and see how the game has developed.
This goal scoring analysing tool uses five different main categories which includes the main different ways to score a goal in ice hockey.

Straight attack goal is scored in a situation when offensive team gets the puck over the op-posing team's blueline and takes a shot to the net at the end of the attack. It will be a straight attack goal if the shot goes straight in to the net or after a rebound the puck is put in to the net. If the goalie makes a save, and the puck goes to the corner, it becomes to be an offensive zone play. Different scoring ways in straight attack category are straight attack + rebound, even strength, odd man rush, which means that attacking team has at least 1 player advance situation on the offensive zone blueline (two forwards against one defender), short man rush, which is opposite to the odd man rush and breakaway.
An ice hockey rink is shared in 3 tactical zones: Defensive zone, neutral zone and attacking zone. Turnover goal can be score, by starting the attack from any zone. When turnover goal is scored, defensive team gets the puck and start attacking, if attacking team scores right from attack which was created form turnover it will be marked as a turnover goal. Many times, when turnover goal is scored, the defensive team is unorganized.
Offensive zone plays goals can be made from blueline, walk out, pass from down load or rebound. Most of the goals scored during an ice hockey game are scored from offensive zone, after offensive play.

Power play goals are scored during power play. Power play means that another team has a penalty (2 or 5 minutes) and that team is playing penalty killing. Mostly the power play is played with 5 players against 4, but it can also be played with 5-3 or 4-3. Power play goal can be scored with straight attack, turnover, set play from blueline, set play, rebound, deflect or after faceoff win.

7.2 Data collection

Data collection was done weekly after all the games of that week was played. All the videos of goals were provided by Liiga, in Sanoma's Ruutu service. They had all goal clips cut from each game with all the goals scored in each game. If there was unsure event, or other ways a clip that was not suitable for our use, we watched the whole game and searched the goal from the game.

2013-2014 season's goal analysis data was collected by former Degree program in sports and leisure management student Mikael Tolkki, and 2016-2017 season's goal analysis data was collected by Degree program of sport coaching and management students Simo Korpela, Tero Sainio, Niki Tuomela and Eeri Pulkkinen.
In research both analysing groups used the same instructions for analysing, which were provided to us by Kari Savolainen. He made the instruction (Appendix 3.) 2008 to make student analysing possible. That way every goal was analysed close to same way.

Data was collected in excel sheet which calculated all the number directly for each team.

Straight Attack	**JYP**	**VAS**	**KAL**	**VAS**	**SAI**	**VAS**	**PEL**	**VAS**	**ILV**	**VAS**	**TAP**	**VAS**	**HPK**	**VAS**	**KÄR**	**VAS**	**ÄSS**	**VAS**	**LUK**	**VAS**	**TPS**	**VAS**	**HIF**	**VAS**	**SPO**	**VAS**	**JUK**	**VAS**	**KOO**	**VAS**	**TOT**
behind the net	2		1		1	3	1	3			2	1	2			1	1	1		1		1						1	1	1	11
str.attack + rebound	4	4	3	6	6	6	3	4	5	4	1	7	4	2	3	5	3	5	4	3	3	7	6	8	5	2	7	5	4	5	61
even strength	9	9	10	8	5	8	4	4	8	9	17	8	11	15	5	5	6	6	8	9	9	8	11	5	7	12	6	10	5	7	121
odd man	9	9	12	10	5	8	5	6	8	7	11	4	6	9	13	9	12	4	6	9	10	6	10	8	8	14	9	4	4	11	128
short hand	7	3	7	5	2	5	5	2	6	6	2	3	2	4	2	2	4	2	4	6	3	3	4	4	5	8	3	9	5	6	61
breakaway	1	4	2	5	2	5	3	5	3	4	6	3	10	2	3	2	3		2	7	5	3	4	4		5	6	2	1	4	51
Turnover	**JYP**	**VAS**	**KAL**	**VAS**	**SAI**	**VAS**	**PEL**	**VAS**	**ILV**	**VAS**	**TAP**	**VAS**	**HPK**	**VAS**	**KÄR**	**VAS**	**ÄSS**	**VAS**	**LUK**	**VAS**	**TPS**	**VAS**	**HIF**	**VAS**	**SPO**	**VAS**	**JUK**	**VAS**	**KOO**	**VAS**	
offensive zone	10	4	8	7	10	14	11	9	10	6	6	9	9	9	8	8	8	16	9	9	10	8	15	12	12	8	11	3	5	12	142
neutral zone	1	4	3	5	3	2	1		3	2	3	1	1		1	3		2	3	2	5	1	4	2	1	2	2		1	4	32
defensive zone		1	3	2	1		2	2	1	2	2	1		1	5	6	1	2	4	3	2	3	3	2	1	3	2	2	3	2	30
Offensive Zone Play	**JYP**	**VAS**	**KAL**	**VAS**	**SAI**	**VAS**	**PEL**	**VAS**	**ILV**	**VAS**	**TAP**	**VAS**	**HPK**	**VAS**	**KÄR**	**VAS**	**ÄSS**	**VAS**	**LUK**	**VAS**	**TPS**	**VAS**	**HIF**	**VAS**	**SPO**	**VAS**	**JUK**	**VAS**	**KOO**	**VAS**	
carrying the puck+shot	2	2	8	6	5	11	11	9	7	8	7	7	7	5	6	2	6	4	2	5	7	7	8	6	5	5	5	6	6	7	92
shot from the blue line	5	7	8	7	3	11	12	8	7	8	14	6	12	5	8	8	9	5	9	14	11	5	8	8	5	11	4	8	12	9	127
pass from down low	2	7	6	11	8	11	10	6	7	9	10	9	6	7	8	5	6	6	7	14	5	2	8	8	6	3	4	5	10	9	103
rebound	22	22	15	12	11	15	15	16	11	12	14	15	19	12	17	13	13	25	24	13	22	15	9	9	15	19	15	21	18	19	240
lateral pass	10	4	11	8	7	8	11	12	7	9	11	7	7	7	9	10	5	11	7	10	8	4	13	8	10	9	6	9	7	10	129
deflect	8	9	2	5	7	8	10	6	7	9	7	5	12	3	5	6	7	8	4	7	7	3	6	6	7	7	7	5	5	9	101
walk out	1		7	3	3	8	7	3	4	5	4	2	2	2		1	1	3	1	4	3	2	1			4	2		4	6	40
Power Play	**JYP**	**VAS**	**KAL**	**VAS**	**SAI**	**VAS**	**PEL**	**VAS**	**ILV**	**VAS**	**TAP**	**VAS**	**HPK**	**VAS**	**KÄR**	**VAS**	**ÄSS**	**VAS**	**LUK**	**VAS**	**TPS**	**VAS**	**HIF**	**VAS**	**SPO**	**VAS**	**JUK**	**VAS**	**KOO**	**VAS**	
straight attack	6	1	3	6		1		1	1	2	1	2		2	4	2	1	1	7	1		3		3	2	4	6	1	2	2	33
turnover	2	1	3	1	2	2		2		1	2		1						1				2		1			3	1		15
set play from blueline	15	3	7	4	2	12	7	8	7	7	18	7	9	8	8	7	7	7	9	8	10	6	3	9	5	10	8	8	8	15	123
set play	15	10	18	7	12	9	11	13	7	9	17	10	12	12	8	9	8	10	13	14	10	14	7	15	11	14	6	14	12	7	167
rebound	9	7	11	9	11	11	8	11	8	8	10	11	6	10	11	11	5	5	8	8	10	9	8	8	7	6	10	7	10	9	132
deflect	3	4	6	4	2	6	4	4	6	2	4	2	3	7	7	2	1	5	2	6	1	2	1	2	2	3	3	3	3	2	48
face off winning	1	1		2		1	3	3	3	1	3	3	1	1				1	2	4	5	2			1		1	1	1	3	21
Box play	3	2	2		3	3	3	6	4	4	2	2	2	3	2	3	7	2	3	6	4	3	2	2	1	2	1	4	3	3	42
Face off winning	1	1	2	2	2	1	5	1	1	5	1			1	1	4	5	3	2	2	3	1		1	3	1	1	2			27
Penalty shot	1	1	2	2		2	1	2			2			3	2	1	2		2	1					1			1			13
Empty goal	11	3	8	3	3	10	4	4	12	7	8	4	9	6	10	6	7	8	8	11	14	5	5	10	4	9	3	7	6	11	112
TOTAL																															
Straght attack	32	29	35	34	21	35	21	24	30	30	39	26	35	32	26	24	29	18	24	35	30	28	35	29	25	41	31	31	20	34	433
Turnover	11	9	14	14	14	16	14	11	14	10	11	11	10	10	14	17	9	20	16	14	17	12	22	16	14	13	15	5	9	18	204
Offensive zone play	50	51	57	52	44	72	76	60	50	60	67	51	65	41	53	45	47	62	54	67	63	38	53	45	48	58	43	54	62	69	832
Even strength	**93**	**89**	**106**	**100**	**79**	**123**	**111**	**95**	**94**	**100**	**117**	**88**	**110**	**83**	**93**	**86**	**85**	**100**	**94**	**116**	**110**	**78**	**110**	**90**	**87**	**112**	**89**	**90**	**91**	**121**	1469
Power Play	**51**	**27**	**48**	**33**	**29**	**42**	**33**	**42**	**32**	**30**	**55**	**35**	**32**	**40**	**38**	**31**	**22**	**29**	**42**	**41**	**36**	**36**	**21**	**37**	**29**	**37**	**34**	**37**	**37**	**38**	539
Other	16	7	14	7	8	16	13	13	17	16	13	6	11	13	15	14	21	13	15	20	21	9	7	13	9	12	5	14	9	14	194
TOTAL	**160**	**123**	**168**	**140**	**116**	**181**	**157**	**150**	**143**	**146**	**185**	**129**	**153**	**136**	**146**	**131**	**128**	**142**	**151**	**177**	**167**	**123**	**138**	**140**	**125**	**161**	**128**	**141**	**137**	**173**	2202

Figure 10. Goal analysis excel sheet, season 2016-2017

When goal was scored it was marked in excel under right category, for both teams. For one who scored the goal and as well for the team who allowed the goal. Excel sheet calculated the amounts to side for total goals scored by each category and to under for each teams' total goals.

