

An instrument for analyzing offensive game sense in ice hockey

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<p>During the past 30 years, the emergence of game centered game teaching models and the advances in research about decision making in sports have lead to game sense being largely viewed as a defineable and teachable trait, instead of something intangible. This can be seen as the common consensus in the world of ice hockey, as well.</p> <p>This is a project-based Bachelor's thesis that aimed to produce an instrument for analyzing individual's game sense in offensive game situation roles in ice hockey. Some previous instruments for assessing decision making, and therefore game sense, in ball games exist, but they lack the specificity needed to be used to analyze the individual's decisions in detail.</p> <p>The instrument focuses on the first three seconds of each possession by the analyzed player. It has 15 varibles for the player's actions, derived from Finnish Ice Hockey Association's Meidän peli game teaching model. These variables are grouped into four categories: right decision, forcing the play, settling and freezing. The instrument disregards skill execution, which means that the observer focuses on the visible intent of the player's actions, rather than the outcome.</p> <p>The instrument was tested by using four Finnish U16 elite level ice hockey players as test subjects. The sample size for the trial was 10 games, which resulted in total of 1321 possessions being analyzed. With this kind of sample size, the instrument was found to give distinct, detailed and practical information about the player's offensive game sense.</p> <p>Although, judging from a common sense perspective, there seems to be strong evidence of face, construct, content and ecological validity, the validity and reliability of the instrument have not been scientifically confirmed.</p>	
<p>Keywords Ice hockey, game sense, decision making, analysis, instrument, Meidän peli</p>	

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1 Introduction

The main emphasis in teaching invasion games to beginners has traditionally been in teaching individual technical skills (Mäki 2008, 22). The International Ice Hockey Federation's teaching progression pyramid shown in figure 1 somewhat verifies the same assumption. Although, there are individual tactics in the pyramid, they are merely seen as execution of one or more technical skills to gain an advantage against the opponent. In our opinion, the wording of the phrase strongly emphasizes the technical part of the action and all but overlooks the brainwork of choosing the most efficient action according to the situation.

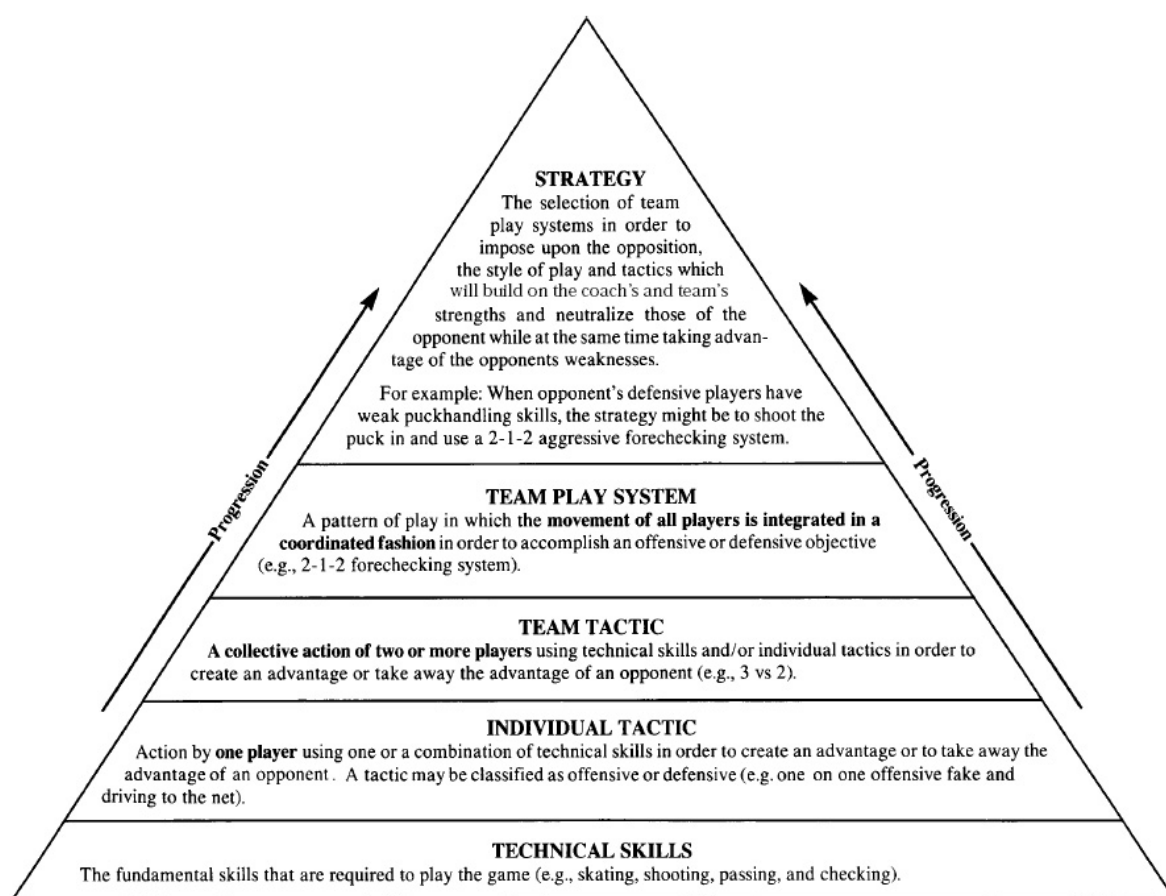


Figure 1. Teaching progression pyramid (IIHF coach development manual, level I, 2007)

