HOW TO SCORE GOALS IN FLOORBALL!

ANALYSIS OF GOAL SCORING IN THE IFF MEN'S WORLD FLOORBALL CHAMPIONSHIPS 2016

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1. MyCoazh
2. KIHU - Research Institute for Olympic Sports
3. Floorball Australia and University of Canberra
4. Finnish Floorball Association
5. International Floorball Federation
6. The Statistical Research Service TUPA of the University of Tampere

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SUMMARY

The aim of this study was to investigate how the goals were scored in the IFF Men's 11th World Floorball Championships (WFC) 2016. Variables related to all 488 goals scored in the 48 WFC tournament games were coded using the MyCoazh analysis software and further analysed with Microsoft Excel.

Summary of the findings:

Goals and Key Performance Indicators

- A total of 488 goals (an average of 10.2 goals per game) were scored from the 4599 shots taken (scoring efficiency 10.6%) in the 48 games played in the WFC 2016.
- 93.8% of the time, a three-goal lead was safe from the winning point of view.
- The team scoring the first goal won the game in 75% of games.

Scorer

- The best scorers at WFC 2016 were playing as left forwards (32.6% of all goals).
- 59.0% of goals were scored by players playing with a left grip (left hand below) and that share was almost the same as the percentage of left gripped players in the tournament.
- The listed 1st lines of teams scored the most goals (43.4%).

Shots that lead to a goal

- On average, teams were shooting 47.9 shots per game, 18.6 shots on goal per game (shooting accuracy 38.7%) and it took 3.7 shots on goal to score a goal (27.0% of shots on goal scored).
- On average, goals were scored 5.7 metres from the goal.
- The most common way to score was from a shot directly following a cross-pass (23.0%).
- The most common type of scoring shot was the drag shot (23.0%).
- 64.0% of all goals were scored from the best scoring area (the 8 m "triangle" in front of goal).
- The highest percentage of goals were scored in the bottom third of the goals (42.0%).

Timing of the goals

- 31.3% of goals were scored in the 1st period, 30.7% in the 2nd period and 38.0% in the 3rd period or extra time/penalty shootout.
- The highest percentages of goals were scored in the last 5 minutes of both the 2nd period (10.9%) and 3rd period (12.1%).

Assists

- 88.3% of all the goals were assisted by at least one prior pass.
- The best assisters were playing in the centre for the 1st lines of teams.
- On average, passes assisting goals were 8.3 metres long. The highest percentage of goals were scored after just one pass (23.0%).

Offenses that lead to a goal

- The highest percentage of goals were scored after an organised attack (28.5%).
- The highest percentage of goals were scored following ball possession gained in the offensive zone (36.0%).
- The highest percentage of goal-scoring attacks originated from free hits and hit-ins (18.0%).
- The highest percentage of goals were scored within 3 seconds of gaining the initial ball possession (32.0%).
- Most goals were scored with the combination of 2-3 players (52.6%).

Defensive actions influencing goal scoring

- 57.0% of the goals scored were due to crucial mistakes or errors made by the defensive team/player.
- 84.0% of the goals were made without an opponent pressuring or only with small pressure.

Keywords: floorball, goal analysis, match analysis, performance analysis, elite level

1 INTRODUCTION

1.1 Game of floorball

Floorball is an indoor sport resembling both field hockey and ice hockey, which originated in Sweden in the 1970s. Its practise is quickly growing around the world through Europe to North America, and especially in Asia and Oceania. In 2017, there were 66 member countries in the International Floorball Federation (IFF). IFF and floorball has an ambitious goal to develop and grow floorball into a sport played at the Olympic Games, and floorball gained full recognition with the International Olympic Committee (IOC) in 2011.

The game is played with a very light plastic "wiffle" ball inside a 20 m x 40 m low boarded indoor court, where two teams of 6 players (one goalkeeper, and five field players) play on a synthetic flooring and try to score in the opponent's goal and prevent the opponent from scoring in their goal. All players except the goalkeeper play with light-weight carbon fibre and plastic sticks. The ball can be played only under the player's knee level and rough tackles are forbidden.

Floorball players need a good floorball game intelligence (game focusing, perceiving, sensing and decision making), stick handling skills, speed, balance and mobility, physical strength, stamina, endurance and co-operation with team mates. It is widely acknowledged that the top international and national games differ significantly in the pace and physicality of the game. There are three different positions for field players in floorball (defender, centre and forward) and the fourth position is a goalkeeper. The two defenders and two forwards nominally have a left and a right side, although game play is usually quite dynamic. It is quite important to understand that the players' positions rotate quite a lot and all field players actively participate in both offensive and defensive play.

Tactically, floorball has learned a lot from similar sports like ice hockey and basketball; however modern floorball has developed its own unique tactics. In floorball, there is no offside rule and that helps make the game one of the fastest ballgames in the world. From virtually every part of the rink, it takes only about 3 seconds to reach the opponent's goal.

There are 5 different phases or moments in the game; established defense, transition from defense to attack, established attack, transition from attack to fore-checking and defense and set pieces. When discussing tactics, the zones of the rink (offensive zone, neutral zone and defensive zone) are considered. The result of a floorball game is always decided at the line level: line against opponent's line. One player cannot win the floorball game alone, but a single action by one player can make a pivotal difference in the final outcome of the game.

To see more about floorball go to IFF Floorball - Channel 1 on YouTube and watch the video "IFF Story of Floorball" (https://www.youtube.com/watch?v=T2VRNHK7Omo).

1.2 Background of the study

As the sport of floorball is relatively young, the amount of scientific research is rather limited. Most of the published studies are related to injuries and only a few articles have been published regarding game analysis, such as "Ball Possession Effectiveness in Men's Elite Floorball According to Quality of Opposition and Game Period" (Gomez, Prieto et al, 2013) and "Modern Trends in Finish of Offensive Actions in Men's Floorball" (Bykov, 2015). Other references used to build the present analysis model were as follows:

"Swedish Floorball Federation WFC Game Analysis from 2012 and 2013", "Salibandyn maalivahtipeli: maalivahtipelin analyysi vuoden 2010 MM-kilpailuista" (Ihme & Stützel, 2012; "Goalkeeping in floorball: analysis from WFC 2010"), "Skill Analysis of Ice Hockey" (Westerlund, 1992b), "Theory of Standard Sum in Ice Hockey" (Westerlund, 2003), "Analyzing reasons behind the goals in ice-hockey" (Elomo & Poikonen, 2015), "Valmentaminen salibandyssä" (Pulkkinen, Korsman & Mustonen, 2013; "Coaching in floorball") and some game analyses from football: "Quantifying the Performance of Individual Players in a Team Activity" (Duch et al. 2010) and "Individual ball possession in soccer" (Link & Hoernig, 2017).

1.3 Purpose of this analysis

The purpose of this analysis was to:

1. Analyse how and why the goals were scored in the IFF Men's 11th World Floorball Championship (WFC) 2016 tournament.
2. Set the baseline for analysis and examine how international floorball develops in the forthcoming WFC tournaments.
3. Produce insights regarding how to analyse performance in floorball, especially goal scoring.

2 METHODS

2.1 Playing system in the IFF Men's 11th World Floorball Championships

The IFF 11th Men's World Floorball Championships were held in Riga, Latvia in 2016. Sixteen teams qualified to the final tournament and played in four pools (A, B, C, D). The teams were divided into the pools according to their IFF rankings and based on a ballot, with the top 8 teams placed in pools A and B and the next 8 teams placed in pools C and D. In the group stage, there were 3 games for each team meaning that a total of 24 games were played in this stage of the tournament. After the group stage, the first play-off round was played in which the teams placed 3rd and 4th in pools A and B played against the teams placed 2nd and 1st in pools C and D, respectively. This stage was followed by quarter finals, semi-finals and grand finals. Play-off and placement games were also played to determine the finishing position of all teams in the tournament. Altogether 48 games were played in 9 days at the men`s World Floorball Championships 2016. The results of all games were used to analyse goal scoring at both the tournament and team levels.

2.2 Goal analysis

All the goals of the tournament were analysed using MyCoazh (www.mycoazh.com), which is a real-time game analysing software for iPad. The analysis includes the most common variables associated with goal scoring. For each goal scored the following variables were recorded in Microsoft Excel:

- the scoring team and opposition team, the score in the game and goal difference, the period and game time of the goal, and any special situations (e.g. powerplay, empty net).
- the level and type of defensive error, what action led to the turnover and where on the field.
- the zone of the court where the possession was gained and where the shot was taken, the type of attacking play, the type of scoring chance, the time in possession, the number of passes and players involved in the offense, the type of shot, the location in the goals of the shot, the length of the final pass, and the distance of the shot from goal.
- the playing line, playing position, and playing grip of the scorers and assisters. The lines, playing positions and playing grip were used as they were presented on the IFF website game reports and player profiles (www.floorball.org).

The Key Performance Indicators (KPIs) of teams included the following:

- Shots For contains all the shots (goals, shots on goal, shots blocked and shots wide) as does Shots Against.
- Shooting Accuracy (ShoAcc) is the percentage of Shots on Goal from Shots All.
- Scoring Efficiency (ScoEff) is the amount of Goals For/Shots All.
- Goalkeeper's saving percentage (Save%) is Shots saved*100/Opponent's Shots on Goal.
- Expected Goals For (xGF) and Against (xGA) can be described as estimations computed to turn each goal scoring attempt into a number between 0 and 1, representing the odds of that attempt producing a goal.
- Corsi-index is the percentage of Shots For/Shots For + Against and in ice hockey it has been considered as a decent measure of possession.

- PDO is a sum of a team's shooting percentage (Goals*100/Shots on Goal) and saving percentage (Shots saved*100/Opponent's Shots on Goal). In the long run, PDO will always regress towards 100 and it is considered as a proxy of how lucky the team is.

All the games were analysed by the same game analyst who has experience of analysing over 3,000 games. The reliability of the analyst using the MyCoazh analysis system has been tested, showing that over 95% of the actions were consistent when the same game was coded twice on different days (real-time and from video).

3 RESULTS AND DISCUSSION

3.1 The results of the tournament

It was Finland that won the WFC 2016 tournament in a shoot-out against Sweden, whilst Switzerland beat Czech Republic for the bronze medal. Not surprisingly, those top 4 teams scored a large percentage of goals in the tournament making 164 goals (34%) out of the 488 in one quarter of the games played (24 games). The teams finishing 5th-8th made 127 goals (26%) in 28 games played. The next set of teams finishing 9th-12th made 107 goals (22%) in 24 games, whilst the lowest ranking teams finishing 13th-16th scored 90 goals (18%) in their one fewer game each (20 games). (Table 1.)

A clear difference was also seen in goals conceded. The top 4 teams conceded just 84 goals (17%) out of the total of 488. Teams ranked 5th-8th conceded twice as many with 168 goals (34%) against with some of the larger losses in the tournament against those top 4 teams. For teams ranked 9th-12th the share of conceded goals was 125 goals (26%) and these numbers leave 110 goals (23%) conceded by the teams finishing 13th-16th. Here once again one must remember that the top 4 teams played 24 games, 5th-8th teams played 28 games, 9th-12th teams played 24 games and the bottom 4 teams played just 20 games. (Table 1.)

By splitting the top 8 and next 8 teams, the tournament system evens out the amount of goals and makes for closer games across the board. In this entire analysis one must take into consideration the differing number of games from 5-7 that teams played during this tournament as seen in the table below as well as the different ranking levels of opposition teams played due to the tournament system.

Table 1. Final rankings of the WFC 2016 tournament.