Excel sheet created automatically separated statistics for each team, that showed where they stand on statistic, compared to the whole leagues average of how many goals they were scored and how many goals they were allowed.

	TPS	Average	Against
straight attack	30	29	28
turnover	17	13	12
zone play	63	55	38
TOTAL	110	98	78
PP	36	36	36
OTHERS	21	13	9
All TOTAL	167	147	123

Figure 11. Example TPS individual numeral statistics 2016-2017

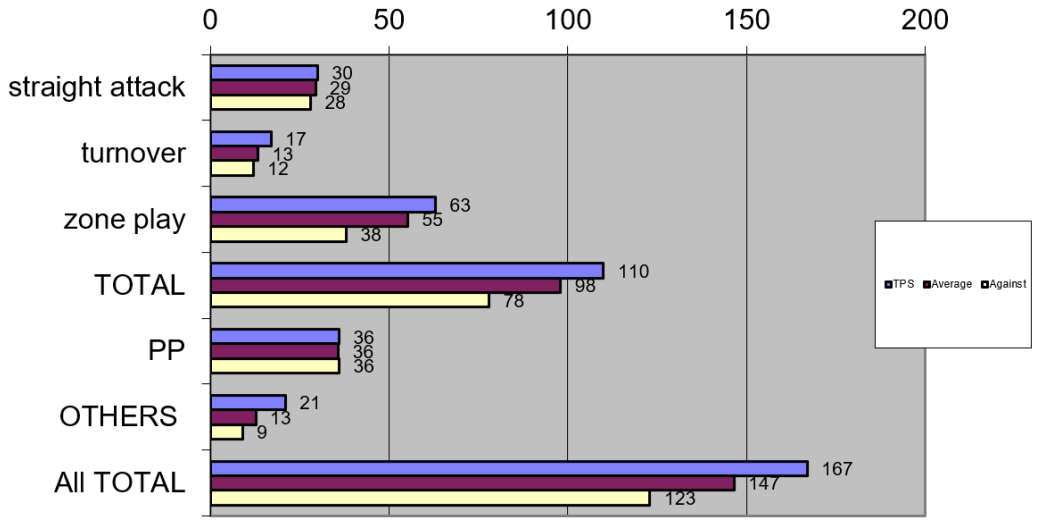


Figure 12. Example TPS individual table statistics 2016-2017

Goals were analysed only from regulation time, no over time or shootout goals counted. Both seasons followed the same regulation analysing rule.

7.3 Statistical analysis

In this research each goal scored was analysed based on five different main categories and in 20 different sub categories. Same time as the data was entered to the excel, the

sheet calculated it to right categories and gave us needed values on main and sub categories.
When all the 450 games where analysed and the data entered to the excel sheet, we made two comparative histograms on the amounts of goals in each main and sub category.

One histogram was made with amounts of goals. From that histogram we were able to view the difference in numbers. Difference was compared between the season in amounts of total goals scored in each category.

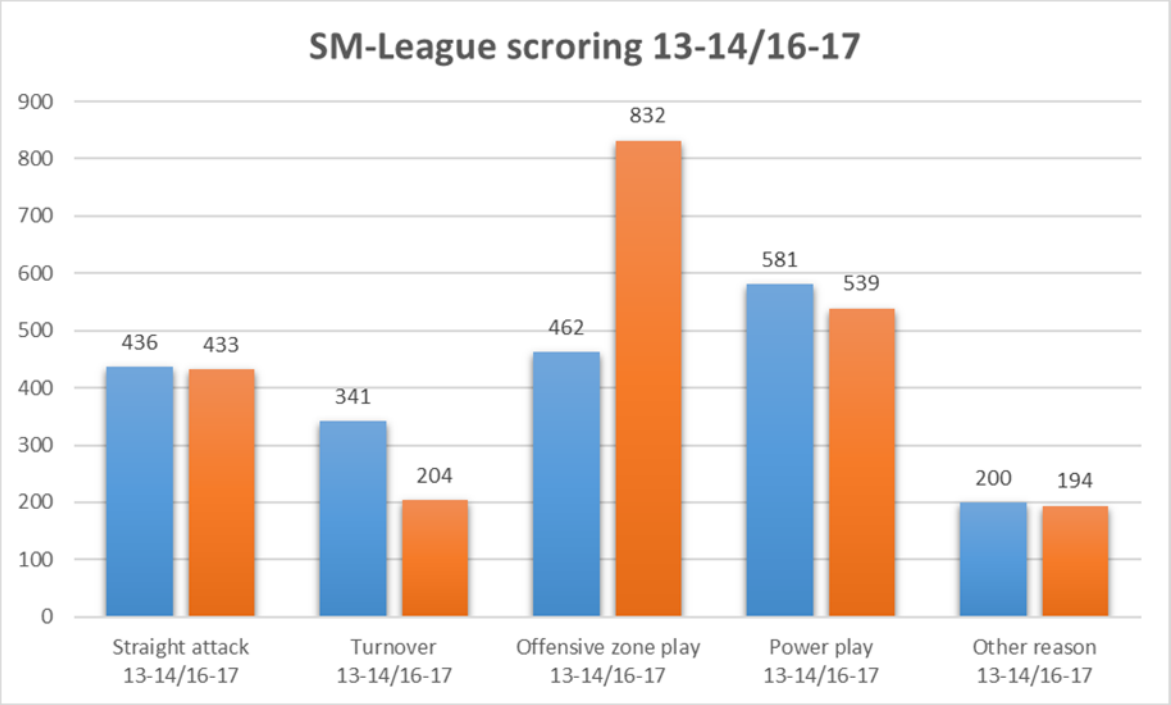


Figure 13. Example of numeral histogram.

Second comparative histogram was made with percentage amounts. In that histogram goals scored in each category were compared with percentages. From that we were able to see the trend on goal scoring and view the difference between seasons.

Percentage	2013-2014	Change	2016-2017
Straight Attack			
behind the net	7.11%	-4.57%	2.54%
str.attack + rebound	18.58%	-4.49%	14.09%
even strength	31.88%	-3.94%	27.94%
odd man	14.22%	+15.34%	29.56%
short hand	19.27%	-5.18%	14.09%
breakaway	8.94%	+2.84	11.78%

Figure 14. Example of table of percentage differences

When comparing the amounts of scored goals between the seasons, just as a number, we used T-Test to provide us a realistic statistical difference. A t-test is a type of inferential statistic used to determine if there is a significant difference between the means of two groups, which may be related in certain features. When T-test is calculated it provides a p-value. From p-value it's possible to view how significant the difference is in eyes of statistical analysis. When reading the p-values, if p-value is less than 0.001 the different is very significant, if the p-value is less than 0,01 the difference is significant and is the p-value is less than 0,05 the difference is almost significant. Other cases in scenario the difference is not significant.

	2014	2017		
Sarake1	Turnover	Turnover2		
JYP	26	11		
KAL	17	14		
SAI	23	14		
PEL	27	14		
ILV	22	14	p-value:	6,13747E-09
TAP	20	11		
HPK	29	10		
KÄR	24	14		
ÄSS	22	9		
LUK	30	16		
TPS	27	17		
HIF	23	22		
Jok/SPO	25	14		
BLU/Jok	27	15		
KooKoo		9		

Figure 15. Example table of t-test result. P-value 6,1375E-09 = 0,0000000809 (very significant.

8 Results

This study provides us accurate numbers on amounts of goals scored in each studied category with numeral and percentage difference.
We tried to accomplice answers to three different research questions, how many goals were scored during season 2013-14 compared to 2016-2017 season in different scoring categories, difference in goal scoring between seasons 2013-2014 and season 2016-2017 and if there was a connection between the blue line rule change and goal scoring.

Every statistical histogram, percentage table, excel table and t-test table can be viewed in appendices. In this results paragraph there is used only necessary tables and histograms. Average goal amounts in this paragraph has been rounded to closest even number (1,4=1 and 1,5=2).