The explanation of individual tactics in the pyramid is an example of the traditional view, held by coaches and players alike, that game sense is something inherent and intangible – something that cannot be coherently explained nor taught. Among others, this view is shared by Jim Dowd, a sixteen-season NHL-veteran and currently a junior

hockey coach, who, in a recent interview for NHL.com, compared hockey sense with common sense and said that “You can turn a kid into a robot, but you can’t teach hockey sense”. (Kimmelman 2013)

The idea of initiating the teaching of a game from a game situation, instead of first learning technical skills, was first brought to a wider attention by Bunker and Thorpe in 1982 (Blomqvist M 2001, 10). Their Teaching Games for Understanding model (TGfU) was developed to change the perspective of teaching games in physical education classes in schools. The traditional way of first learning the technical skills and then implementing them in a game situation was replaced by a new problem-centered teaching method. TGfU put “the WHY before the HOW” (Hopper and Kruisselbrink 2002, 4). In other words, it put the students in a game situation and forced him to come up with the correct technical skill to solve the problem that the game presents. Therefore, the model, which is shown in figure 2, highlights the importance of acting with a purpose – playing with game sense.

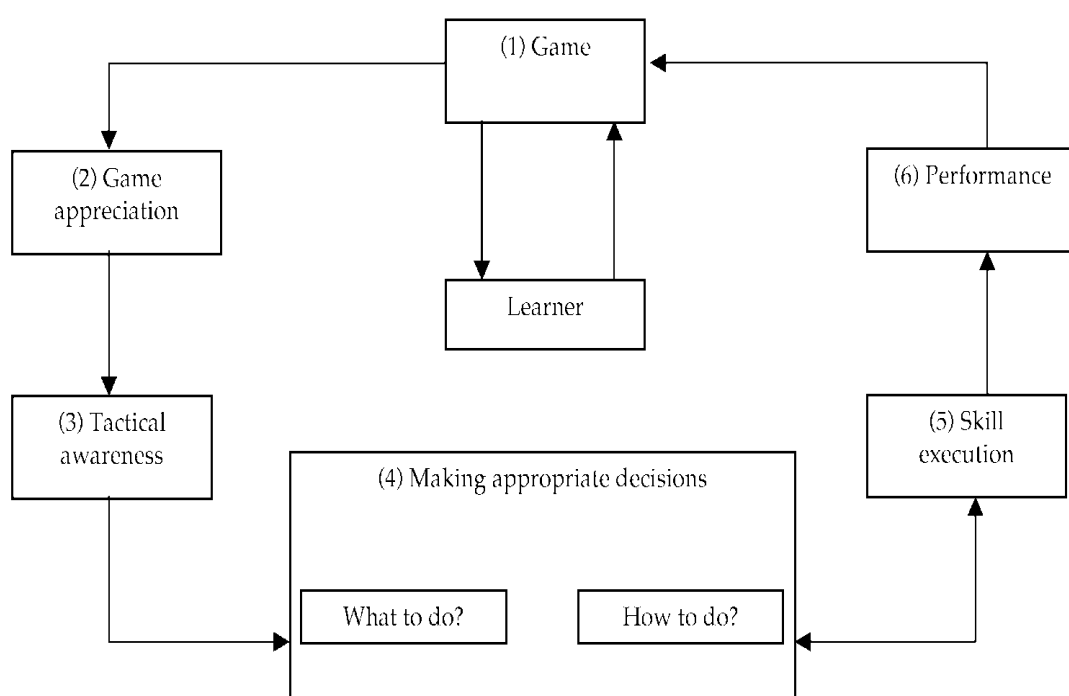


Figure 2. The TGfU model by Bunker and Thorpe 1982

Although, the TGfU model as such hasn’t probably played any role in Finnish ice hockey coaching, similar ideas have begun to push through. In the past 20 years, the

voices supporting the view of game sense being a teachable trait have become more frequent and audible. The traditional model, where “the why” is generally a rigid game plan drawn up by the coach, has made way to a model, where players are given a structure for the co-operation of the five man unit on ice and then encouraged to solve the problems on their own, in the most efficient manner in relation to the game objectives. In other words, the coach’s chess pawns have begun to think for themselves.

On the other hand, the view of game sense, especially in offense, being something inherent and incomprehensible has led many coaches to impose no structure on their team’s offense and give very little feedback to a player about choices in offensive situations. The lack of a thorough and indisputable description of game sense and the game’s objectives has left the coaches and players unable to assess the efficiency of decision made by the player – there has been no wrong or right choices unless they immediately produce a goal in either end of the ice.

The goal of our thesis is to create a clear and thorough assessment tool for a player’s game sense in offense. The tool primarily gives information about the player’s game sense as a puck carrier, but conclusions about the player’s game sense as a non-puck carrier in offense can also be drawn. We wanted the tool not only to tell us if a player has a good game sense or not, but also to give an idea of the specific situations where he excels or fails and how does he do so. The idea for such tool has risen from the need to assess the efficiency of our coaching process. We coach elite level U16 ice hockey players in Lahti, Finland and teaching game sense, especially in offense, has been our primary focus for the past two years.