Final Ranking	Team (IFF ranking before WFC 2016)	Games	Wins	Draws	Losses	For-Against (Difference)	For-Against (Average)
1	Finland (2)	6	6	0	0	43-14 (+29)	7.2-2.3
2	Sweden (1)	6	5	0	1	44-14 (+30)	7.3-2.3
3	Switzerland (3)	6	4	0	2	40-27 (+13)	6.7-4.5
4	Czech Republic (4)	6	3	0	3	37-29 (+8)	6.2-4.8
5	Denmark (12)	7	6	0	1	34-26 (+8)	4.9-3.7
6	Norway (6)	7	2	1	4	27-41 (-14)	3.9-5.9
7	Germany (7)	7	2	1	4	26-55 (-29)	3.7-7.9
8	Estonia (8)	7	1	1	5	40-47 (-7)	5.7-6.7
9	Slovakia (9)	6	4	0	2	36-23 (+13)	6.0-3.8
10	Latvia (5)	6	1	1	4	31-34 (-3)	5.2-5.7
11	USA (10)	6	3	0	3	27-27 (0)	4.5-4.5
12	Canada (13)	6	2	0	4	13-41 (-28)	2.2-6.8
13	Poland (14)	5	2	1	2	29-21 (+8)	5.8-4.2
14	Thailand (-)	5	2	0	3	24-20 (+4)	4.8-4.0
15	Australia (16)	5	1	1	3	19-31 (-12)	3.8-6.2
16	Singapore (18)	5	1	0	4	18-38 (-20)	3.6-7.6

3.2 Goals and Key Performance Indicators

The amount of goals

In total 488 goals were scored in the 48 games played at WFC 2016 in Riga. This means an average of 10.2 goals per game, which was about the same in the last four men's WFCs (2010, 2012, 2014 and 2016). During the group stage a total of 247 goals were scored in 24 games. This means an average of 10.3 goals per game. The number of goals scored in the play-off rounds and the placement games was 241 in 24 games (10.0 goals per game). From all goals, 73% were scored in "normal" 5v5 gameplay. From the remaining 27%, 73 goals (15%) were scored with a numerical advantage during power play, which was much higher than the 9.9% reported by Bykov (2015) for the WFC 2012. A further 9% of goals were scored immediately following a free hit or hit-in. The remaining 3% of goals came from special situations such as penalty shots, short-handed, without the goalie or into an empty net.

Goal Difference

Floorball is a goal scoring and goal preventing game. Because of that, it is justifiable to analyse the goal differences in the games. In the WFC 2016 the average goal difference was 4.0 goals (for-against: 7.1-3.1). The goal difference was greater during the group stage (4.3; 7.3-3.0) than during the play-off stage (3.9; 7.0-3.1). This difference is slightly affected by the fact that the result cannot be a draw in the play-offs. There were also four games in the play-off stages with at least a 10 goal difference compared to only one such game in the group stage. With this in mind, the play-off stage generally brought closer games, especially in the last games where the teams were about the same level.

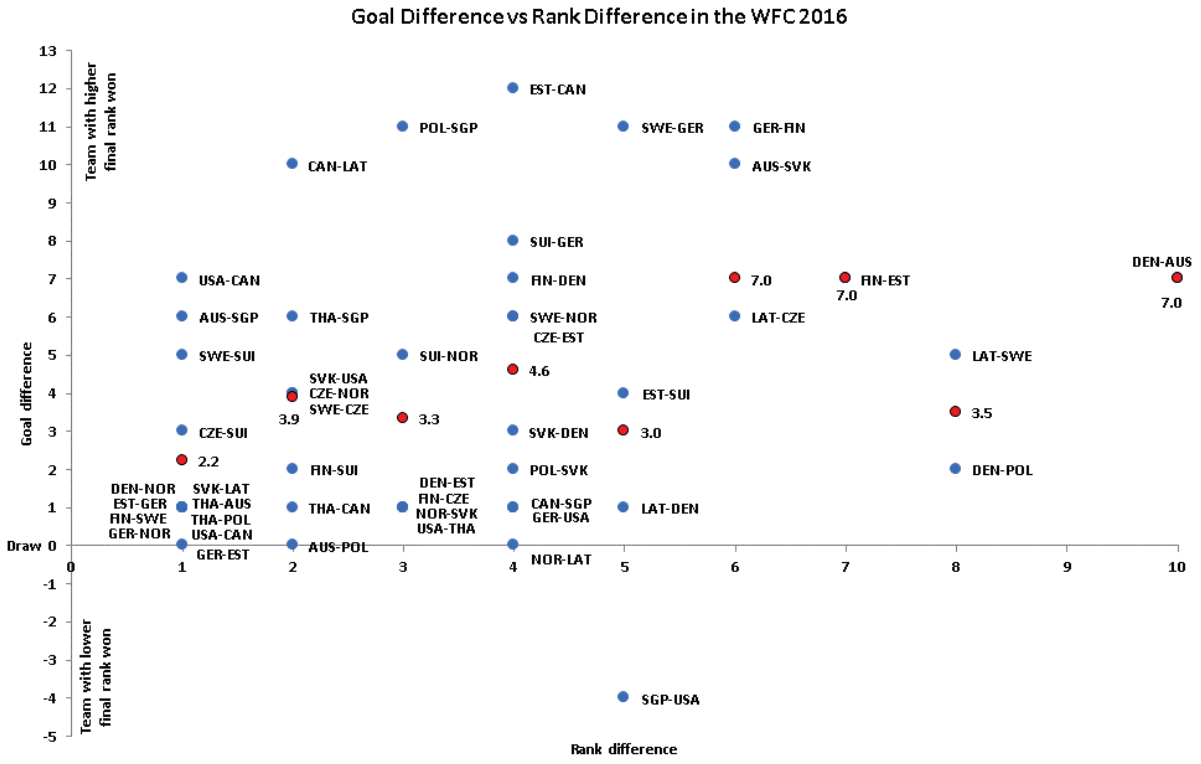

Figure 1. Goal Difference vs Rank Difference at WFC 2016 (Blue dots = individual games; Red dots = average goal difference).

The goal difference in games between the top 4 teams was 2.7 goals (6 games), 0.8 goals (5 games) between teams 5th-8th, 4.6 goals (5 games) between teams 9th-12th and 4.2 goals difference between teams 13th-16th. The large differences in the last two groups were due to a gap between Slovakia and Latvia compared to USA and Canada and some larger losses suffered by Singapore. When the goal difference was compared to the difference in the final tournament rankings (Figure 1), it was found that in only one game the team with a lower final ranking was able to win against a team that ended up ranked higher after normal 60 minutes playing time (rank 16 SGP beat rank 11 USA 9-5). This was partly due to tournament system and rather large differences between the teams.

Figure 2 presents the average total number of goals and the average goal difference in the games played between the top 8 countries in the last four World Floorball Championships. It can be seen that the average goal difference has dropped from 6.1 to 4.2. It is worth noting that in 2010 and 2012 the tournament playing system was different and the number of games played between the top 8 countries was not the same as in the WFC 2014 and 2016.

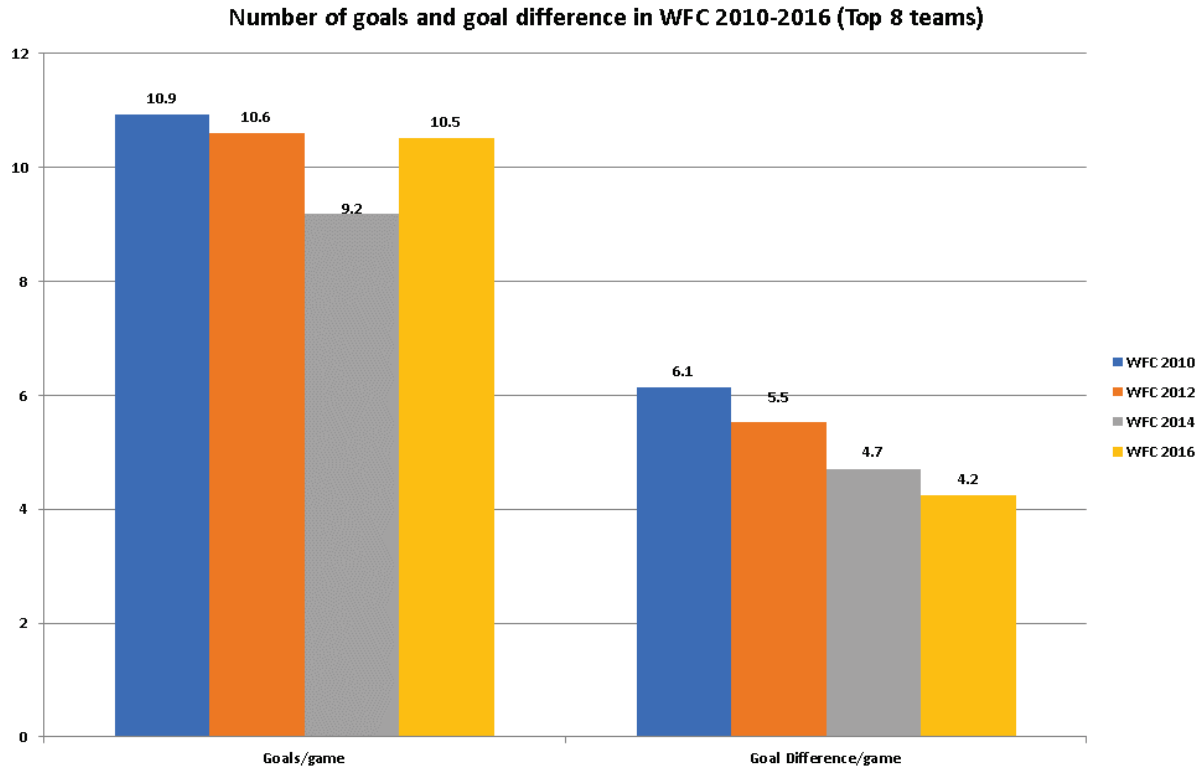

Figure 2. Average number of goals and goal difference in games between the top 8 teams at men's World Floorball Championships 2010-2016.

In WFC 2016, 19 games (40%) ended with a large goal difference of 5 goals or more and the remaining 29 games (60%) ended with a goal difference of 4 goals or less. A total of 22 games were tight with a goal difference of 2 goals or less (46%) (Figure 3). In the game of floorball goals can be scored very quickly, so even a 4 goal difference is not impossible to turn around and equalise or even win, if the flow of the game changes. This is unusual, however, as establishing a three goal lead in the WFC 2016 meant winning the game in 94% of the games.

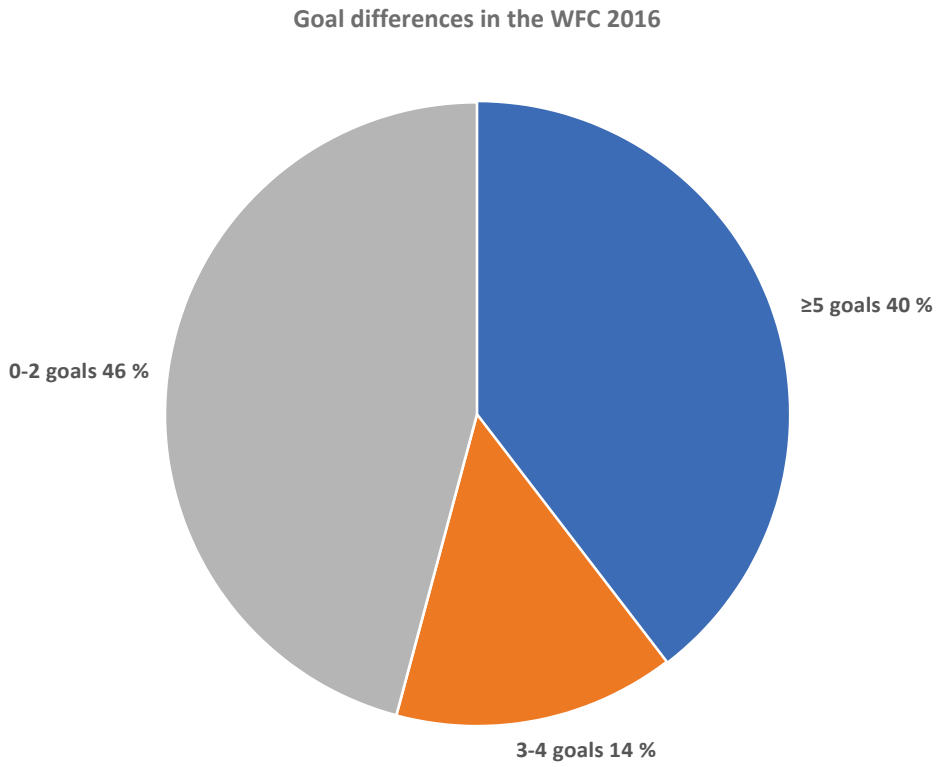

Figure 3. The percentage of large (5 or more), clear (3 or 4 goals) and tight (2, 1 or draw) goal differences in the final game results at WFC 2016.

How many goals lead was safe from the winning point of view?

In the WFC 2016, if a team took a one goal lead in the game, then that team won the game 65% of the time (31 out of 48). Increasing the lead to two goals increased the winning percentage already to 83% (40 out of 48) and increasing the lead to three goals increased the winning percentage to 94% (45 out of 48). There were no games in which a team was able to overcome a 4 or 5 goal deficit to win, although Estonia came very close against Denmark.