8.1 Goals scored during season 2013-14 compared to season 2016-2017 in different scoring categories

On the histogram that views the main data categories (Figure 16.) it is clearly shown that amounts of goals have not changed much between the season.

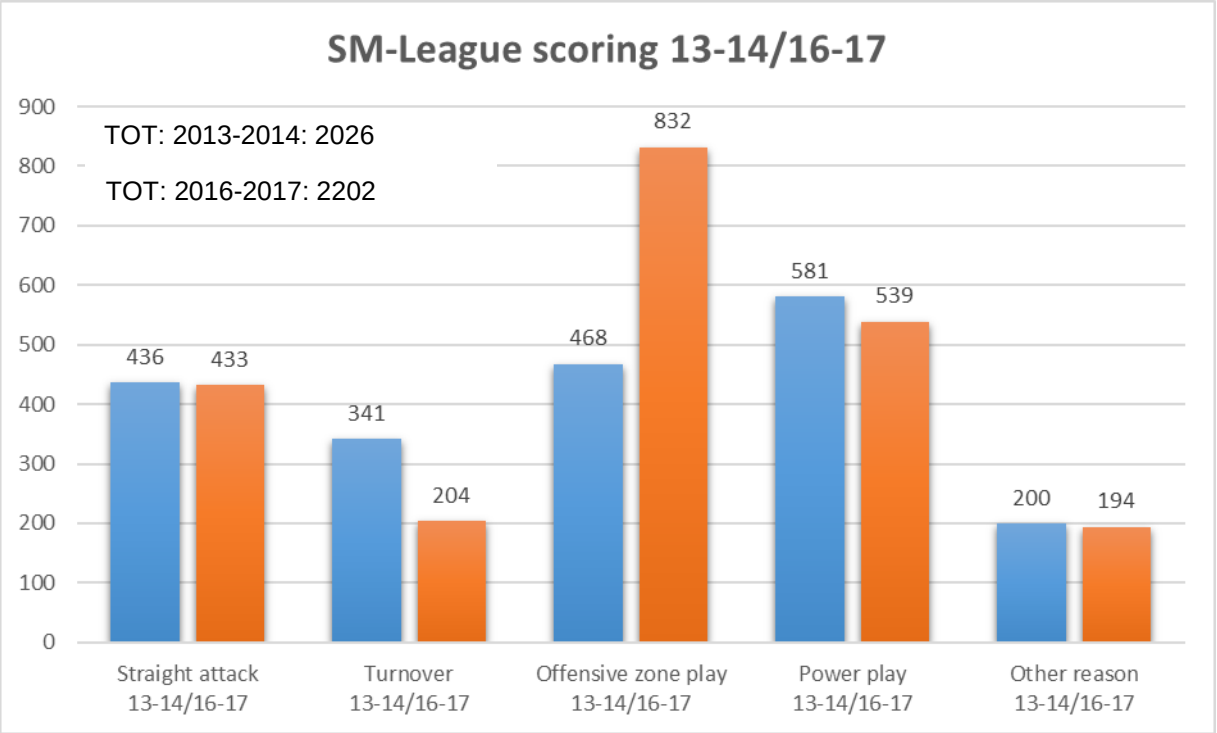


Figure 16. Total amounts of goals scored in SM-League in season 2013-2014 and 2016-2017. Goals shown in 5 main data collection categories.

During season 2013-2014 there were only 14 team in SM-league, which gives for every team a scoring average of 145 goals for the season. During 2016-2017 there were a one more team in SM-League, total 15 teams, competing. With 15 teams the scoring average for season 2016-2017 was 147 goals per team, so just 2 more goals, per team, than 2013-2014. From t-test value total scoring amounts doesn't provide a significant difference, with p-value of 0,813, and 81% marge of error.

	2014	2017		
	Total	Total		
JYP	152	160		
KAL	100	168		
SAI	154	116		
PEL	153	157		
ILV	142	143		
TAP	162	185		
HPK	138	153		
KÄR	181	146	p-value total	
ÄSS	128	128	0,813163269	
LUK	152	151	M of E: 81%	
TPS	134	167	no significant difference	
HIF	145	138		
Jok/SPO	154	125		
BLU/Jok	137	128		
KooKoo		137		

Figure 17. T-Test table of the total goals scored during seasons 2013-2014 and 2016-2017. P-value is more than 0,05, and it means that the difference was not a significant.

During both season, straight attack and power play, played close the same role in goal scoring. There is no significant difference in t-test result ether, straight attack with p-value of 0.257 and powerplay with p-value of 0.0997. Straight attack goal was scored 2013-2015 average 32 goal per team and power play goals average 42 goal per team. During 2016-2017 season there was 29 goal average in straight attack per team and 36 goal average per team in power play. The marge in number was minimal and like noticed before the difference in p-values was not significate ether between the season.

Larger different in the goal scoring between the two seasons was found in turnover and offensive zone play goals. During 2013-2014 season there was score average 24 goals per team from turnovers, but during 2016-2017 season there was scored only average 14 goals per team from turn overs. T-test provided a very significant p-value of 6,1375E-09 (0,0000000809), with <0,01% marge of error.

Same trend was found in offensive zone play goals, just other way around. There was scored during 2013-2014 season only 33 goals average per team of offensive zone plays. 2016-2017 the average amounts goals scored after offensive zone plays was 55 goals per team. T-test provided a very significant p-value of 3,15109E-07 (0,0003241771), with <0,01% marge of error.

8.2 Differences in scoring styles between the seasons 2013-14 and 2016-17?

Looking at the big picture there were no big difference in amounts of goals between the 2013-2014 and 2016-2017 seasons. But when taking a closer look there has been differences in some main category's and even bigger differences in some sub-categories. The largest difference in main categories was in offensive zone plays. During season 2013-2014 there were scored only 462 goals from offensive zone play, and 2016-2017 there was 832 goals scored. To see how big of a change and difference it really was, we can look to the percentage histogram (Figure 18.). There is compared all the 5vs5 main categories. 2013-2014 season there were just a small difference between each three percentages and all the categories were close to even. For 2016-2017, offensive end zone plays goals, took enormous step up. Change in percentages between 2013-2014 and 2016-2017 season was 19,09% climb up. At the same time the amount of goals scored from turnovers has digressed 13,50%. During 2013-2014 there was scored 341 goals, but 2016-2017 there were only 204 goals from turnovers.

Percentage	2013-2014	Change	2016-2017
TOTAL			
Straght attack	35.02%	-5.54%	29.48%
Turnover	27.39%	-13.50%	13.89%
Offensive zone play	37.59%	+19.09	56.68%

Figure 18. Percentage histogram shows the percentage difference between the main even strength scoring categories. There is powerplay and other goals left out of count. Just 5vs5 game situation goal categories shown.

When breaking down the main categories to sub-categories, we can see where the real differences were. Looking the percentage table (Figure 19) there is found the percentage difference in every main-category and sub-category. The number of teams has not taken in notice. That was not founded as a meaningful factor in this comparison.

Percentage	2013-2014	Change	2016-2017		
Straight Attack					
behind the net	7.11%	-4.57%	2.54%		
str.attack + rebound	18.58%	-4.49%	14.09%		
even strength	31.88%	-3.94%	27.94%		
odd man	14.22%	+15.34%	29.56%		
short hand	19.27%	-5.18%	14.09%		
breakaway	8.94%	+2.84	11.78%		
Turnover					
offensive zone	48.39%	+21.22%	69.61%		
neutral zone	25.81%	-10.12%	15.69%		
defensive zone	25.81%	-11.10%	14.71%		
Offensive Zone Play					
carrying the puck+shot	6.84%	+4.22%	11.06%		
shot from the blue line	22.01%	-6.75%	15.26%		
pass from down low	21.58%	-9.20%	12.38%		
rebound	31.20%	-6.68%	24.52%		
lateral pass	9.83%	+5.67%	15.50%	Deflect 16-17	12.14%
walk out	8.55%	-3.74%	4.81%		
Power Play					
straight attack	16.52%	-10.40%	6.12%		
turnover	3.62%	-0.84%	2.78%		
set play from blueline	21.00%	+1.82%	22.82%		
set play	27.37%	+3.61%	30.98%		
rebound	18.07%	+6.42%	24.49%		
deflect	6.88%	+2.03%	8.91%		
face off winning	6.54%	-2.64%	3.90%		
Box play	16.50%	+5.15%	21.65%		
Face off winning	28.00%	-14.08%	13.92%		
Empty goal	45.50%	+12.23%	57.73%	Penaltyshot 16-1	6.70%
TOTAL					
Straght attack	35.02%	-5.54%	29.48%		
Turnover	27.39%	-13.50%	13.89%		
Offensive zone play	37.59%	+19.09	56.68%		
Even strength	61.45%	+5.26%	66.71%		
Power Play	28.68%	-4.2%	24.48%		
Other	9.87%	-1.06%	8.81%		
TOTAL	100%		100%		

Figure 19. Table of percentage changes between all the main- and sub-categories. Comparing 2013-2014 and 2016-2017 season.