When researching the subject, we found that very few studies have been made about game sense and virtually no tools for assessing it had been developed. The primary reason for the lack of studies in the field is the difficulty in finding a valid and reliable testing method. In other words, objectively determining a good decision from a bad one has been perceived to be hard. (Blomqvist M 2001, 24.) Nevertheless, we managed to find one potent assessment tool called Game Performance Assessment

Instrument(GPAI) created by Mitchell, Griffith and Oslin in 1994 (Oslin et al 1998, 232-233). However, we found the tool to give very little information about the player's decisions on the ice besides the perception of the decision being right or wrong. Therefore, we decided to create our own assessment tool.

2 Ice hockey as a game

Ice hockey is an invasion game played on ice. The game is played between two teams, both consisting of five skaters and a goalie simultaneously on the ice. A single game is won by the team that scores a higher amount of goals. Therefore, the objectives of the game are to score goals and prevent the opponent from scoring against you. (Koho & Luukkainen 2012, 138.) A goal is scored by putting the puck through a 1,83 meters by 1,22 meters steel frame located at the end of the playing surface. The playing surface, which is 56-61 meters long and 26-30 meters wide, is further divided into three zones, illustrated in figure 3. The zones are commonly known as defensive, neutral and offensive zone. (IIHF Rule Book 2010.) When in possession of the puck, a team is playing offence. The main objective of playing offence is to score a goal. On the other hand, when not in possession of the puck a team is playing defence. The main objective of defence is to prevent the opponent from scoring. In order to achieve these objectives, both teams try to use their own strengths and find the opponent's weaknesses to exploit. (Westerlund 1997, 532.) 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.)

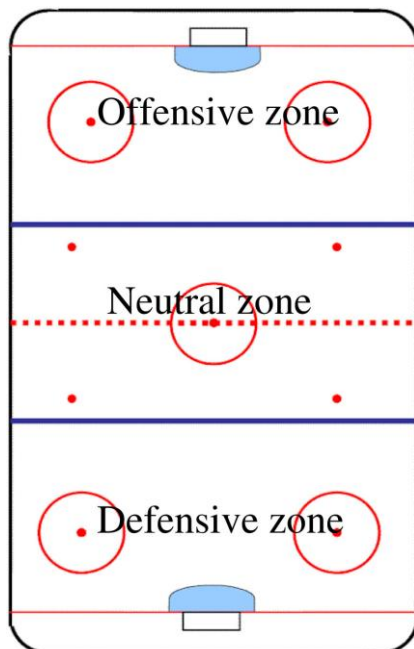


Figure 3. The zones of an ice hockey rink (Modified from IIHF Rule Book 2010).

2.1 Tactics and systems in ice hockey

In the past decades ice hockey was a game with strictly divided positional roles for players, defenders defended and forwards attacked. The team play based more on the team systems, and less individual or team tactics. (Westerlund 1997, 527.) This approach of treating the tactical aspect of the game only as pre-set co-operation models for the five man unit could be seen as less than optimal for the development of an individual player's game sense. Nowadays, due to the development of the game, the players have to be more comprehensive in their game playing abilities. Every player has to know how to defend and how to attack. (Rautakorpi 2010.) The game has become faster and the players have to be able to react to rapidly changing game situations quicker. This calls for the player possess the ability to play the game using his game sense, individual and team tactics, not only the team play system.

2.1.1 Individual tactics

Tactics can be divided in two groups, individual tactics and team tactics. To be able to execute team tactics, a player has to first be aware of the individual tactics needed in the game. Individual tactics consist of the actions of an individual player with and without the puck in defensive and offensive situations. (Mero & Helimäki 2004, 371.) In other words, individual tactics are the actions made by the individual using his game sense and technical skills in order to solve the problems that the game presents. It is critical for a player to understand team tactics and team play system also when executing individual tactics. (Westerlund 1997, 534.)

2.1.2 Team tactics

Team tactics are used both in offensive and defensive situations (Mero & Helimäki 2004, 371-372). They can be defined as two or more individuals working in collaboration and using their individual tactics to solve a problem that the game presents (Westerlund 1997, 532). A good example of the use of team tactics in an offensive situations could be a 3 on 2 rush, where the center is carrying the puck and forcing the opposition defender or defenders to close in on him. The two wingers stay wide in order to be able to win space to a scoring area, when the puck is passed to them. After one of

the defenders has committed to the center, the center uses his game sense to spot the winger in open space and technical skill to pass the puck to him. The winger, on the other hand, has used his game sense to stay in an open space and uses his technical skills to receive the puck in full stride. The third forward on the rush has used his individual tactics to stay wide and make the other defender take notice of him, thus enabling the other two forwards to create a 2 on 1 on the other side of the ice. An example of team tactics in defensive game situation, could be presented by viewing 2 on 2 situation in the corner of the defensive zone. The player defending the puck carrier has a good angle on his man and is able to close in on him and initiate a steal by removing the opponent from the puck – all this has required individual tactics from the player. In other words, he has used his game sense and technical skills. The player defending the non-puck carrier sees his team-mate initiating the steal, and uses his individual tactics to situate himself in a position wherefrom he can access the loose puck before the man he is covering, without fully surrendering the defensive side in relation to the opponent he is covering. After the player defending the puck carrier has created a loose puck his team-mate is able to pick it up. Therefore, the team tactics employed by the two defenders have resulted in a steal.