Importance of the first goal

The importance of a single goal in floorball is not as big as in, for example, football or ice hockey because there are more goals scored in floorball. However, to make the first goal seems to increase the probability of winning the game significantly. In this tournament, the team scoring the first goal won the game 36 times out of 48 games meaning that the probability of winning the game after scoring first was 75%. The team scoring the first goal of the game ended in a draw 3 times (6%) and lost 9 times (19%). Nevertheless, it must be emphasized that scoring first and then losing happened only once in the group games, but 8 times in the play-off games (including the grand final). In practice, this means that the first goal becomes less important as games gets tighter. (Figure 4.)

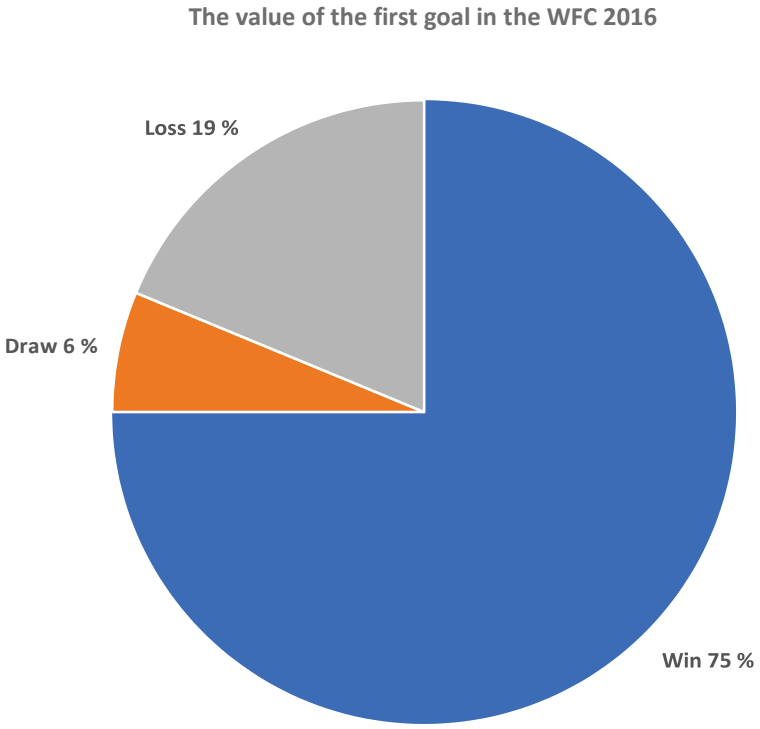

Figure 4. How often the team that scores the first goal wins, draws or loses the game.

Key Performance Indicators (KPIs)

Table 2 presents a summary of the Key Performance Indicators (KPIs) of floorball. Firstly, Shots For and Against by teams showed that the tournament system is functioning well considering that all the teams got a decent amount of shots. There were small variations between the teams in both Shooting Accuracy and Scoring Efficiency. The better teams tended to have better numbers, but the differences were small, with CZE Scoring Efficiency 0.16 being the highest and CAN 0.05 the lowest. It is also worth mentioning that the Scoring Efficiency varies more between individual players than between teams meaning that this variable is more suitable to use when analysing individual players against each other rather than when making comparisons between different teams.

Corsi% can be considered as a rough estimation of ball possession. In general, the best teams had the highest Corsi%, but as can be seen, some teams managed to succeed also quite well with less ball possession. The best example was Denmark, which relied heavily on counter attacks and their final standing in the WFC 2016 was clearly better than could be expected based on their IFF ranking before the tournament.

In this study Expected Goals (xGs) correlated with actual Goals (Gs) by 0.80 ($p<0.001$), which can be considered a strong correlation. Tournament ranking and Shooting Accuracy correlated negatively 0.61, as expected, because the highest ranking is the lowest number, and so did Scoring Efficiency ($r=0.66$). Shooting Accuracy correlated with Goals For only 0.48, but the correlation co-efficient between Scoring Efficiency and actual Goals For was as high as 0.84. Saving percentage and Goals Against were correlating negatively with 0.43. Corsi% correlated with Goal Difference ($r=0.87$) and PDO with Goal Difference ($r=0.64$).

Table 2. Key Performance Indicators (KPIs) of each team.

Team	Shots for	Shots Against	Shot Acc (%)	Sco Eff	Save (%)	xGF	GF	xGA	GA	Corsi (%)	PDO
FIN	353	186	38.5%	0.12	77.8%	46.8	43	19.0	14	65.4%	109.5
SWE	388	239	40.7%	0.11	86.0%	40.8	44	20.0	14	61.9%	114.6
SUI	288	233	42.7%	0.14	74.5%	33.0	40	30.0	27	55.3%	106.6
CZE	267	209	46.0%	0.16	64.8%	32.0	37	22.0	29	56.0%	93.0
DEN	284	382	38.4%	0.12	79.6%	28.0	34	33.3	26	44.4%	106.3
NOR	285	372	36.3%	0.14	72.0%	26.3	27	34.0	41	43.4%	98.8
GER	264	430	41.1%	0.10	72.2%	20.3	26	37.0	55	38.6%	96.6
EST	336	338	37.1%	0.12	65.3%	31.0	40	28.3	47	47.4%	99.5
SVK	300	249	36.3%	0.12	71.1%	30.5	36	17.3	23	54.8%	102.5
LAT	332	281	37.8%	0.09	72.0%	28.0	31	36.8	34	54.0%	95.6
USA	269	270	38.4%	0.10	75.3%	22.5	27	23.0	27	49.7%	101.6
CAN	244	368	36.6%	0.05	74.3%	17.3	13	36.3	41	40.6%	89.1
POL	314	176	37.0%	0.09	63.0%	29.3	29	23.0	21	63.9%	85.7
THA	250	247	35.8%	0.10	77.7%	23.0	24	24.5	20	52.9%	105.9
AUS	198	306	32.3%	0.10	74.9%	21.3	19	34.0	31	38.6%	103.0
SGP	227	313	38.8%	0.08	68.3%	23.5	18	35.8	38	42.0%	89.4
AVG	**287.4**	**287.4**	**38.4%**	**0.11**	**73.0%**	**28.4**	**30.5**	**28.4**	**30.5**	**50.0%**	**100.0**

3.3 Scorer

Goals scored by playing positions

The best scorers at this tournament were playing as left forwards (32.6%) followed by right forwards (30.1%) and centres (23.2%). Left and right defenders were equally responsible for scoring with a total of 70 goals (14.2%). These distributions were almost the same as reported by Bykov (2015) for the WFC 2012. (Figure 5.)

Grip of the scorer

In WFC 2016, 59% of the goals were scored by players with a left grip (left hand below), while the rest (41%) were scored by players with a right grip (right hand below). This distribution was almost the same as the distribution of players playing with a left or right grip according to the IFF website's team introductions. The ideal situation from the coaches' point of view would be that the players on the right side of the rink are left gripped and those on the left side of the rink are right gripped. However, that is not always the case. European teams tend to have a majority of left gripped players whereas in some other teams (e.g. Australia and Singapore) the majority of the players are right gripped. The latter may be due to players' backgrounds in other sports such as field hockey. Especially in these cases, the players' grip does not always correlate with their handedness. It is generally considered that around 90% of the world population is right handed and should therefore for biological reasons (brain lateralisation) play with a left grip (left hand below). Nevertheless, the most important thing is to have players on both sides of the rink that are able to shoot and pass instantly with one touch.

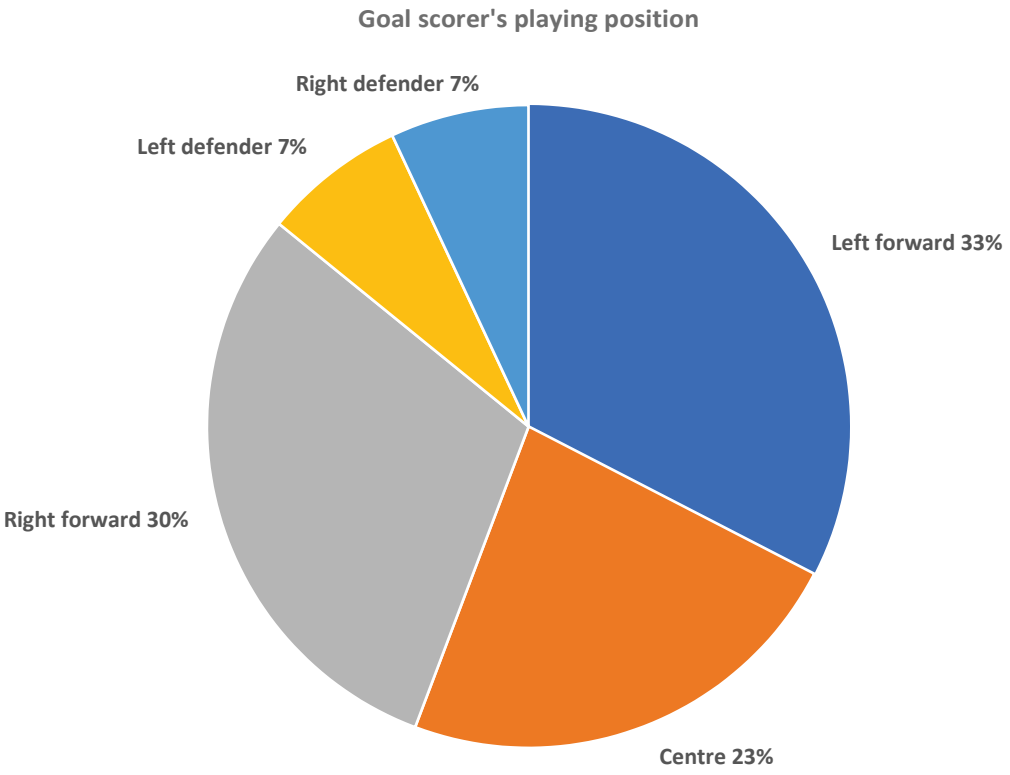

Figure 5. Percentages of goals scored by each playing position.

Goals scored by lines

The listed 1st lines of teams scored the most goals with 212 goals out of 488 (43.4%). Players from the 2nd lines scored 31.6% (154 goals), while the 3rd lines of teams scored 22.7% (111 goals) and the remaining 2.3% (11 goals) were scored by players listed on the 4th line. Coaches usually nominate their most effective line as the first line. Therefore the 1st line tends to get more playing time and more power play situations. It is also quite common that some teams play parts of, or even whole games, using only their 1st and 2nd lines. The logical consequence of this uneven distribution of playing time is that the 1st line makes the most goals and the 3rd line the least goals.

The line effectiveness of different teams by the number of goals is presented in Figure 6. The figure reveals that the teams employed different line tactics. The most effective line in the tournament was Estonia's 1st line followed closely by the Finland's 1st line featuring the tournament's top scorer Peter Kotilainen. Sweden's lines appear to have been set up and played much more evenly, all with high effectiveness. Thailand's 1st line, with players having Swedish and Finnish background, was the third most effective line in the tournament and featured two of the tournament's top 5 point scorers. Latvia's higher distribution of goals for the 3rd line could be indicative of their 1st and 2nd lines mostly being matched up against very strong 1st and 2nd lines of higher ranked teams in most of their games.

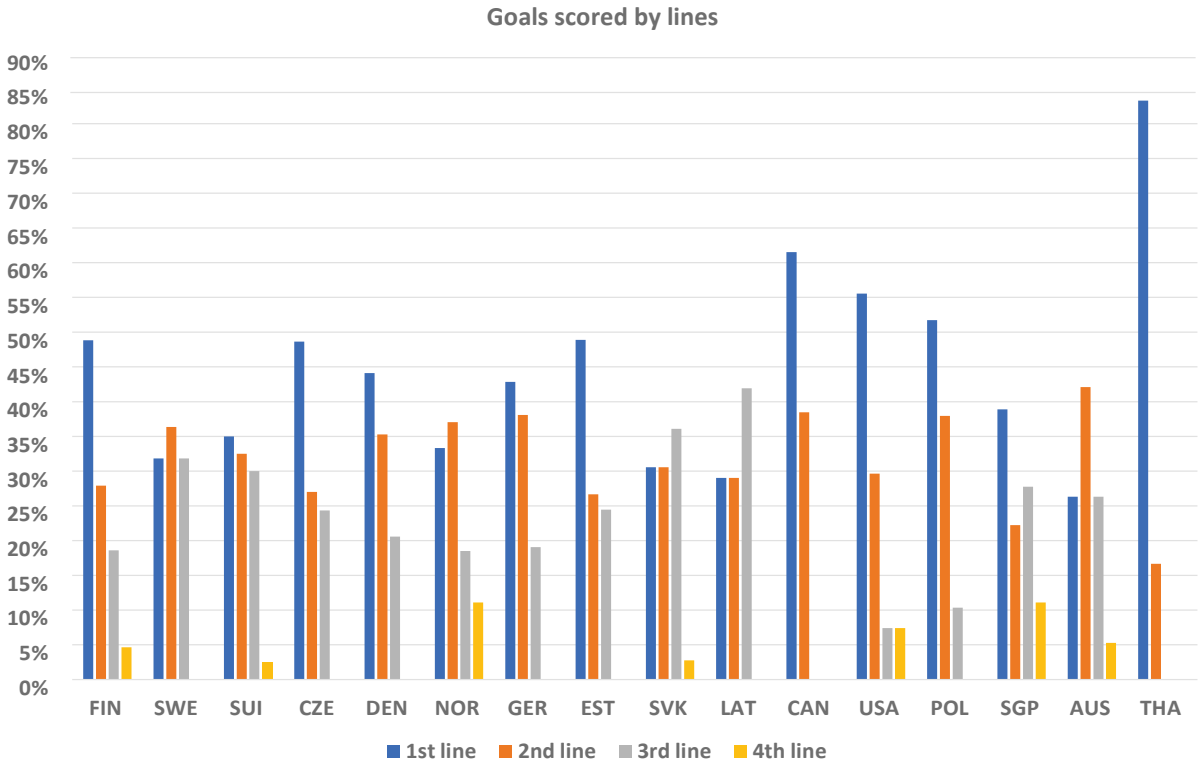

Figure 6. Percentages of goals scored by the different lines of each team.