Straight attack goals played in main category level pretty much the same role between both seasons. But when looking the sub-categories, there was found that odd man rush goals increased a lot from season 2013-2014 to season 2016-2017. Average amounts increased form 2013-2014's 4 goals to 2016-2017's 9 goals per team. Totally 2013-2014 there was scored 62 odd man rush goals and 2016-2017 there was scored 128 goals. Looking the straight attack histogram (Figure 20.) it shows a decrease in amounts of goal in 4 out of 6 sub-categories. That can be found as an equaliser for the enormous step up of odd man rush goals. Average number of goals doesn't change in any category more

than by 2 goals. Behind the net: 2/1, straight attack + rebound: 6/4, even strength: 10/8, short hand: 6/4 and breakaway: 3/4 (Marked as “category: 2013-2014 goals/2016-2017 goals”).

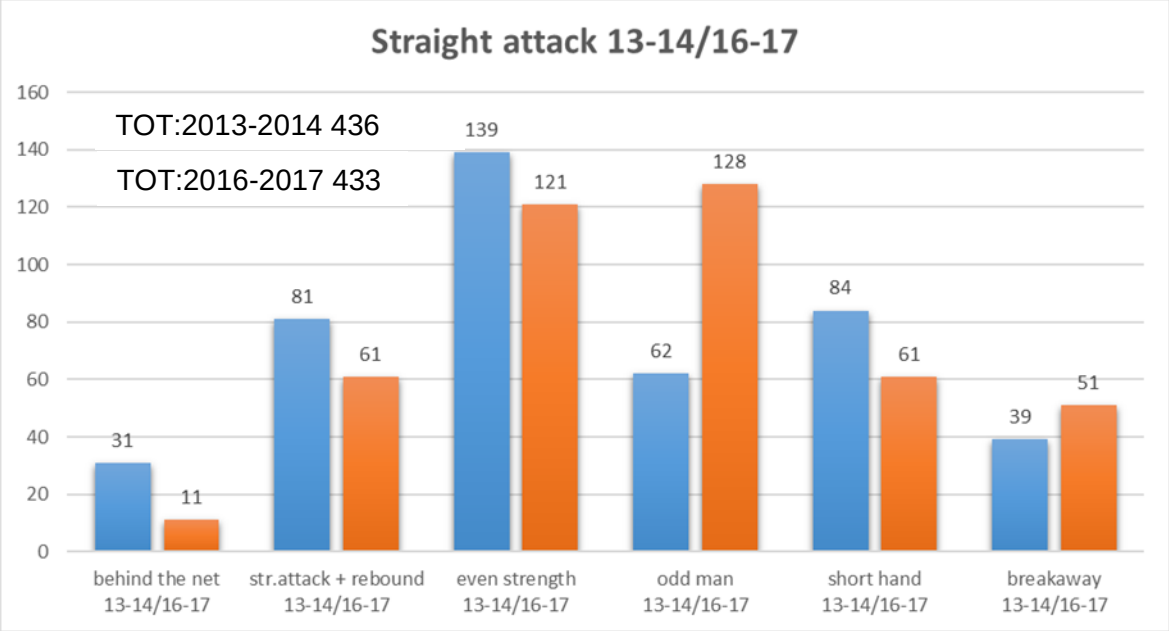


Figure 20. Breakdown of straight attack main category to its sub-category.

From turnover statistics it’s found that in main category level there was scored much more turnover goals during 2013-2014 than 2016-2017. Like noticed previously the average per team dropped 10 goals per team from 2013-2014 to 2016-2017.

Histogram of turnovers sub-categories (Figure 21.) shows that the biggest change happened in neutral and defensive zone turnovers. Average in both categories was 2013-2014 6 goals per team and it decreased for 2016-2017 to 2 goals per team. That change in percentages was in neutral zone turnovers 10,12% and in defensive zone turnover it was 11,1%.

Offensive zone turnovers played the biggest role on goal scoring from turnovers on both seasons. 2013-2014 for offensive zone turn over was scored average 12 goals per team, which was twice more than form neutral and defensive zone turnovers. Same trend repeated itself during season 2016-2017. There was scored average 9 goals from offensive zone turnovers, which was more than three times more than form neutral and defensive zone turnovers.

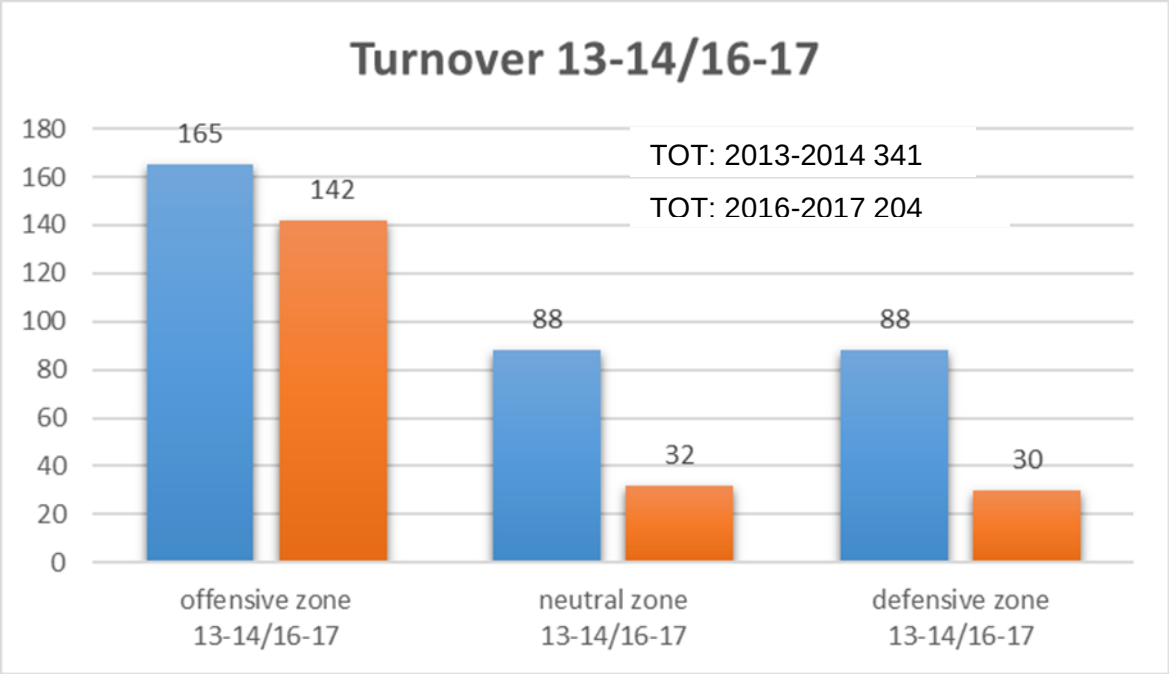


Figure 21. Breakdown of turnover main category to its sub-category.

Offensive end zone play was the category where was found the most changes. Histogram of the end zone play goals (Figure 22.) shows that rebound goal amounts increased with almost 100 goals. That gave an average goal amount increase from 10 goals per team 2013-2014 to 16 goals per team in 2016-2017. As a percentage from total end zone goals the increase was only 5,67%, but there was score total 462 goals during 2013-2014 and 832 goals 2016-2017 season, so it brings the percentage number down.

There was a clear increase from 2013-2014 to 2016-2017 on carrying the puck + shot category as well. That increased in percentage comparison with 4,22% and, in averages it increased from 2 goal average per team to 6 goal average per team.

Looking end zone play histogram (Figure 22.) it shows a small change in each other sub-category. Average number of goals doesn't change in any category more than by 2 goals. Shot from blue line: 7/8, pass form down low: 7/7 and walk out: 3/3 (Marked as "category: 2013-2014 goals/2016-2017 goals").

Deflection goals were not analysed during season 2013-2014, so it has not been opened in this thesis work. It has some effects on other category results, but it is seen just a small amount of goals average each season (7 goal average with 14 and 15 teams) so in that reason it has been left out without notice.