2.1.3 Team play system

Team play systems are learned patterns and structures that a team tries to execute during a game (Koho & Luukkainen 2012, 22). These systems provide the structure for efficient collaboration of the whole five-man unit in defensive and offensive situations. A team usually has separate team play systems for defense and offence in all three areas of the ice. For example, a team's defensive team play system in offensive zone, could be described with the numbers 1-2-2. This indicates the positioning of players in defensive situation in offensive zone. Team play system also includes information about the player's desired actions in the situation. However, a team play system that dictates the player's actions without any room for adapting to the situation can hamper the development of the player's game sense. A team's team play systems are the back bone for the collaboration of the five-man unit. Therefore, they usually remain more or less the same throughout the season. (Westerlund 1997, 532-533.) However, a team may have multiple systems for one zone, for example offensive zone defense, in order to be

able to change strategies according to the opponent (IIHF coach development manual, level I, 2007).

2.1.4 Strategy

Strategy is the team's way to try to play offensive and defensive game against a certain opponent. The team tries to bring up their strengths and prevent opponent from using their strengths in game. Strategies are closely linked to team systems. When deciding and planning game strategies team tries to choose the most effective system against the opponent. For example, against a team with superior offensive talent a team could employ a more defensive neutral zone defense system, such as the 1-4 trap, to create defensive odd-man-plus situations in the neutral zone, instead of engaging in a more aggressive offensive zone defense that could result in defensive odd-man-minus situations in the neutral zone. (IIHF coach development manual, level I, 2007.)

3 Playing skills required in ice hockey

Ice hockey is a game that requires a variety of different skills such as technical, physical, mental skills and game sense.

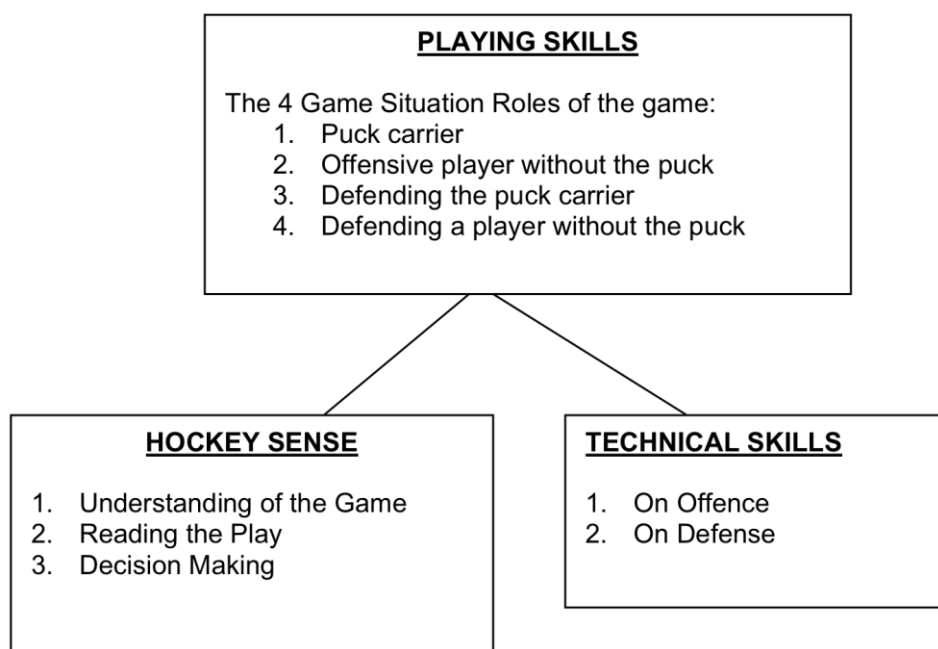


Figure 4. The composition of playing skills in ice hockey (IIHF Level 2 Manual 2008, 2).

3.1 Technical skills

Ice hockey is the world's fastest ball game. It is played on slippery surface and the players have to be able to use their upper body, for example to manage the puck or check, while using their lower body skating. This fact, of the lower and upper body doing separate tasks simultaneously, already sets the level of skill requirements high. (Pykälä 2012, 56.) There are several technical skills in ice hockey. The skills can be divided to two groups, offensive and defensive technical skills. The most important skill in both groups is the skating skill. In order to transform any of the other technical skills into efficient individual tactics, a player needs to be able to perform that skill while skating. (Westerlund 1997, 536; FIHA.)

Offensive technical skills include: skating, shooting, passing, receiving, puck control, fakes, and blocking. Most of these skills are performed while carrying the puck. (Westerlund 1997, 536.)

Defensive technical skills include: skating, blocking shots, stick checking and body checking. The last three mentioned are performed against opponent's puck carrier. (Westerlund 1997, 536.)