The game-deciding goals were scored by the teams' 1st lines 21 out of 48 times (44%). The 2nd line made those crucial goals 16 times (33%), which leaves for 3rd line only 10 game deciding goals (21%). This distribution is almost the same as for all the goals.

3.4 Shots that lead to a goal

Shooting technique

The various techniques used for shots were categorized into 9 different types. The most common scoring shot was the drag shot with 113 goals or 23% of the goals scored with this technique. This is a particularly useful shot from the longer scoring distances at full speed because the player can hide the start of the shot from the goalkeeper. 16% of all the scoring shots were fast wrist shots/snap shots. 15% of goals were made by sweeper shots. For sweepers one needs some space and time, but it is a very efficient, usually one touch shot. 12% of goals were scored using pure wrist shots. 9% of all goals were scored from slap shots, and, being powerful, it has a higher distribution for defenders from longer range. 6% of goals were made on the backhand and almost the same from the air by volley (7%). Although the rules of floorball state that a player is allowed to play the ball with the stick only below the knee level, low passes made just off the ground over the defender's stick and shots with a volley are very difficult to stop if executed well. Overall, the volley skills in floorball are essential and should not be ignored during the training process. 5% of goals were made by feints or dribbles against the goalkeeper, especially by centres (including penalty shots), and 7% by deflections/steerings. The technique of shooting used that led to goals according to the playing positions and side of the field is shown in the Table 3.

Table 3. Number of goals scored using different shooting techniques according to playing positions.

	Left forward	Centre	Right Forward	Left defender	Right defender	ALL
Drag shot	25.8%	19.5%	18.4%	34.3%	32.4%	23.2%
Snap shot	16.4%	23.9%	11.6%	11.4%	14.7%	16.2%
Sweeper	20.8%	8.8%	15.6%	8.6%	5.9%	14.5%
Wrist shot	10.7%	12.4%	14.3%	11.4%	8.8%	12.1%
Slap shot	5.7%	4.4%	11.6%	8.6%	23.5%	8.6%
Deflection	8.2%	8.0%	9.5%	0.0%	2.9%	7.6%
Volley	6.9%	5.3%	8.8%	8.6%	2.9%	7.0%
Backhand	4.4%	5.3%	5.4%	14.3%	2.9%	5.5%
Feint/Dribble	1.3%	12.4%	4.8%	2.9%	5.9%	5.3%
TOTAL (n)	**159**	**113**	**147**	**35**	**34**	**488**

Shooting position and distance

Altogether 64% of all the tournaments' goals were scored from the best scoring area, which was defined as the "triangle" shaped area from goal line to about 8 meters away (Figure 7). The average distance from goals where the goals were scored was about 5.7 metres. As shown in Figure 8, different types of shots were more effective than others from different distances, with slap shots having the greatest scoring distance and deflections, feints and dribbles having the smallest scoring distance.

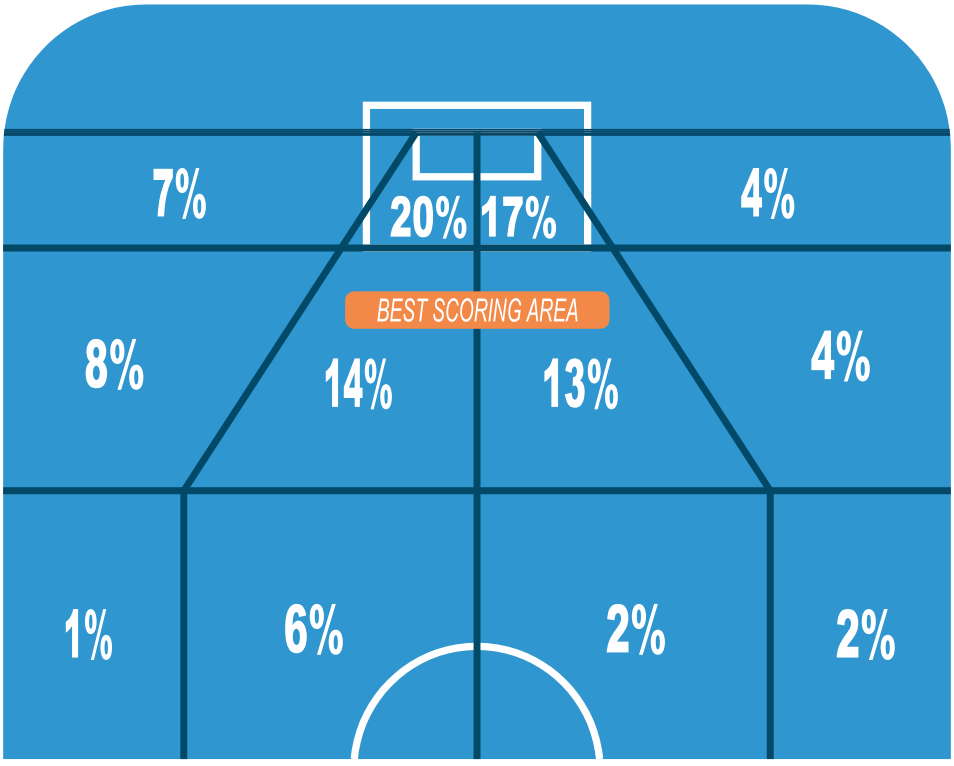

Figure 7. Goals from different shooting areas (%). The best scoring area is the "triangle" shape in front of goals (that includes 20%+17%+14%+13%=64%).

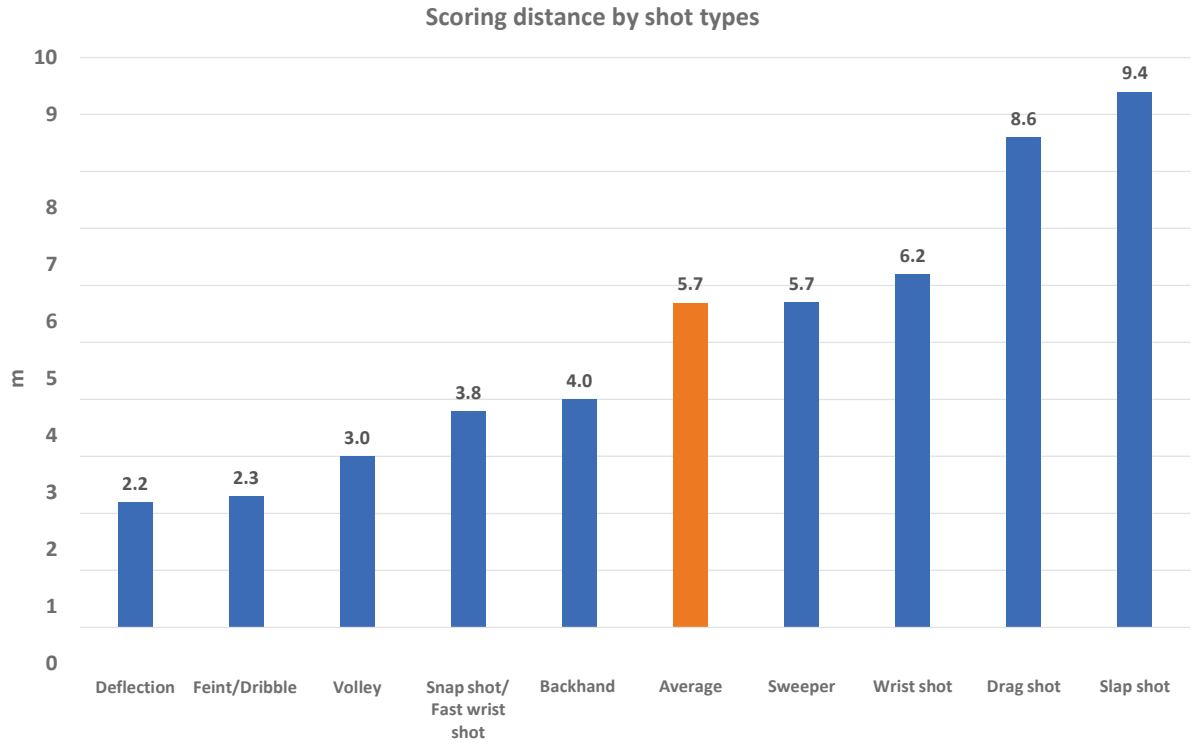

Figure 8. The average scoring distance (m) for different shot types.

The average scoring distance for each team at WFC 2016 is presented in Figure 9. In floorball, there are big differences in shooting skills between players. Top players can score goals from longer distances and narrow angles. This, however, was hardly noticed in the scoring distance statistics where top and bottom teams made their goals almost from the same distance. Average distance statistics revealed that Slovakia made their goals from the longest range (7.4 m) and Singapore from the closest (4.5 m).

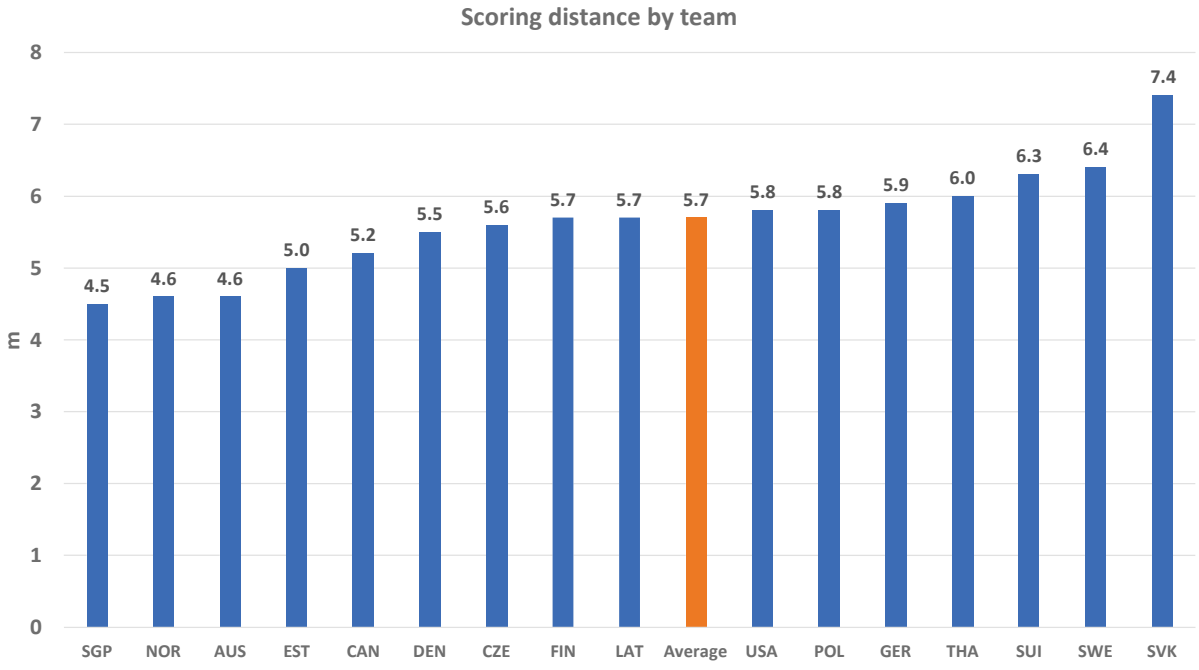

Figure 9. The average scoring distance (m) for each team.