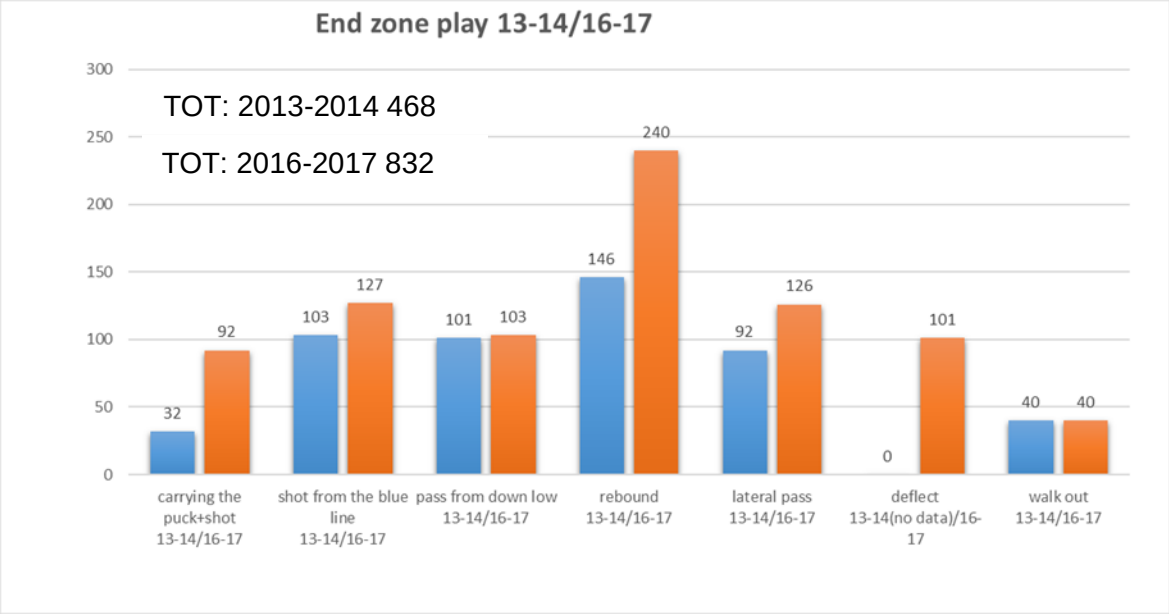


Figure 22. Breakdown of offensive end zone play main category to its sub-category.

Power play goals had a 6-goal average change between seasons. Average amount of goals scored in power play 2013-2014 was 42 goals and 2016-2017 it was 36 goals. Like noticed before with t-test results, the p-value was not large enough to count it as a significant difference.

In sub-categories histogram of power play goals (Figure 23.) it is found that the largest difference on power play scoring was happened in power play straight attack goals. During season 2013-2014 there was scored average 7 goals per team from power play straight attacks. 2016-2017 the average amount of goals scored from that same category was only 2 goals per season. Percentage difference in that category between the season shows 10,4% decrease in goal amounts from 2013-2014 season to 2016-2017 season. Otherwise the scoring in power play during both analysed seasons stayed close to same. Changes in percentages were less than 4% in each category, except rebounds where the change was 6,42%. But on goal average amounts in each sub-category the change was at larges 2 goals. Turnover: 2/1, set play from blueline: 9/8, set play: 11/11, rebound 8/9, deflect: 3/3 and face off winning: 3/1 (Marked as “category: 2013-2014 goals/2016-2017 goals”).

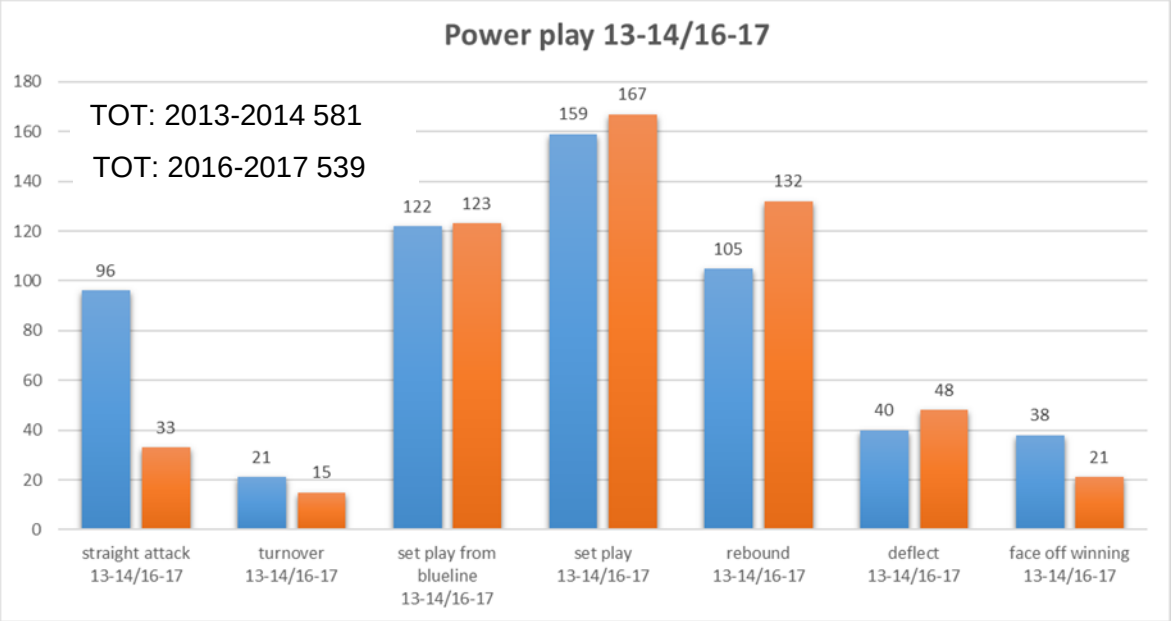


Figure 23. Breakdown of power play main category to its sub-category.

Last main category analysed was other goals (Figure 24.). That included other special situations from inside of the game. Numbers of average goals stayed with in rage of small difference between the seasons in each sub-category. Box play with average 2 goals per team 2013-2014 and 3 goals per team in 2016-2017. Same rate was found on empty net goals, 2013-2014 with average of 7 goals per team and with 7 goals also per team in 2016-2017.

Only category with larger change was a face off winning sub-category. There was scored average 5 goals per team during 2013-2014, and only average 2 goals per team during 2016-2017.

There were 13 goals scored from penalty shots, which were counted if team was given a penalty shot during regulation in game (no shootouts counted). While analysing 2013-2014 data, all the penalty shot goals were left with out category, so they were not counted in any other category. For that reason, penalty shot sub-category, has been left out without notice in this study.

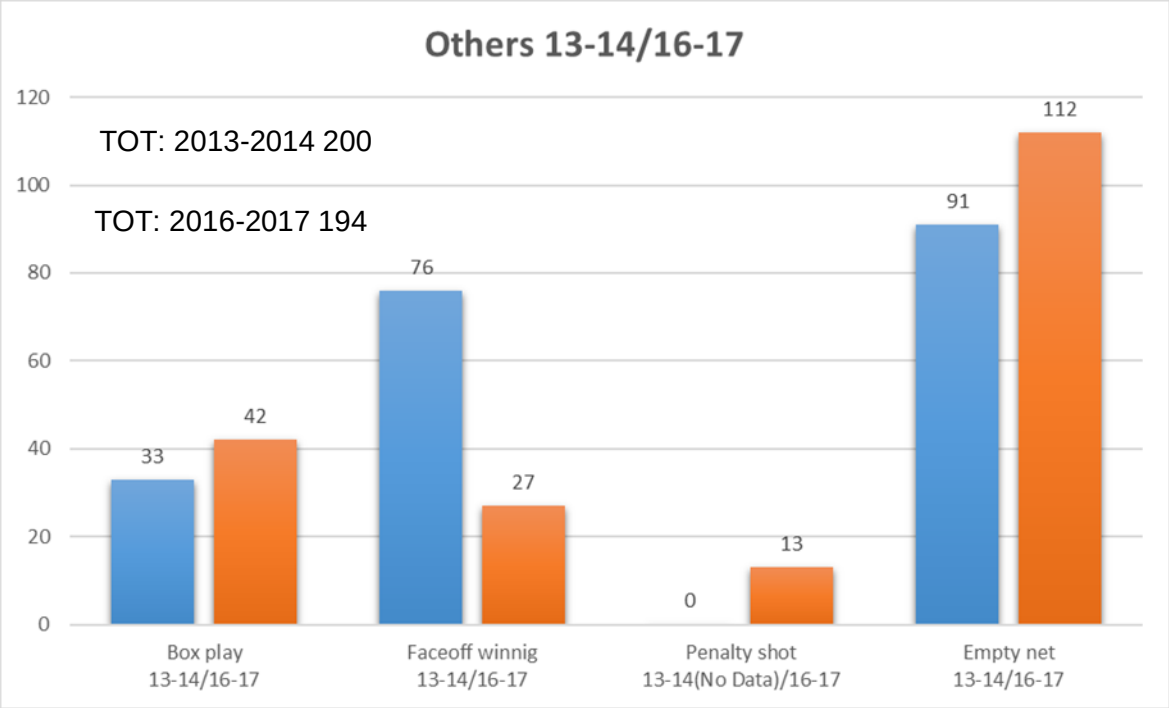


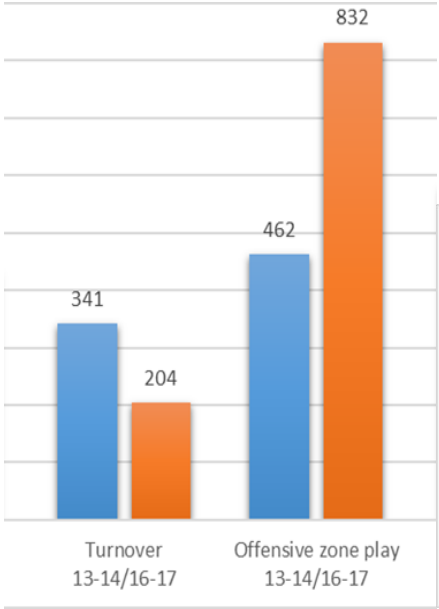
Figure 24. Breakdown of other main category to its sub-category.