3.2 Game sense

Game sense is a part of a player's ice hockey skills (IIHF level II Manual 2008, 2). It can be defined as an individual's ability to perceive the situations in game and make right choices for according to the priorities of the game, further explained in chapter 4 of this thesis, and the team's strategy (Kilpivaara 2012, 77-78). Game sense can be divided into offensive and defensive game sense, according to the game situation roles, further explained later in this chapter. Offensive game sense refers to a player's game sense in offensive game situation roles. (FIHA.) Good game sense in offensive play can support individual's defensive game sense, too (Kilpivaara 2012, 77-78). With a good game sense an individual is able to take full advantage of his strengths and compensate for his weaknesses in his other abilities, such as physical, mental and technical skills. Logical, evaluative and original thinking and acting are some of the qualities that support game sense. (Mero & Helimäki 2004, 373.) In an average ice hockey game, the possession of the puck changes 7,7 times in minute and approximately 450 times during the whole game. The average length of a team's possession being 4,7 seconds. This fact sets the level of requirement for game sense very high in ice hockey. There has been a question tossed around for a long time whether game sense can be learned or if it's just something you have or don't have? When processing a case study about Wayne Gretzky (Dallas Ice Jets 2013) it can be seen that numerous different training methods, for example, creating game situations with immovable objects and targets where to shoot have, with an extremely high number of repetitions, developed his game sense to a very high level. (Dallas Ice Jets 2013.) In some scientific literature, the term "decision making skills" is used when referred to the sequence that is here described as game sense (Farrow 2012).

Game sense consists of three different abilities that are used in the following order in a game situation:

- Understanding the game
- Reading the play
- Decision making

(IIHF Level 2 Manual 2008, 2; Westerlund 1997, 534.)

3.2.1 Understanding the game

Understanding the game means that an individual understands the rules and the priorities of the game, as well as the principles for collaboration in his team in defensive and offensive situations (Kilpivaara 2012, 78). In order to understand these, a player must first understand, which team has the possession and is, therefore, playing offence and which team doesn't have the possession and is, consequently, playing defence (FIHA). Good team play is based on how well individuals interpret and cooperate in rapidly changing game situations (Westerlund 1997, 534).

3.2.2 Reading the play

Reading the play refers to how an individual perceives a situation in a game. For example, where is the puck and how are the players positioned on ice at the current moment. This translates in to the ability of being able to anticipate what will happen next in the game. (Westerlund 1997, 535.) To be able to read the play, the player has to know how to play with his head up seeing the ice with or without the puck (Farrow 2012). Implicit learning strategies, for example guided discovery or convergent discovery, has been found to be effective in both developing decision making and skill execution, for example passing with the puck with your head up, in game situations (Psotta & Martin 2011, 13; Farrow 2012). The players have to be able to see the open space on the ice – where he can go or where he can play the puck. When observing the situation, players look for familiar patterns that help them to make quick decision by using their intuition. (Farrow 2012.) A number of studies have shown that expert players detect familiar patterns from game situations significantly more often than novice players (Mulligan et al 2011, 198; Farrow 2012). The players, who are less skilful in observing

the surroundings in a game situation, fixate on observing movements, while players with better observation skills concentrate on finding the open space for play (Farrow 2012). Correia et al. (2012) also found that, in an experiment that involved video of a game situation in rugby, expert rugby players were better at identifying the information that was relevant for the opportunity of action that a situation presented, than recreational, intermediate, professional and non-rugby players. In other words, they were better at detecting the essential information about the surroundings, which enabled them to select the correct course of action more often than others. (Correia et al. 2012, 318.) Players, who are skilled in perceiving their surroundings, have not been found to possess superior visual function. Rather, expert players have a larger bank of sport specific strategies and patterns in their subconscious that they can use to intuitively identify the situations the game presents. Therefore, training the vision in a non-sport-related setting hasn't been found to improve sport-specific environment awareness in subjects with regular eyesight. (Farrow 2012.) The biggest limiting factor in ice hockey for reading the play is the lack of time and space. The higher level the game is played, the less time and space the player has to make the decision. (Dallas Ice Jets 2013.)

3.2.3 Decision making

For centuries human decision making was only examined from the outside. Access to investigate the functions of the brain – the organ that is responsible for the decisions – was out of sciences reach. The lack of knowledge regarding the processes of the brain led people to strive solely for rationality, and see emotions as detrimental for effective decision making. In essence, effective decision making was perceived to include carefully deliberating all the possible options and then choosing the one that combines the highest possible probability of happening with the highest possible gain. This kind of rational thinking is still the preferred norm for decision making regarding economic affairs. However, the modern scientific evidence regarding decision making suggest that, in some situations, process of relying on rationality is not the optimal tactic the brain chooses to employ. The rational brain needs time to make its decision, time that it doesn't necessarily have in all situations. This leads to seemingly slow decision making and consequently to a poor outcome. Therefore, when making decisions in the context of a fast paced ball game, such as American football or ice hockey, humans rely

on the parts of the brain responsible for emotion. In other words, we tend to do what feels right, instead of carefully pondering what is right. This intuitive decision making happens unconsciously and is based on past experiences from similar situations. (Lehrer 2009, XV, 6-7, 100, 248-249.)