Direction of the shot

In this analysis the goal was divided into 9 different zones (left, centre, right; and top, middle, bottom). 42% of the goals in the WFC 2016 were scored to the bottom third of the goals, 26% to the top third and 32% in the middle. On the other hand, 41% of the goals were scored to the left side of the goal, 36% to the right side and 22% in the centre. (Figure 10.)

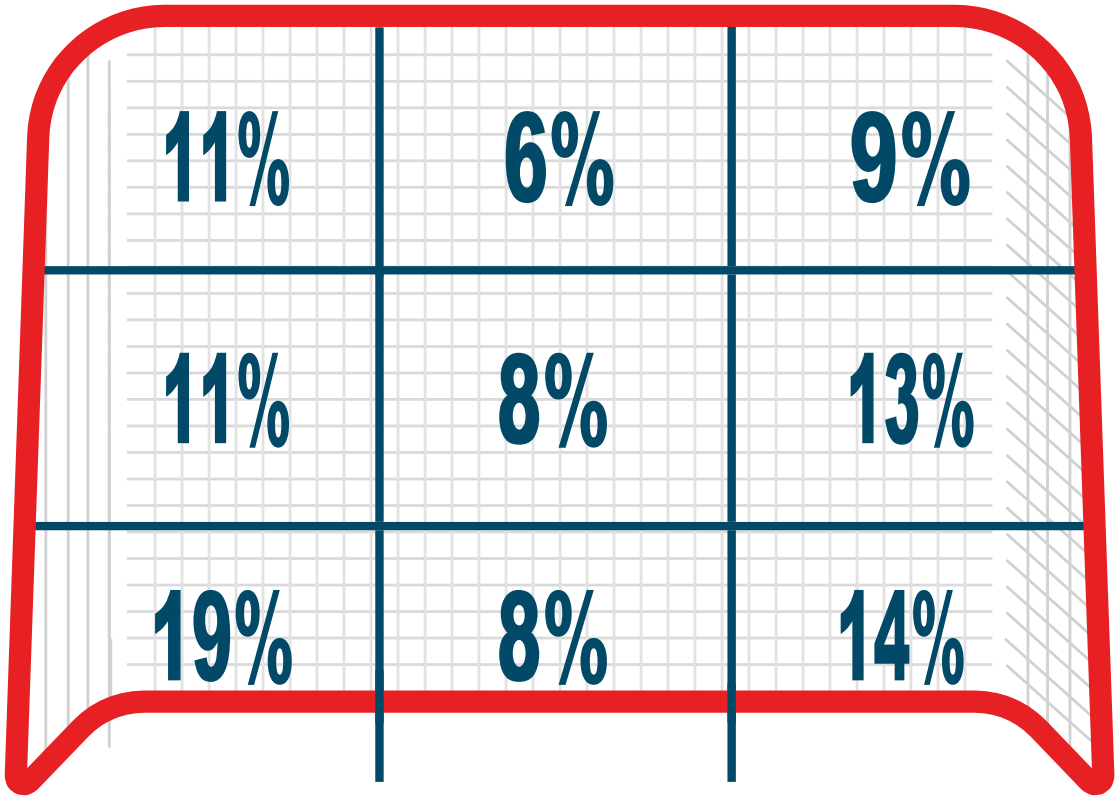

Figure 10. Percentage of goals scored in each zone of the goals.

Goalkeepers in floorball must have good reactions, the ability to move both laterally and forwards towards the ball in order to cover as large an area as possible, and good anticipation of the game. From the goalkeeper's point of view cross-passes or lateral ball movement just before the shot makes saves much more difficult. Based on the present analysis, it is recommended that the goalies emphasize their training slightly more to those techniques which are aimed for saving the shot directed to the bottom height of the goal.

3.5 Timing of the goals

Goals by periods

Almost all goals were scored during normal game time (482/488), with only six goals scored during either extra time or awarded following penalty shots. Of the goals scored in normal time, 153 goals were scored in the first period (31.3%), 150 in the second period (30.7%) and 179 in the third period (36.7%) of games. 6 goals (1.2%) were scored in the 6 play-off games that went into extra time (ET, 3 goals) or penalty shootout (PS, 3 goals). The grand final was one of those three games in which the game was resolved by penalty shots. (Figure 11.)

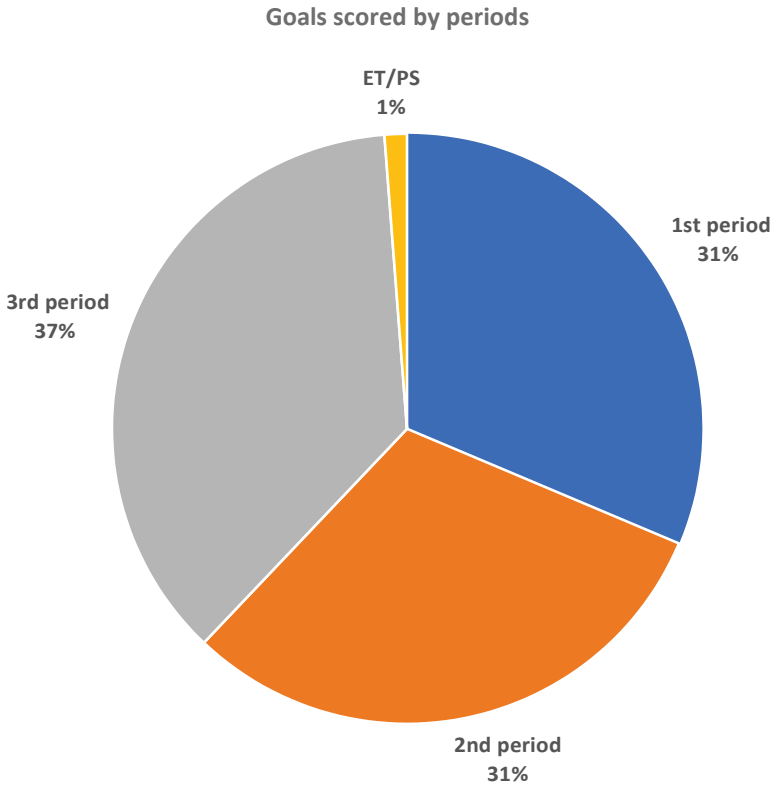

Figure 11. Percentage of goals scored by game periods.

Goals by time zones

When the goal scoring is divided into 5 minute blocks of time, it can be seen that the number of goals was lowest in the first 5 minutes of games and in the middle of the second period of games in the WFC 2016. The most productive 5-minute periods were at the end of second period (52 goals) and end of the third period (64 goals) in the games. The end of the second period seemed to be the first moment to decide the game, as this happened in 28 games (meaning that the decisive goal was made or the goal difference was extended to more than 3 goals), which is quite a high percentage (58%) of all the games. (Figure 12.) It is widely acknowledged that at the start of the game it often takes some time before the teams warm into the game, take risks and accumulate enough shots and scoring chances for a goal. This was also confirmed by the results of this analysis.

There were many games in the WFC 2016 in which the excitement lasted until the very end of the game. This was observed by the greatest number of goals being scored in the last 5 minutes of games, including a large number of the decisive goals. This is the stage of the game where teams are looking to shoot and score more and employ more risky tactics such as playing with 6 field players and without a goalkeeper. In fact, in the final 5 minutes, 12 goals were scored either with a 6v5 situation without a goalkeeper (4 goals) or 5v6 into an empty net (8 goals), which strengthens the fact that teams tried to get back into games by employing tactics with high risks. On the other hand, often the result of the game was already clear and both teams' players' motivation to focus on defense was significantly lowered. At the same time the strikers were still "hungry" to score more – either to enlarge the goal difference or to get a "consolation" goal for their team. These factors, among others such as players' fatigue, explain the high rate of goals in the closing stages of the games.

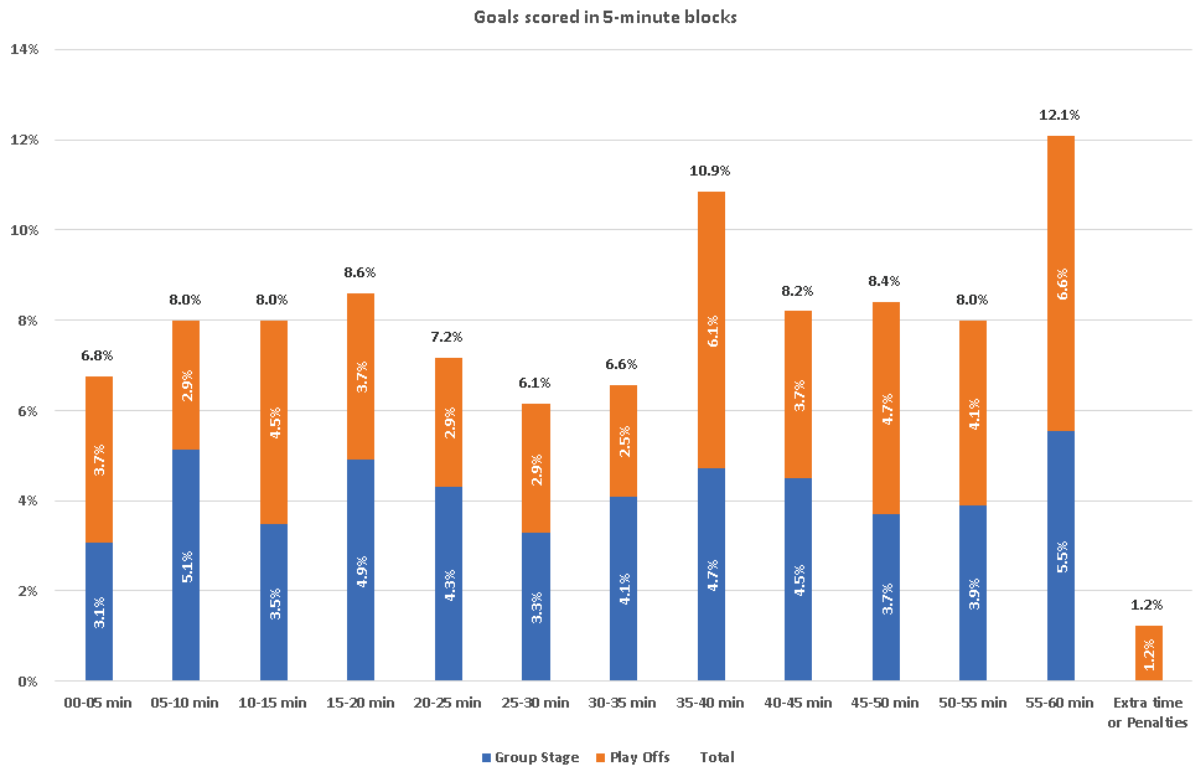

Figure 12. Goals scored in 5-minute blocks in all WFC 2016 games (group games and play-off games).

3.6 Assists

Number of assisted goals

In WFC 2016, 88.3% of all the goals were assisted (note that only one assist is recorded in floorball). If the 12 unassisted goals awarded in the penalty shots are excluded, then there were just 45 unassisted goals (9.5%) in the whole tournament. The best assisters were playing as the centre for teams' 1st lines and they were most often playing with a left grip. The centre has the chance, while playing in the middle of the field, to pass in all directions. If a centre has a good game understanding and enough technical skills to perform these actions in high speed, the playing position gives these players a chance to control the game and make dangerous passes.

Length of the passes that assisted goals

The passes assisting goals were on average 8.3 metres long in the WFC 2016. Passes less than 3 metres preceded 27 goals (6%), 3-5 metres 70 goals (16%), 5-7 metres 107 goals (24%), 8-10 metres 106 goals (24%) and over 10 metres 128 goals (29%). The importance of medium and long passes is apparent from these numbers, likely because these passes catch the defense and goalkeeper out of position. The average passing assist distance for each team at WFC 2016 is presented in Figure 13.