8.3 Effect of the IIHF rule change in scoring between the seasons 2013-2014 and 2016-2017

Effects of the IIHF rule change, concerning the blue line placement, had clear effects on how the goals were scored. On the other hand, it did not increase the total amount of goals scored during one individual game, like IIHF hoped, at least in SM-League when comparing seasons 2013-2014 and 2016-2017.

Like noticed before the average amounts of goals scored per team during these to seasons increased only by 2 goals. That was proven with t-test by p-value of 0,813, which means no meaningful difference between these two seasons.
There were two big effects of the rule change according to the goal analysis made from both seasons. Offensive end zone plays provided average 12 more goals per team during 2016-2017 season comparing to season 2013-2014. At the same time there was a opposite effect of the rule change in turnover goals. 2016-2017 there were average 10 less goals scored per team when comparing 2013-2014 scored turnover goals (Figure 25&26.) Offensive end zone play goals amount increase can be explained straight to the rule change made by IIHF. There was given more room for offensive team to work with and move one, and it made defensive play harder for the defending team. Approximately 1.5 meter added to offensive zone gave an enormous advance for offensive team to create a scoring opportunity each time after entering to the zone.

Amount of the turnover goals decrease can be explained with the blue line rule change as well. Explanation is found when looking in to the sub-categories of turnover play goals (Figure 26.). When blue lines were moved towards the redline, it made the neutral zone smaller and the defensive zone bigger at the same time as offensive zone got bigger. Goals were score with almost same average both 2013-2014 season and 2016-2017 season of offensive zone turnover. But when neutral zone became smaller the number of neutral zone turnover, where goal was scored right after that, dropped. Neutral zone got 3 meters smaller during the rule change, so it became much smaller are to turn the game around. Same effect with defensive zone turnover, it became easier to defending team to regroup after turnover and stop the attack. Defensemen are closer to their own net, when there is more room to work in offensive zone.



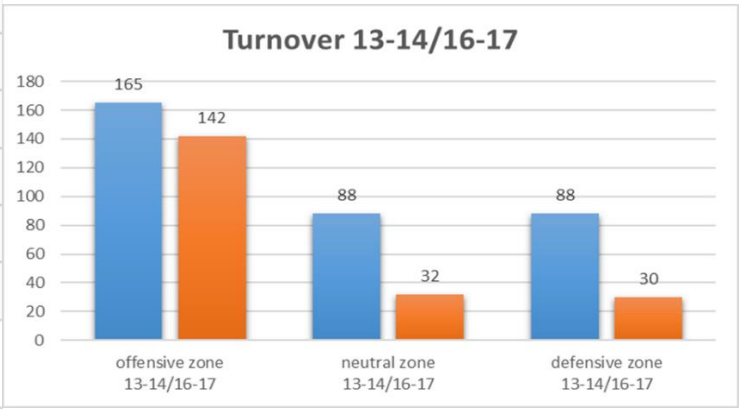


Figure 25. & Figure 26. Histograms of total turnover and offensive zone goals. Histogram of turnover sub-categories.

Going through analysis results there are five sub-categories with results that can be connected to the rule change, odd man rushes on straight attacks, carrying the puck and shot and rebound goals on offensive zone plays, straight attack goals in power play and goals scored straight of faceoff win.

Odd man rush goals average increased form 2013-2014 season's 4 goals to 2016-2017 season's 9 goals (Figure 27.). There is a connection between the increase and rule change. When there is more room on offensive zone, then the distance between attackers and defensemen becomes longer. When puck is lost deep in offensive zone, the opponent team has a greater change to create odd man rush against the defensemen.

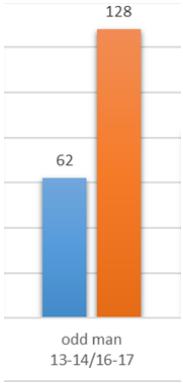


Figure 27. Odd man rush goal amounts in straight attacks.

In offensive end zone play category, there were two sub-categories that had an increase of goal amounts from season 2013-2014 to season 2016-2017. Both, carrying the puck and shot and rebound goals, can be counted as an effect of the rule change, with same reason. When there is more room to work within offensive zone, there is more room to skate and carry the puck than before. That creates more changes to score goal from carrying the puck. Same reason becomes countable when talking about rebounds. When the size of offensive zone was increased, box out playing became harder for defending teams and that made scoring from rebounds easier.

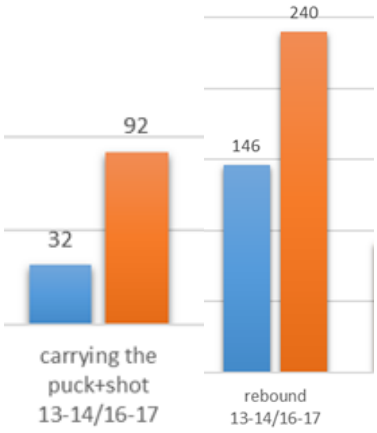


Figure 28. Carrying the puck + shot and rebound histograms from offensive end zone play category.

In power play goals there was a sub-category that can be result of rule change. When playing power play, straight attack goals became much rarer. That is an effect of having more room in defensive zone as a penalty killing team, it is easier to regroup under the power play straight attack and force the team playing power play to the corners and try to steal the puck back. Power play team don't want to take a risk of losing the puck if there is no clear opening for straight attack scoring opportunity.

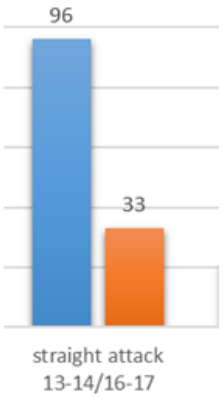


Figure 29. Straight attack histogram from power play category.

Last effect of the blue line change can be found from other category. Goals score straight off faceoff win decreased from season 2013-2014 to season 2016-2017. It can be calculated as an effect of the rule change. When the blue line is farther away from the net, and faceoff win is drawn for defenseman, there is longer distance to shoot the puck to the net than before. It is not that simply explained, because the faceoff circle is still on the same rage of the net than before and some of the shot from faceoff win are taken from the top off the circle. There is still same distance for the puck to travel as before.

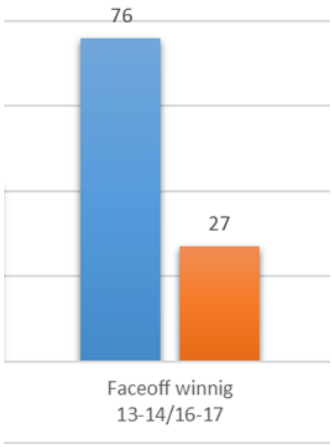


Figure 30. Faceoff winning histogram from other category.

9 Discussion

This thesis provided data of all scored goals from SM-Leagues seasons 2013-2014 and 2016-2017, as well as analysed compare data of the goals between the seasons in total numbers, average numbers, percentage differences and t-test provided p-values. Objective of thesis was to collect, analyse and compare the goal scoring data, to see how goals scoring has changed between the two season and how the IIHF rule change, which was introduced for 2014-2015 season, effected in goal scoring in SM-League. All these objectives were achieved.

Using the same analysing tool as used in this study, there has been done several projects and at least one thesis work based on this analysing tool.
Long term SM-League goal research analysed goal scoring between season 2007-2014 with the same tool as used in this thesis work and came to big picture result of all goals scored from straight attacks, turnovers and offensive zone play covers approximately 20% each of all goals scored. Powerplay goals covers approximately 30% of remaining 40% and the goals scored from other special situations covered approximately 10%. (Savolainen. 2016, 537). According to data used to this thesis shows that form 2007-2014 to season 2016-2017 the percentage difference has shifted a little. Straight attack percentage stayed approximately the same as before (19,7%), but offensive zone plays goals covered almost 40% (37,8%) of all goals during 2016-2017 season. In other hand the turnover goals covered only about 10% (9,3%) of all goals. Power play and other special situation goals cover the remaining 30 % with powerplay goal covering 24,5% and other goals covering 9%.
Thesis work written by Elomo and Poikonen (2015, 31) found by using the same tool that “Number one is turning the puck in a offensive zone. Turning the puck there leads to a goal in 20% chance.” Their analysis was made of season 2011-2012, and it shows that the most effective scoring category has changed from that time for season 2016-2017. For this season the offensive end zone plays rebound goals became most effective individual category to score a goal in game of ice hockey in Finish SM-League.
IIHF rule change was introduced and taken to use for season 2014-2015. IIHF made a rule change for blue lines, to aim for more goals by allowing more room for offensive team to work with. That way their aim was to increase entertainment value of each ice hockey game event. (Savolainen 1 April 2019.) According to our study the effect of moving the blue lines towards centre line was not seen in SM-League as an increase of amounts of goals scored. But it could be said, that it made the game more entertaining for audience. Result showed that there was scored a must larger number of goals after an offensive end zone play. That means that the attacking team was able to hold the puck in their offensive

zone for longer time and create more scoring changes in the zone. That can be counted as an entertaining factor in game of ice hockey and direct result of moving the blue lines. There is possibility alive that all the changes in goal scoring, that were discussed above, are not connected with blue line rule change, and of increase of offensive zone room. Some of it might be just usual development of game over the years. But it can be said that blue line rule change, and increased offensive zone room, had an impact on goal scoring, one way or other.