Lehrer (2009) used NFL quarterbacks as an example to highlight the differences between decision making with the rational brain and decision making with the emotional brain. NFL scouts have tried to gain information about the decision making skills of quarterback prospects, before they are drafted to the league, by making them undergo an intelligence test that assesses logical thinking and math skills. The hypothesis has been that people who score high marks logical thinking will make better decisions in the heated game situations. The result has been just the opposite – many of the all time greatest quarterbacks have tremendously poor scores – Dan Marino, Terry Bradshaw and Randall Cunningham all had scores equivalent to the average score of a janitor – in the intelligence test. Furthermore, some of the prospects that have done extremely well in the test and have, consequently, been among the first picks in the draft, have failed in the league due to poor decision making in game situations. (Lehrer 2009, 6-7.)

The employment of the rational brain areas, in other words over-thinking, in the context of a fast paced game, results in increased self doubt and a situation of “choking” – the execution of previously mastered skill is disrupted, delayed or even destroyed. The amount of information that the rational brain can consciously process is limited, but the emotional brain does its processing in the subconscious and, therefore, can easily make sense of the complex situations presented in a game. The unlimited capacity of the emotional brain allows the preservation of countless past experiences in the subconscious. These experiences are utilized in form of intuition and relying on that intuition has been found to be an effective method for decision making in time constricted situations. (Lehrer 2009, 1-34, 133-166, 248-249.) Spittle et al (2010), among others, have confirmed the theory of intuitive decision making, based on past experiences, by finding, in their study regarding how changes in screen size affect a video based sport related decision making task, that decisions made by expert basketball players were more accurate than decisions made by novice basketball players.

3.2.3.1 Decision making in ice hockey

Decision making skill in ball games can be defined as the player's ability to precisely and quickly choose the correct option of action from numerous alternatives in a situation that is rapidly changing. In other words, a player has to first understand rules and the priorities of the game and principles of how his team co-operates. Then he has to see what the situation in the game is and then make an act, such as pass or shoot. (Westerlund 1997, 534-535.) Therefore, understanding the game and reading the situation, which have previously been described in this chapter, are integral parts of the decision making process. (Farrow, 2012.) Although our strong empirical experience would suggest otherwise, Bruce et al (2011) found, in their research that was conducted on Australian netball players, that, though limitations in motor skill hamper the successful execution of the optimal movement in a given situation, it doesn't affect the actual decision. Interestingly, Royal et al (2006) concluded that physical fatigue led to improved decision making in junior elite male water polo players, but noted also that the result is in contrast with much of the earlier findings about the subject. Factors that make deciding easier also include the familiarity of the opponent, as well as the prevailing physical and mental condition of the player (Mero & Helimäki 2004, 372).

3.3 Playing skills

Playing skill is described as a player's ability to combine technical skills and game sense (Westerlund 1997, 535). Without the required technical skill the player isn't able to perform playing skills, such as scoring a goal, even if he sees and understands the game situation perfectly. Mutually, if the player has a poor game sense, he isn't able to use his technical skills in the most efficient way. Players need playing skills both in situations that require the implementation of individual tactics, such as one against one, as well as in situations that require the utilization of team tactics, such as three against three. (FIHA.)

3.3.1 Game situation roles

There are multiple playing skills required in ice hockey. These skills can be divided according to the game situation roles. There are four game situation roles in ice hockey. (Westerlund 1997, 536.) The roles are divided into offensive or defensive roles, two roles each. Each game situation role has a set of objectives that can be obtained with a correct utilization of his playing skills by a player in that role. Players have to also be ready for quick role changes. (IIHF level II manual 2008, 6-8.) The game presents situations where the player has to be able to change from his current role into any of the other three roles, for example, from defence to offence or from non-puck carrier to puck carrier. (Rautakorpi 2010.)

Game situation roles (Westerlund 1997, 536):

1. Puck carrier (Offensive)
2. Offensive player without the puck (Offensive)
3. Defending the puck carrier (Defensive)
4. Defending a player without the puck (Defensive)

Objectives in the game situation roles according to International Ice Hockey Federation (IIHF Level II manual 2008, 7-8):

1. Puck carrier
 - Shoot
 - Win space towards the net
 - Pass the puck to open a team-mate
 - Carry the puck, know where the opponents are
 - Create time and space for your team mates by staying with the puck
 - Give and go
2. Offensive player without the puck
 - Maintain the balance of the attack
 - Create width and depth
 - Maintain defensive readiness

- Form opportunities for passes by keeping your space or cutting into a free one
- Support the puck carrier by screening players or goalie, creating pressure towards the net and being ready for loose pucks

3. Defending the puck carrier

- Prevent puck carrier from winning space towards the net- Pressure towards smaller space
- Prevent shooting
- Stay on the defensive side of the player – within the range of a length of a stick
- Steal the puck with stick checking or body checking – only when you are within the length of a stick from the opponent

4. Defending a player without the puck

- Stay on the move
- Know where the puck and the players are – be ready for support
- When your opponent is in the scoring area or your team is in the process of stealing the puck, keep stay within a range of a length of a stick from the opponent
- When your opponent isn't near the play or in the scoring area or your team isn't in the process of stealing the puck, keep a bigger distance from the opponent

Table 1. Offensive game objectives (Modified from Koho & Luukkainen 2012, 172).