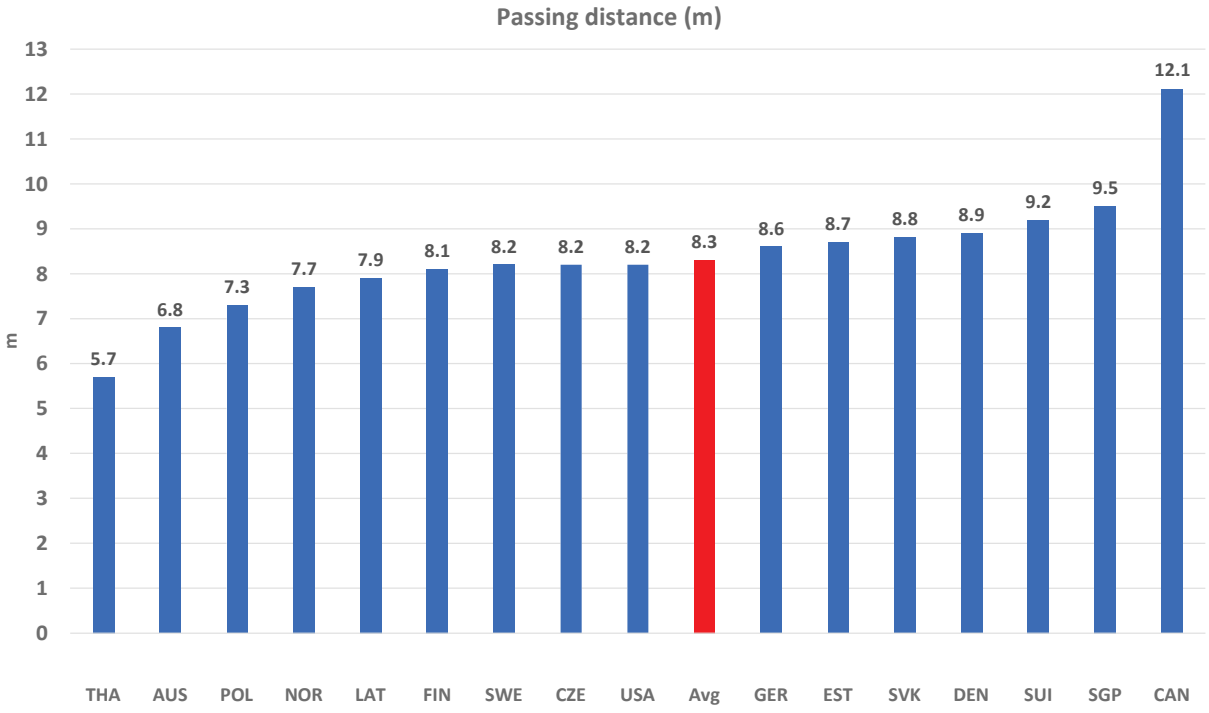

Figure 13. The average passing distance (m) for assists for each team.

3.7 Offenses that lead to a goal

Offense types

The types of offense were divided into counter attacks, fast attacks, organised attacks, turnovers, free hits, hit-ins, power play, shorthanded play, play without the goalkeeper and penalty shots. In this analysis, counter attacks and fast attacks were categorized as fast attacks with the difference whether or not there was a man advantage. In counter attacks there was man advantage for the attacking team (1 v 0, 2 v 1 or 3 v 2). Turnovers were categorized as situations where after the ball possession was won, the team headed straight towards the opponent's goal by dribbling or passing and shooting immediately (blizzard attacking).

As shown in Table 4, organised attacks were the most common way to score (29%). Fast attacks from the defensive half against a structured/set opposition defense (16%) and counter attacks (13%) also accounted for a large proportion of goals. The importance of creating goal scoring opportunities with the numerical advantage during power plays was highlighted by the 15% of goals scored in this way. Ball possession won from turnovers, usually against fewer players in an unstructured defense, were responsible for 16% of goals. Free hits and hit-ins (set plays), especially from the offensive zone, were behind 9% of goals. Penalty shots, goals scored short-handed and goals scored with an extra field player or into an empty net accounted for the remaining 4% of goals.

In floorball, two goals difference can still be considered a tight game. In WFC 2016, 56% of goals were scored in this kind of tight situation (Table 4). Was the game somehow different in terms of statistics when the game was tight compared to when the goal difference was more than 3 goals? The answer is definitely yes, and the difference came from the fact that when the goal difference increased, the trailing team concentrated more on attacks and therefore opened up its game and logically took more risks to score and so also the other team got more chances to score counter attacks and on turnovers.

Table 4. Offense types leading to goals compared to the tightness of the game in WFC 2016.

	0-2 goals	3-4 goals	≥ 5 goals	ALL
Organized attack	29.4%	23.6%	30.9%	28.5%
Fast attack	16.5%	16.0%	14.5%	16.0%
Turnaround	14.7%	15.1%	18.2%	15.6%
Power play	14.3%	11.3%	18.2%	14.5%
Counter attack	9.9%	22.6%	10.9%	12.9%
Free hit	8.5%	5.7%	3.6%	6.8%
Penalty shot	1.8%	1.9%	1.8%	1.8%
Hit-in	2.2%	1.9%	0.9%	1.8%
Short-handed	1.5%	1.9%	0.9%	1.4%
Without goalie	1.1%	0.0%	0.0%	0.6%
Total (n)	**272**	**106**	**110**	**488**

Area where the scoring team got the ball possession

In this analysis the floorball rink was divided into 9 zones (Figure 14) in order to examine where the attacks leading to goals originated. The highest percentage of goals (36%) were made when getting the ball possession in the offensive zone (OFFZONE). Out of those 174 goals which started from the OFFZONE, 84 (48%) were scored in 3 seconds or less after obtaining possession of the ball. This underlines the importance for both teams to react instantly to quick turnovers as they very often lead to goal scoring in floorball. The proportion of goal scoring attacks starting from the defensive zone (DEFZONE) and neutral zone (NEU-ZONE) were equal, both 32%. Overall, the left, centre and right sides of the field were fairly much equal for originating goals. (Figure 14.)

It was also analysed what action led to the turnover, changed ball control or receiving the ball possession prior to goals. The analysis revealed that free hits and hit-ins, especially in the offensive zone provide good scoring opportunities as well as opponent's errors in maintaining possession (first touch, ball protection etc.). Pressure and steals in the offensive zone also resulted in many goals. Interceptions (cover) and duels prior to goals were less frequent in the offensive zone but more so in the neutral and defensive zones. Blocked shots were the most common cause of turnover leading to goals from the defensive zone. Winning the loose ball was of particular importance in the defensive zone. It is worth noting also that winning face-offs did matter when it came to goal scoring, with 3% of the ball possessions leading to goals coming from this action. (Table 5.)

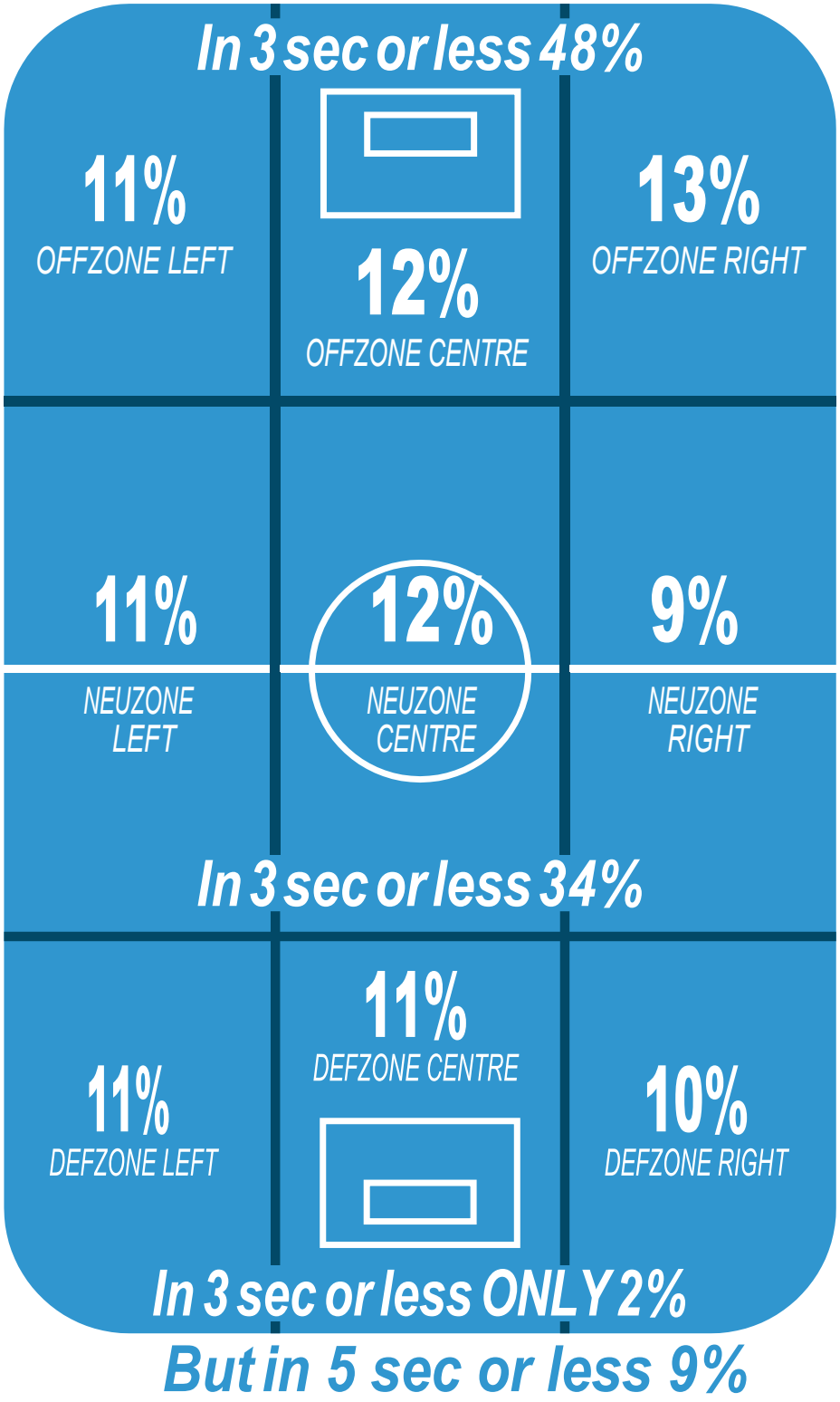

Figure 14. Where the ball possession was won (%) and how many of those goals were scored in 3 seconds or less from that zone (%).

Table 5: How ball possession was won prior to goals according to the zone of the rink.

	OFFZONE	NEUZONE	DEFZONE	ALL
Free hit/Hit-in	25%	10%	19%	18%
Possession	17%	18%	10%	15%
Interception	5%	23%	17%	14%
Duel	7%	14%	11%	10%
Block	4%	1%	20%	8%
Pressure	14%	4%	6%	8%
Steal	10%	11%	3%	8%
First to the ball	2%	5%	9%	5%
Short pass	7%	5%	3%	5%
Face-off	2%	5%	1%	3%
Penalty	5%	1%	0%	2%
Foul	1%	0%	1%	1%
Marking	0%	3%	1%	1%
Missed shot	1%	0%	1%	1%
ALL	100%	100%	100%	100%

Duration of the ball possession before scoring

Goals were scored within just 3 seconds of gaining the initial ball possession in 147 goals (32%). In fact, almost half (49%) of all the goals were scored in less than 6 seconds of a possession starting. These results emphasize how quick the game of floorball is and how quickly goals can be scored. On the other hand, 35% of goals were scored more than 10 seconds after obtaining the ball possession, while it was quite rare to score a goal after more than 30 seconds of ball possession (8%), and this mostly occurred during power play. The distributions of time taken to score goals after obtaining ball possession varied for the different teams as seen in the picture below, which may be indicative of their playing styles as well as their different oppositions. (Figure 15.)