This research-based thesis was done by using the same analysing tool on each year. There were two added sub-categories to the tool from 2013-2014 to 2016-2017, deflection goals in offensive end zone plays and penalty shot goals in other situation goals. Penalty shot goals did not influence data anyway, because 2013-2014 they were not counted to any other category, but deflection goals had some kind of effect on research's reliability. All the goals that were scored by deflection was marked 2013-2014 to some other category, but 2016-2017 they were marked in their own separated category. That influenced on the total number of goals scored from offensive end zone situations. It is impossible to say afterwards how and where the deflection goals were marked 2013-2014. Another reliability issue with this research-based study was a big number of people analysing the goals. There were total five different persons analysing goals during this two-season time, one during 2012-2013 and four during 2016-2017. Every analyser has always a little different aspect of reading the scoring rules. There was clear instruction how the goals were supposed to analysed, but some other might think a one goals as a defensive zone turnover goal and another on as a straight attack odd man rush goal. There is a possibility that this had a little but not noteworthy effect on analysing results.

Thesis provided us clear answers of how the goal scoring has developed over the few years of time and it was proven with several different methods. Blue line rule change has had some effects on the ways of scoring a goal in SM-League, and it has been a good step forward to more entertaining games of ice hockey. Research was done with season right before the change and two seasons after the change. It would be interesting to continue comparing study and see if the rule change had some long-term effect on goal scoring that are not seen yet during 2016-2017 season. When coaches analyse their game and develop it continually, there maybe some effect that are not seen here, including the increase of total amount of goals during a single game of ice hockey, which was the main purpose of the rule change after all.

In general, project gave a better understanding of how goals are scored and where goals are scored in game of ice hockey, and it provided a good knowledge in importance of analysing teams performance continually to develop the game.

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Appendices

Appendix 1. 2013-2014 goal analysis

Straight Attack	JYP	VAS	KAL	VAS	SAI	VAS	PEL	VAS	ILV	VAS	TAP	VAS	HPK	VAS	KÄR	VAS	ÄSS	VAS	LUK	VAS	TPS	VAS	HIF	VAS	JOK	VAS	BLU	VAS	
behind the net	2	2	1	2	3	1	5	2		2	1	3		2	1	3	2	1	1		3	5	3	4	7	3	2	1	62
str.attack + rebound	5	6	9	13	1	3	5	6	13	5	4	5	3	6	4	3	4	6	7	4	7	7	7	7	5	5	6	6	162
even strength	13	8	4	10	5	11	12	10	7	11	15	7	16	8	10	7	8	14	6	8	16	17	7	9	12	13	8	6	278
odd man	6	3	4	4	9	3	8	5	3	3	4	4	3	3	6		3	13	3	4	1	6	1	8	5		6	6	124
short hand	3	5	3	8	10	6	8	10	6	2	5	5	4	5	7	3	10	8	6	5	5	7	8	9	3	3	6	8	168
breakaway	3	4	2	5	3	1		6	1	3	7	3	4	2	3	1	1	5	3	1	4	5	1		4	2	3	1	78
Turnover	**JYP**	**VAS**	**KAL**	**VAS**	**SAI**	**VAS**	**PEL**	**VAS**	**ILV**	**VAS**	**TAP**	**VAS**	**HPK**	**VAS**	**KÄR**	**VAS**	**ÄSS**	**VAS**	**LUK**	**VAS**	**TPS**	**VAS**	**HIF**	**VAS**	**JOK**	**VAS**	**BLU**	**VAS**	
offensive zone	11	17	9	21	13	10	14	8	11	10	12	15	8	11	11	7	12	16	12	14	11	15	12	10	14	3	15	8	330
neutral zone	6	10	6	6	5	4	8	6	6	7	4	6	8	7	7	5	6	6	7	8	5	5	4	9	8	3	8	6	176
defensive zone	9	7	2	9	5	7	5	4	5	3	4	10	13	4	6	4	4	10	11	5	11	5	7	3	3	11	4	5	176
Offensive Zone Play	**JYP**	**VAS**	**KAL**	**VAS**	**SAI**	**VAS**	**PEL**	**VAS**	**ILV**	**VAS**	**TAP**	**VAS**	**HPK**	**VAS**	**KÄR**	**VAS**	**ÄSS**	**VAS**	**LUK**	**VAS**	**TPS**	**VAS**	**HIF**	**VAS**	**JOK**	**VAS**	**BLU**	**VAS**	
carrying the puck+shot	3	2	3	3	1	2	3			5	2	1	6		2	2		2	1	3	4	4	3	4	2	1	2	3	64
shot from the blue line	12	7	3	11	14	8	6	5	7	5	9	6	6	4	11	9	1	4	7	5	4	11	10	10	7	7	8	9	206
pass from down low	7	7	3	5	3	11	14	5	9	10	11	4	7	7	12	4	9	11	6	5	8	16	5	5	5	4	4	5	202
rebound	11	13	7	11	11	8	4	13	14	12	14	5	15	11	14	5	16	10	6	11	6	15	8	7	14	9	7	15	292
lateral pass	4	4	5	3	4	3	2	4	2	4	6	2	3	7	5	2	3	2	1	3	1	2	2	4	6	1	2	5	92
walk out	2	2	3	2	3	1	1	1	4	3	5	4	4	2	3	2	3	7	3	4	2	3	4	4	1	1	3	3	80
Power Play	**JYP**	**VAS**	**KAL**	**VAS**	**SAI**	**VAS**	**PEL**	**VAS**	**ILV**	**VAS**	**TAP**	**VAS**	**HPK**	**VAS**	**KÄR**	**VAS**	**ÄSS**	**VAS**	**LUK**	**VAS**	**TPS**	**VAS**	**HIF**	**VAS**	**JOK**	**VAS**	**BLU**	**VAS**	
straight attack	12	6	3	11	4	7	5	7	6	9	6	9	8	5	11	3	2	6	7	5	10	7	6	8	8	10	8	3	192
turnover	1	1	1	1	5			6	2			1	2	1	1	1		5		2	2		4		2	2	1	1	42
set play from blueline	9	5	7	7	12	9	10	9	10	8	8	3	5	14	9	7	6	11	9	9	4	13	14	7	14	11	5	9	244
set play	10	12	9	14	12	11	14	9	7	13	21	9	7	12	13	10	11	15	19	12	12	7	4	9	9	13	11	13	318
rebound	3	6	4	6	7	9	6	10	8	6	9	8	7	6	14	6	9	5	13	5	6	11	7	5	6	13	6	9	210
deflect	4		1	3	2	5	3	4	6	1	1	3	1	2	3	4	2	1	2	4	4	5	3	2	6	4	2	2	80
face off winning	4	5	2	1	6	2	1	5	5	2	2			2	6	6	2	1	1	5		2	7	2	2	1		4	76
Box play		2	1	2		2	3	4	1	4	3	1	2	2	7	2	3	2	3	3	2	3	2	2		4	6		66
Face off winning	7	5	3	4	6	3	7	6	5	6	2	5	2	3	6	6	6	6	9	4	5	5	8	5	5	8	5	10	152
Empty goal	5	6	5	5	10	5	9	7	4	10	7	4	4	8	9	1	5	7	9	6	1	12	8	8	6	5	9	7	182
TOTAL	**JYP**	**VAS**	**KAL**	**VAS**	**SAI**	**VAS**	**PEL**	**VAS**	**ILV**	**VAS**	**TAP**	**VAS**	**HPK**	**VAS**	**KÄR**	**VAS**	**ÄSS**	**VAS**	**LUK**	**VAS**	**TPS**	**VAS**	**HIF**	**VAS**	**JOK**	**VAS**	**BLU**	**VAS**	
Straght attack	32	28	23	42	31	25	38	39	30	26	36	27	30	26	31	17	28	47	26	22	36	47	27	37	36	26	31	28	872
Turnover	26	34	17	36	23	21	27	18	22	20	20	31	29	22	24	16	22	32	30	27	27	25	23	22	25	17	27	19	682
End zone play	39	35	24	35	36	33	30	28	36	39	47	22	41	31	47	24	32	36	24	31	25	51	32	34	35	23	26	40	936
Even strength	**97**	**97**	**64**	**113**	**90**	**79**	**95**	**85**	**88**	**85**	**103**	**80**	**100**	**79**	**102**	**57**	**82**	**115**	**80**	**80**	**88**	**123**	**82**	**93**	**96**	**66**	**84**	**87**	**2490**
Power Play	**43**	**35**	**27**	**43**	**48**	**43**	**39**	**50**	**44**	**39**	**47**	**33**	**30**	**42**	**57**	**37**	**32**	**44**	**51**	**42**	**38**	**45**	**45**	**33**	**47**	**54**	**33**	**41**	**1162**
Other	12	13	9	11	16	10	19	17	10	20	12	10	8	13	22	9	14	15	21	13	8	20	18	15	11	17	20	17	400
TOTAL	**152**	**145**	**100**	**167**	**154**	**132**	**153**	**152**	**142**	**144**	**162**	**123**	**138**	**134**	**181**	**103**	**128**	**174**	**152**	**135**	**134**	**188**	**145**	**141**	**154**	**137**	**137**	**145**	**4052**

Appendix 2. SCORING ANALYSIS instructions

HAAGA-HELIA
University of Applied Sciences

GAME ANALYSIS

Ice hockey

Kari Savolainen

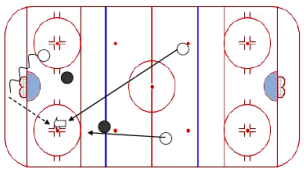
2008

1. STRAIGHT ATTACKING GAME

Straight attacking game means controlled attacks from defensive or neutral zone, when the end result of these attacks is goal or a scoring chance. Combined factor to these are, that the goals are made against the opponents organized defense.