Defensive zone offence	Neutral zone defence	Offensive zone offence
<ul style="list-style-type: none"> • Win space • Make space, if you cannot win space • Enable a fast and easy first pass • Try to advance the play via the middle lane • Offer passing opportunities in all three lanes • Defensive readiness 	<ul style="list-style-type: none"> • Win space • Make space, if you cannot win space • Offer passing opportunities in all three lanes • Try to advance the play via the middle lane • Play the puck to the player leading the rush, cross the zone by passing the puck • Try to accelerate when crossing the neutral zone • Defensive readiness 	<ul style="list-style-type: none"> • Score • Pass and move • Shoot • The direction of movement towards the net • Supporting acts of scoring (rebounds, screening the goalie, deflecting) • Defensive readiness

Table 2. Defensive game objectives (Modified from Koho & Luukkainen 2012, 172).

Defensive zone defence	Neutral zone defence	Offensive zone defence
<ul style="list-style-type: none"> • Prevent the opponent from scoring, aim for steal • Angle the opponent to small space, protect the middle of the ice • Find an opponent to defend or defend a zone • Position yourself between the opponent and the net • Defend away the opponent's stick • Offensive readiness, fast reaction 	<ul style="list-style-type: none"> • Prevent the opponent from winning space, aim for steal • Angle the opponent to the boards • Defend the red line • Cover passing lanes into the middle of the ice • Backcheck hard • Offensive readiness, fast reaction 	<ul style="list-style-type: none"> • Prevent opponent from winning space, aim for steal • Cover the middle when the opponent has the puck in good control • Pressure hard when the opponent doesn't have the puck in good control • The nearest player pressures hard, the second nearest supports and the third player covers the middle • After a steal react with a fast transition to offence and try create a scoring chance

Game situation roles and priorities

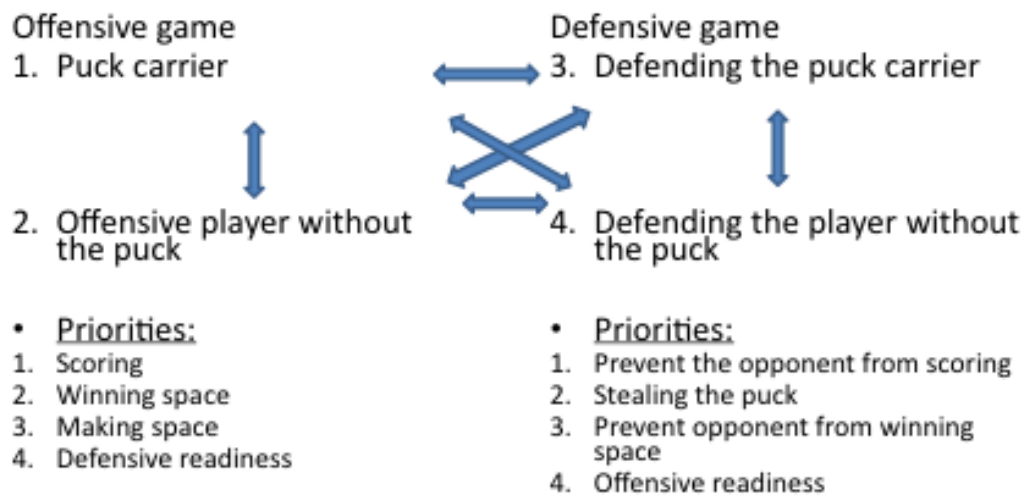


Figure 5. Game situation roles and priorities (Modified from IIHF Level 2 manual 2008).

4 Priorities of the game

Rautakorpi (2010) states that the game of ice hockey should be played according to priorities. By basing their game on the priorities, it is easier for teams to create game tactics and systems, and for individuals to follow the team's game plan and make right decisions in game situations. Players should always try to execute the highest priority possible. Priorities can be divided into offensive and defensive priorities. The priorities are the same on the individual and on the team level. On the team level, the execution of the priorities requires two or more individuals to cooperate. Executing priorities is in connection with team and individual tactics. For example, team tactics or an individual tactic could be utilized to change the objective of an odd-man-minus offensive situation to scoring, although most teams, and individuals within the team, would consider defensive readiness as a right option and dump the puck. The priority, which the individual or the team tries to achieve, changes depending on the number of players involved in the situation. For example, in odd-man-plus defensive situation outside of the scoring area the first objective is to steal the puck, whereas in odd-man-minus defensive situation the main objective is to prevent the opponent from winning space by covering the middle and staying on the defensive side. The priority, which is tried to be achieved, is also influenced by the zone the play is in (defensive, neutral and offensive zone). For example, a direct act of attempting to score isn't sensible in the defensive zone. (Rautakorpi, 2010.)