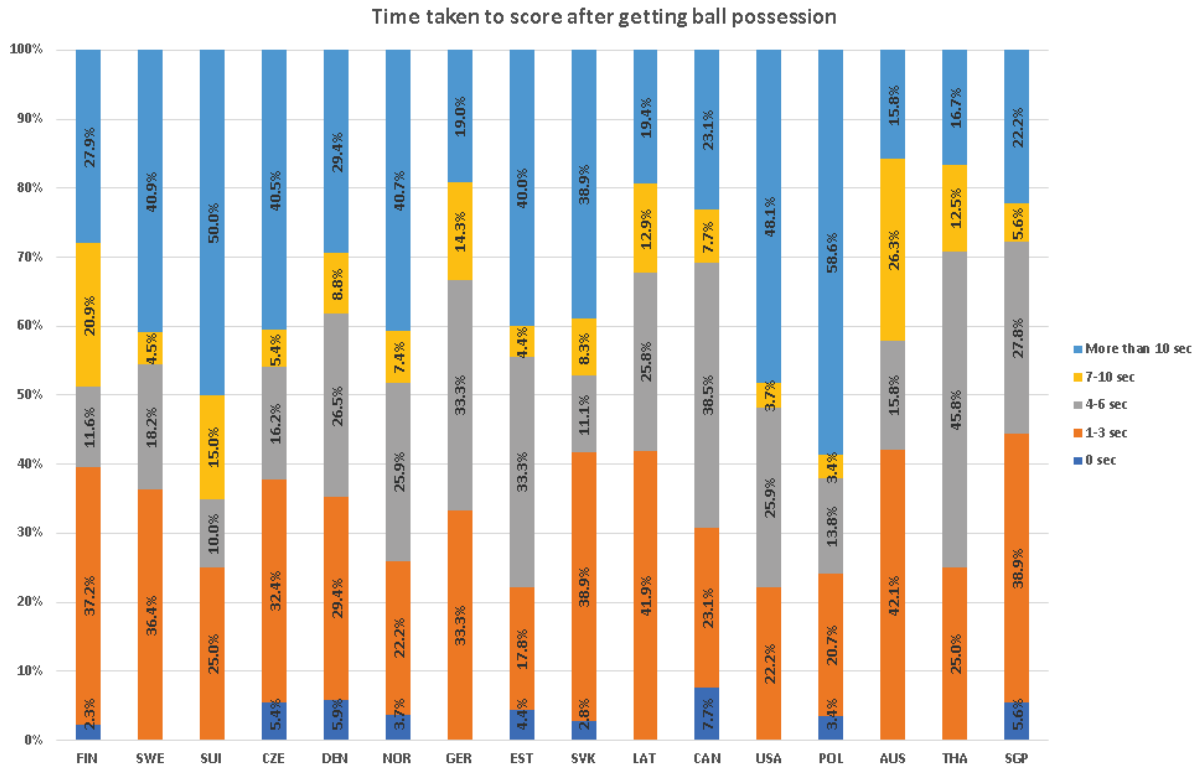

Figure 15. Time taken to score after getting ball possession for different teams (%). 0 sec = penalty shot.

The number of passes before scoring

It was found that 23% of goals were scored with only one pass and about 10% without a pass. This underlines those quick turnover situations and fast counter attacks. Just 2 passes were made prior to 16% of goals. So, the total percentage of goals made after no more than 2 passes was almost half (49%). The numbers start to drop steadily from then on. More than three quarters of all goals were scored after 6 or fewer passes. This correlates well with the amount of time of the scoring ball possessions and numbers of players involved (Figure 16).

On the other side, about one in every ten goals was scored after 10 or more passes. Most of these long passing combinations were made during power play. The highest number of passes in a single possession (sequence) in the WFC 2016 tournament before scoring the goal was Switzerland's 35 passes in a power play goal and Czech's 28 passes in normal 5 vs 5 game play.

The connection between zones and number of passes could be noticed very easily: the less passes, the nearer the team was to the opponent's goal. On average only 2.7 passes were made after the ball was won before a goal was scored in the Offensive Zone, 3.4 passes before a goal for balls won in the Neutral Zone and on average 5.6 passes in possessions (sequences) that were started in the Defensive Zone and led to a goal. The interesting detail was that, when it comes to goal scoring, with three passes (or less), still the ball possession can be won and the attack initiated from anywhere on the rink. From the altogether 228 goals that were made with three or less passes in normal game situations, ball possession was won in the Offensive Zone 37%, 38% in the Neutral Zone and 25% in the Defensive Zone.

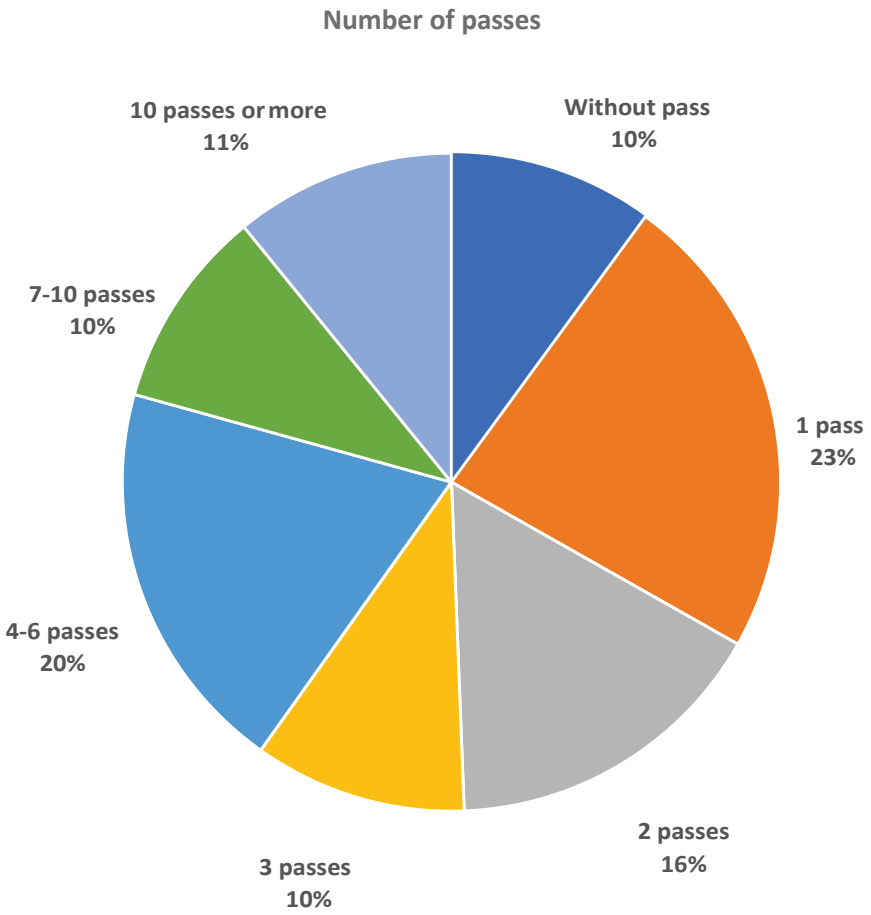

Figure 16. How many passes were made before the goal (%).

The number of players involved in the attack before scoring

Floorball is a team, or more precisely, a line effort even when there is only one player with ball possession or scoring. The decisions and actions of the player with the ball are affected by both the locations of their line mates and the locations of the opposition players on the court.

Only 9.6% of all the goals were scored unassisted, and still in those cases the roles of other players play an important part. Over one quarter of the goals were scored with the combination of just 2 players (27.0%) and that was the most common number of players involved in goal scoring in this tournament. Not far behind was the situation where a goal was scored with 3 players directly involved (25.6%) in passing and shooting.

Figure 17 presents the number of players directly involved in playing the ball before the goal was scored. In the exceptional cases of 6, 7 and even 9 players involved, there was such a long ball possession period (sequence), that the team with the ball has managed to make substitutions during the possession.

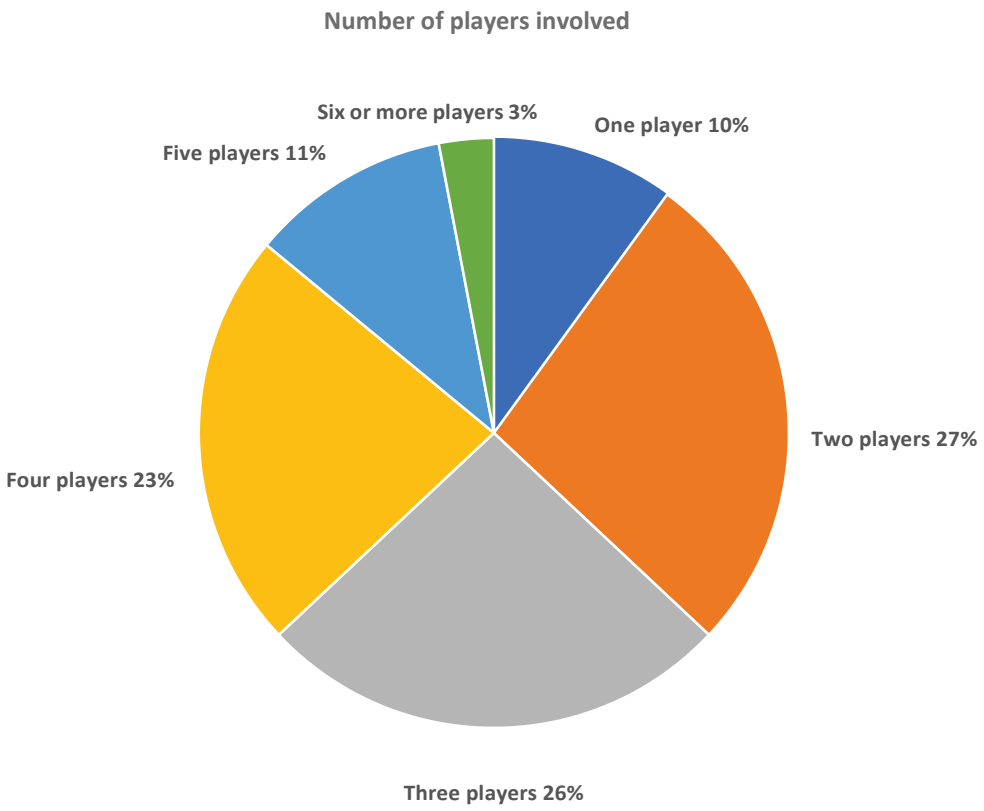

Figure 17. Number of players involved in play before the goal was scored (%).

Different ways of creating scoring chances and shots

The goals were categorized into 13 different situations or ways of creating a shot/scoring chance (Table 6). The most common way to score was with a shot directly following a cross-pass (23.0 %). Steering or deflecting the ball in from a pass into the area close to goals was next (16.2%). Commonly in organized attacks a pass from behind the goal area can occur and this resulted in 14.3% of goals. Fairly dangerous also was a shot following lateral movement with the ball (10.0%) and rebounds (8.6%). In a breakaway, the player is all alone against the opponent's goalkeeper and 8.4% of goals were scored in these situations. Moderately common in floorball is running with the ball directly towards goal, which was categorised as a shot rushing/running towards the goal. This was responsible for 8.2% of goals. An ordinary shot was just a shot, before it there was no running, dribbling or other movements. 3.7% of goals were scored in this way. Sometimes a player shot after breaking in towards goals from the side or the corner (3.1%). Then there were some special cases such as penalty shots, Zorro and old-timers from behind the goals, as well as the very unfortunate own goals which together were responsible for the remaining 4.5 % of goals in the WFC 2016 (Table 6).

Table 6. Goals scored depending on the ways of creating the shot or scoring chance in tight (draw, one or two goal difference situations), in clear (3 or 4 goals difference) or in large (games where the goal difference is 5 or more) (%).

	0-2 goals	3-4 goals	≥ 5 goals	Total
Shot from cross-pass	23%	24%	22%	23%
Steered/deflected shot in front of goal	15%	13%	22%	16%
Shot from a pass from behind the goal	14%	12%	17%	14%
Shot following lateral movement	13%	7%	5%	10%
Rebound	8%	11%	9%	9%
Shot rushing/running towards the goal	8%	10%	7%	8%
Breakaway	7%	13%	9%	8%
Ordinary shot	4%	6%	2%	4%
Shot breaking in from the side/corner	4%	3%	2%	3%
Penalty shot	2%	4%	3%	3%
Zorro/oldtimer from behind the goal	2%	0.0%	1%	1%
Own goal	0.4%	0.0%	0.9%	0.4%
Screened shot	0.4%	0.0%	0.0%	0.2%
Total (n)	**272**	**106**	**110**	**488**

It is worth noting that when the goal difference was 3 or 4 goals, the number of breakaways increased and when the difference was 5 or more, steered goals in front of goals were as common as shots from cross-pass. Also, when the difference was 5 or more goals shots from a pass from behind goals became more common. The former might be because of the opponent taking more risks to get back into the game and the latter implies that better teams got near the goals and maintained possession in offense more easily.

3.8 Defensive actions influencing goal scoring

How many goals could have been avoided by better defensive actions?

On a philosophic level one could say that all goals could be avoided by better defensive actions, but according to the present analysis 88% of the goals could have been avoided, in one way or another. 57% of all the goals scored at WFC 2016 were due to crucial mistakes or errors made by the defensive team/player. Quite often there occurs a sort of chain of unsuccessful actions. So, one could say, that the level of the defending matters substantially. In this analysis only 12% of all the goals were scored without defensive error at all or with just a very small mistake. However, this variable needs to be interpreted with caution as it is subjective in nature and depends more on the opinion of the analyst. (Table 7.)

The most common mistake was missing the opportunity to block the shot (defender and/or goalkeeper), which happened in 26% of goals. After that better marking/screening of the opponent could have prevented 20% of the goals, whilst increased defensive pressure might have prevented a further 10% of the goals. The remainder of the mistakes mostly fall into failed actions to get or maintain ball possession such as clearing the ball, intercepting/covering the ball, lost duels, not being first to the ball, a bad first touch or ball protection, fouls/hits/penalties, and also failed passes resulting in a turnover (intercepted passes).