1.1. Behind the net

When situation starts from team's defensive or neutral zone from other reason than an instant steal of the puck, and leads straight to scoring chance via end zone of the rink.



Attacking team

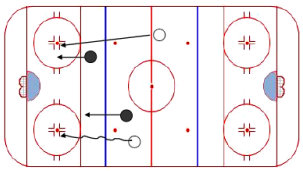
Defensive team

1.2. Straight attack + rebound

When situation starts from team's defensive or neutral zone from other reason than an instant steal of the puck and leads to scoring chance after the rebound

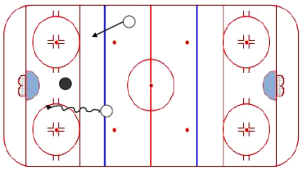
1.3. Straight attack even strengths

When situation starts from team's defensive or neutral zone from other reason than an instant steal of the puck and leads straight to scoring chance. **A criterion is the situation in the offensive blue line. For example, 1-1, 2-2 etc. situations**



1.4. Straight attack odd man rush

When situation starts from team's defensive or neutral zone from other reason than an instant steal of the puck and leads to scoring chance. **A criterion is the situation in the offensive blue line. For example, 2-1, 3-2, etc. situations**



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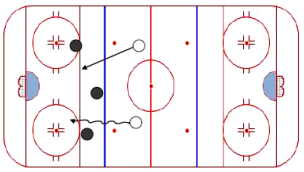
When situation starts from team's defensive or neutral zone from other reason than an instant steal of the puck and leads to scoring chance. **A criterion is the situation in the offensive blue line. For example, 1-2, 2-3, etc. situations**



1.6. Straight attack on breakaway

When attack starts from team's defensive or neutral zone from other reason than instant steal of the puck and leads to scoring chance, **criteria being here breakaway, → player alone against the goalie**

2. Turnover game

Puck stealing situations means the situations where puck loosing causes offensive situations immediately (offensive zone, neutral zone, defense zone). Common for these kinds of situations is that opponents defense is unorganized.

2.1. Stealing the puck in the offensive zone

Immediately created scoring chance because of stealing the puck in the offensive zone.

2.2. Stealing the puck in the neutral zone

Immediately created scoring chance because of stealing the puck in the neutral zone.

2.3. Stealing the puck in the defensive zone

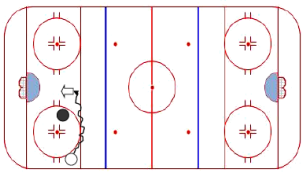
Immediately created scoring chance because of stealing the puck in own blue line.

3. Offensive zone play

End zone play means those situations which are created by "forced play". Common to different categories is that real scoring place has developed from puck holding or passing chains in the offensive zone. Direct attack game and puck stealing turns into end zone play if the attacking team can hold the puck at least 5 sec. and it is not straight consequence from stealing the puck.

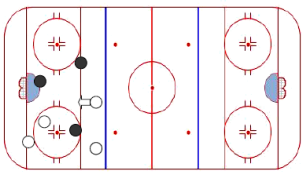
3.1. Carrying + Shooting

A shot in the offensive zone after carrying the puck in the offensive zone play.



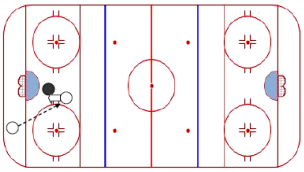
3.2. Shot from the blue line

Shot under the blue line after offensive zone play.



3.3. Pass from down low

Shot to the puck which is coming from the end after the offensive zone play.



3.4. Rebound

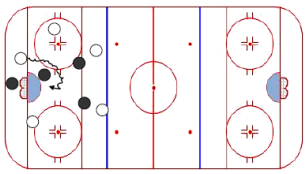
Shot to the rebound puck after the offensive zone play.

3.5. Lateral pass

Laterally passed puck shot after the offensive zone play. (Defenders shot can also be like this)

3.6. Walk out

Up behind the net after the offensive zone play.



4. Power play

Mark always to this category when team can create a real scoring place while playing power play (5-4, 5-3, 4-3) or delayed penalty.

4.1. Straight attack

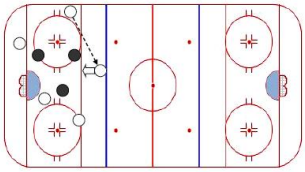
A immediately shot in power play in a direct attack without the "forced play" period.

4.2. Turnover

In this category the attack starts when team steals the puck from the opponent team. For example at the offensive zone or at the neutral zone. It can also be the result of a won face off at the offensive zone.

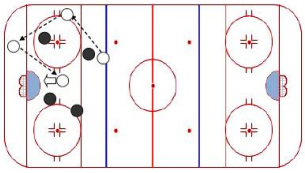
4.3. Set play from blue line

When the power play goal is scored with a shot coming from the blue line.



4.4. Set play

PP goal that is scored after an end zone play. (Includes all the other set plays except those that end in a shot coming from the blue line).



4.5. Rebound

PP goal scored from a rebound.

4.6. Deflect

PP goal scored from a deflect

4.7. Face off winning

PP goal scored right after face of win

5. Box play (Short handed)

When team manages to create a scoring chance while being short handed.

6. Face of winning

Goal scored after winning a face off in the offensive zone while playing 5 on 5.

7. Empty net

Goal scored in to a empty net.

Appendix 3. T-Test results and p-values

	2014	2017		
Sarake1	Straight attack	Straight attack2		
JYP	32	32		
KAL	23	35		
SAI	31	21	p-value:	0,257078538
PEL	38	21		
ILV	30	30		
TAP	36	39		
HPK	30	35		
KÄR	31	26		
ÄSS	28	29		
LUK	26	24		
TPS	36	30		
HIF	27	35		
Jok/SPO	36	25		
BLU/Juk	31	31		
KooKoo		20		

	2014	2017		
Sarake1	Offensive zone	Offensive zone2		
JYP	39	50		
KAL	24	57		
SAI	36	44		
PEL	30	76		
ILV	36	50		
TAP	47	67	p-value:	3,15109E-07
HPK	41	65		
KÄR	47	53		
ÄSS	32	47		
LUK	24	54		
TPS	25	63		
HIF	32	53		
Jok/SPO	35	48		
BLU/Juk	26	43		
KooKoo		62		

	2014	2017		
Sarake1	Even strenght	Even strenght2		
JYP	97	93		
KAL	64	106		
SAI	90	79		
PEL	95	111		
ILV	88	94		
TAP	103	117	p-value:	0,04742
HPK	100	110		
KÄR	102	93		
ÄSS	82	85		
LUK	80	94		
TPS	88	110		
HIF	82	110		
Jok/SPO	96	87		
BLU/Juk	84	89		
KooKoo		91		

	2014	2017		
Sarake1	**power play**	**power play2**		
JYP	**43**	**51**		
KAL	**27**	**48**		
SAI	**48**	**29**		
PEL	**39**	**33**		
ILV	**44**	**32**		
TAP	**47**	**55**	p-value:	0,099676886
HPK	**30**	**32**		
KÄR	**57**	**38**		
ÄSS	**32**	**22**		
LUK	**51**	**42**		
TPS	**38**	**36**		
HIF	**45**	**21**		
Jok/SPO	**47**	**29**		
BLU/Juk	**33**	**34**		
KooKoo		**37**		

p-value total	p-value straigth	p-value turnover
0,813163269	0,257078538	6,14E-09
M of E: 81%	M of E: 25%	M of E: <0,1%
no significant difference	no significant difference	very significant difference

p-value Offensive zone	p-value Even strenght	p- value power play
3,15E-07	0,0474215	0,099676886
M of E: <0,1%	M of E: 5%	M of E: 10%
very significant difference	almost significant difference	no significant difference