Table 7. Defensive errors which led to a goal and the perceived level of the error.

	Major	Moderate	Minor	All
Block	20%	31%	39%	26%
Marking	15%	34%	14%	20%
Failed short pass	15%	4%	11%	11%
Pressure	13%	6%	9%	10%
Protection	11%	2%	7%	8%
Duel	8%	6%	7%	7%
First touch	5%	2%	0%	4%
Interception	0%	7%	9%	3%
Possession	5%	1%	2%	3%
Clearing the ball	3%	1%	0%	2%
First to the ball	1%	1%	0%	1%
Failed long pass	2%	1%	0%	1%
Penalty	1%	0%	2%	1%
Foul	0%	1%	0%	0%
Hit	0%	1%	0%	0%
Shot into a block	0%	1%	0%	0%
Total (n)	**280**	**151**	**44**	**475**

Level of pressure

42% of all the goals at the WFC 2016 tournament were made without an opponent pressuring the scorer. Without pressure means that there was not an opponent within about 2 metres of the player scoring. When only small (and usually a bit late) pressure was applied another 42% of goals were scored. Small pressure means that there was one opponent within one metre's distance. A total of 15% of goals were still scored when moderate pressure was applied by only one defensive player (14%) or high pressure was placed on the scorer by two or more defensive players (1%). (Figure 18.)

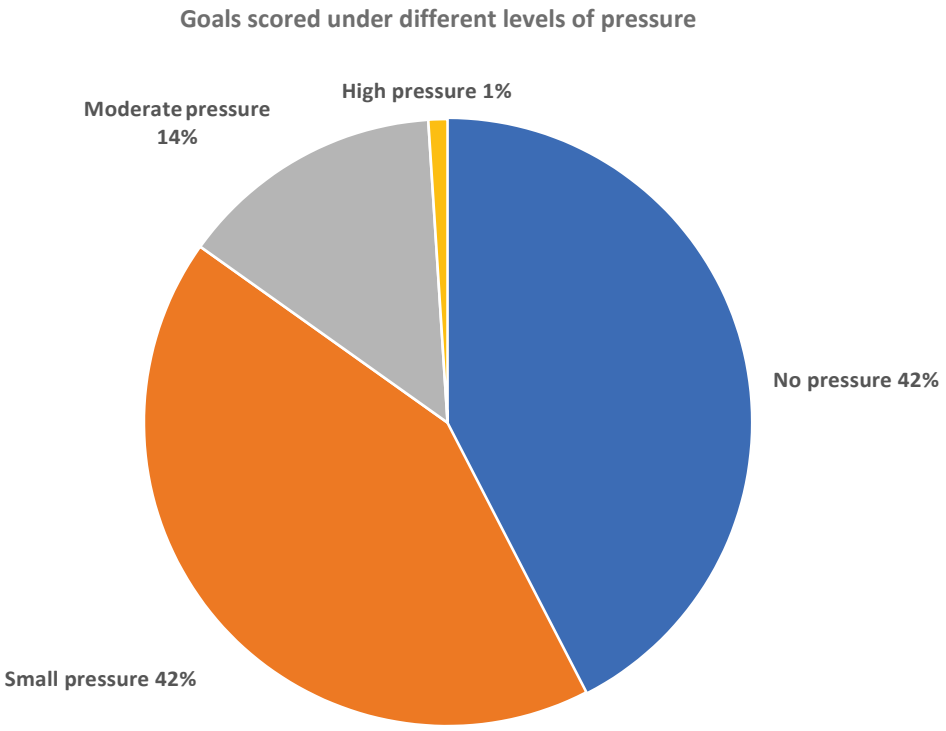

Figure 18. The percentage of goals scored under different levels of pressure (%). (No pressure = closest defender around 2m or more away; Small pressure = closest defender around 1m; Moderate pressure = one player close; High pressure = two or more players close)

The number of defenders versus the number of attackers when the goal is scored

The number of the goal scoring team's players participating in the attack versus the number of defensive players is a variable that describes the balance between attacking and defending teams at the moment when the goals were scored. Most goals were scored in even number situations or with one less player involved for the offensive team. (Figure 19.)

The number of defensive players (including the goalkeeper) under the ball at the moment of the goal scoring was also analysed (Figure 20). The most common situation was that the whole line and the goalkeeper were under the ball (24%), with decreasing numbers as the number of defenders under the ball got lower. The conclusion is quite clear. It is more important what the players are actually doing in defense rather than the number of them there.

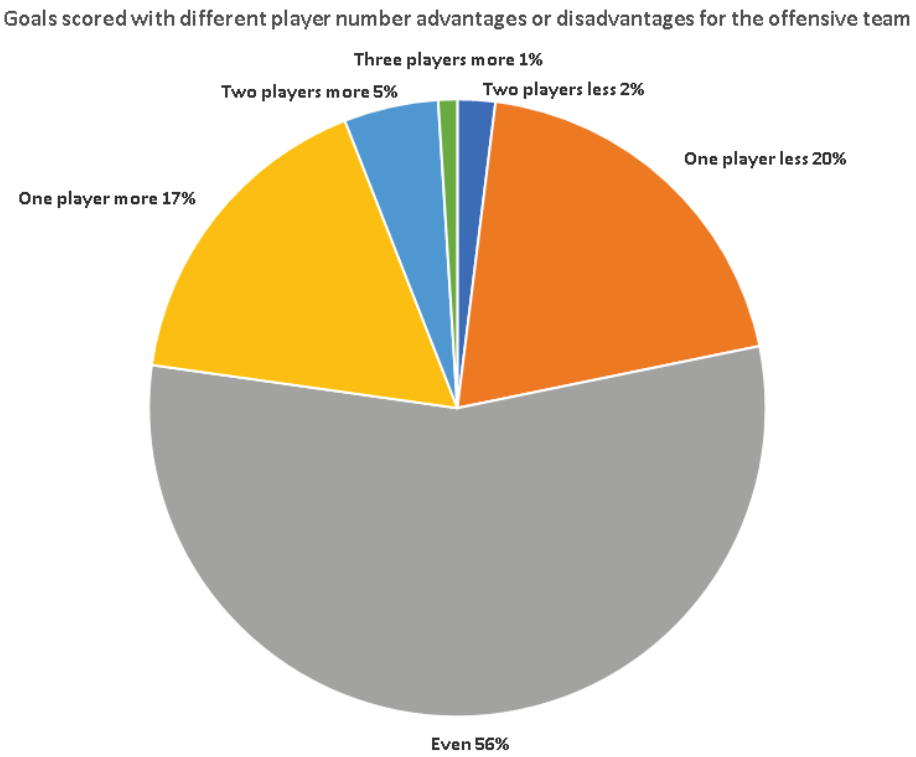

Figure 19: The percentage of goals scored with different player number advantages or disadvantages for the offensive team (penalty shots, power plays, shorthanded and without the goalie situations excluded). (Less = more defenders than attackers "under the ball" when the goal is scored; More = more attackers than defenders)

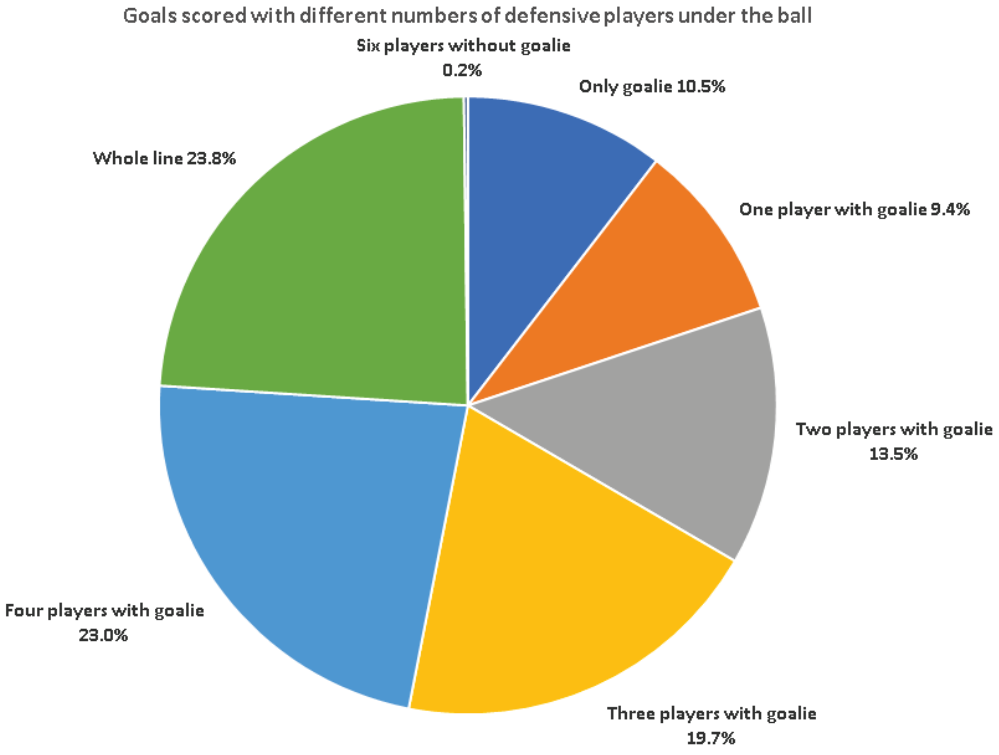

Figure 20. Number of goals scored with different numbers of defensive players under the ball in goal scoring situations.

4 CONCLUSIONS

In the whole tournament, there were 488 goals scored from 4599 shots. It took approximately 3.7 shots on goal to score a goal (27% of shots on goal scored) and on average teams were shooting 9.4 times (including blocked and missed shots) to get one goal. So, the shooting accuracy in this tournament was on average 38.7% and the scoring efficiency was 10.6%. Keeping in mind the different playing system between the tournaments, these numbers are very similar to those found by Bykov for the 2012 men's WFC.

The most "common" goals were scored as follows:

- the situation in the game was tight.
- the most goals were scored in the last 5 minutes of the 2nd and 3rd periods.
- the goal scorer was a player from the team's 1st line.
- the goal scorer was a left forward playing with a right grip.
- the shooting technique was a drag shot.
- there was a cross-pass from the attacking zone.
- the shot was to the lower left of the net.
- most often the goal was assisted by the centre from the 1st line playing with a left grip.
- usually there were 2 or 3 players directly involved in the ball possession prior to the goal.
- almost all the goals were preceded by some defensive error.
- the ball possession prior to scoring was won most often in the attacking zone.
- the time taken to score a goal after winning the ball possession was 1-3 seconds.
- there were as many offensive team players as defensive team players in the goal scoring situation.
- small or no defensive pressure was applied to the goal scorer whilst taking the shot.

The game of floorball is both a goal scoring and goal preventing game. Goals are not made without shots and the best way to score is to shoot immediately after a cross-pass, preferably just a couple of seconds after stealing or winning the ball possession within the offensive or neutral zones. Goals can be made very quickly in floorball, because there are no offside rules and the ball can travel the length of the rink in seconds. In just 1-3 seconds after winning the possession of the ball a team can create a goal scoring situation originating from almost any area of the field. Usually ball possession can be gained from all over the rink and only one or two players are involved in ball possessions that create quick scoring situations. Still, most of the goals are scored from organised attacks and could be prevented by making less defensive errors and by applying better pressure on and marking of the opponent. The key is avoiding mistakes in the "danger zone" and keeping the line and player positions on the field balanced, so that the opponent cannot use counter attacks and especially giving the opponent hard pressure.

The aim of this analysis was to describe how the goals were scored. If one wants to get the analysis to the next level, the data of players' positions all the time (or to be precise at each of the moments when something is happening to the ball) should be added. There were not so many differences between different teams as was expected for goal scoring, but of course both the level of goaltending and of the shooting skills matters as well as the game situation, the type of offense and the quality of the opposition. Perhaps because the number of goals by different teams was still relatively low, there were quite a few things that would have a statistical meaning that might be revealed with more data.

A variable that is recommended to be added in the future is whether the shooter and assister were playing the ball with one touch or more. Most of the good scoring chances were made by a couple of quick passes followed by a shot with one touch. The differences in scoring chances gives us an image of how the team tried to attack, once again we can't be sure of this just based on the numbers, however there were some distinct differences between the teams. This was the first version of the WFC goal analysis. It was a good start and the plan is to rerun this analysis when the next men's WFC takes place in Prague, December 2018.

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