Offensive priorities (Rautakorpi, 2010):

1. Scoring
2. Winning space
3. Making space
4. Defensive readiness

Defensive priorities:

1. Prevent the opponent from scoring
2. Stealing the puck
3. Preventing the opponent from winning space
4. Offensive readiness

The terminology used in the aforementioned theory of priorities has been also used when referring to game objectives. Much of the previous educational literature concerning the game, including the IIHF Coaching Manuals, refers to the priorities as game objectives. However, game objectives often include a variety of specific means or instructions to an individual player, such as pass the puck to an open team-mate. Priorities, on the other hand, are strictly defined to be the eight aforementioned objects of the game. The means to achieve a priority are then classified to be under the priorities, not on the same level with them. (IIHF Level II manual 2008; Rautakorpi 2010; Koho & Luukkainen 2012, 172.)

4.1 Puck carrier

Puck carrier's first priority is to score a goal. Every time the puck is in the scoring area the offensive player's main objective should be scoring. (Westerlund 1997, 533.) The playing skills required from the puck carrier to score a goal are versatile and high quality shooting, passing and faking (Koho & Luukkainen 2012, 141-142). By his using game sense the puck carrier has to make the decision when to shoot, pass or fake. According to Rautakorpi (2010) the puck carrier has the option to shoot or pass when he is in an odd-man-plus offensive situation. When the situation is even-man or odd-man-minus, the priority is to score by shooting.

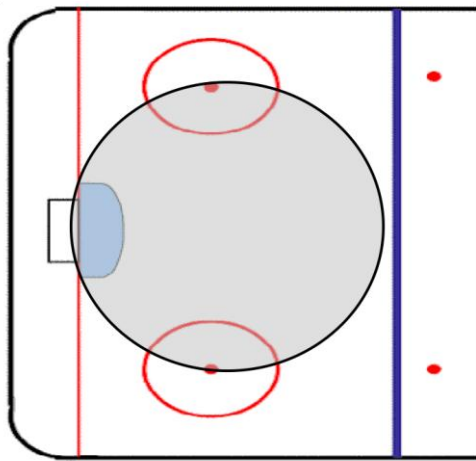


Figure 6. The scoring area (Mikkola 1987, 11).

Puck carrier's second priority is to win space towards opponent's net. This priority comes to use when scoring isn't possible. (Westerlund 1997, 533.) There are two options for puck carrier regarding how to win space: carrying the puck towards the opponent's net or passing the puck in vertical or diagonal direction to a player who is closer to the opponent's net. Versatile passing and puck control skills combined with game sense are the most important playing skills when trying to achieve the second priority. (Rautakorpi 2010.) Winning space is the fastest way to produce a scoring chance. In an optimal situation, the puck carrier should try to win space through the middle lane, so he would have more passing lanes open, if he can't win the space by carrying the puck. The pass should be played so that at least one of the opponent players is played out from the situation with it. This gives the player, who receives the puck to a better chance to start scoring or continue winning space, since he has fewer opponents between him and the goal. The puck carrier has to understand, when it is wise and effective to win space. (Koho & Luukkainen 2012, 142-144.)

The third priority for the puck carrier is to make space so that the team could try to achieve priority number two, winning space. This priority is executed, when priorities number one and two aren't possible. Making space is usually used, when there isn't a possibility to form odd-man-plus or even-man attack towards the opponent's net. Puck carrier's objective then is to keep his team in possession of the puck. (Westerlund 1997, 533 & 536.) The puck carrier can move laterally with the puck, pass the puck

laterally or vertically or diagonally to a teammate who is further from the opponent's net. By passing the puck laterally or vertically or diagonally away from the opponents net the puck carrier tries to find a teammate with open space so the team could try to achieve priority number one or two. (Rautakorpi 2010.) Any action that keeps the possession of the puck in the team, but doesn't result in the puck moving towards the opponents net, can be categorized as making space. Effective acts of making space, however, always result in a chance for winning space. The main playing skills for puck carrier in this priority are versatile skating, passing, receiving and protecting the puck combined with game sense. The puck carrier has to know, when is the time and the place to make space instead of winning space. When making space, one objective is to move the puck so that at least one of the opponent's players is played out from the situation. Such a play has a bigger chance of resulting in an opportunity to win space, since the puck carrier has fewer opponents in front of him. (Koho & Luukkainen 2012, 144-147.)

The fourth priority, defensive readiness, means that the offensive puck carrier has a readiness to change from the offensive role to a defensive role quickly, when he loses the puck (Westerlund 1997, 533). Defensive readiness is used, when there aren't any options to move with the puck or pass the puck to own teammates, since the puck carrier is under defensive pressure and in an odd-man-minus offensive situation. Defensive readiness is the minimum requirement for offensive game. It is the only priority, which doesn't aim directly or via other priorities to scoring. Defensive readiness for the puck carrier means that he doesn't lose the puck in the critical areas, like on the blue lines or in front of the own net, so opponent team could easily have a scoring chance. (Koho & Luukkainen 2012, 147-149.) In defensive and neutral zone this means that under pressure, when there is no space to move or pass the puck, the puck carrier understands to dump the puck to a position further from own net. In odd-man-minus attacks, the puck carrier can also try to score in offensive zone by shooting, because the shot's offensive risk is pretty low when there is an odd-man-plus defensive situation behind the shooter. (Rautakorpi 2010.) In our instrument the term "defensive readiness" is substituted by "dumping the puck".

4.2 Offensive player without the puck

The priorities for offensive player without the puck are the same as for the puck carrier: scoring, winning space, making space and defensive readiness.

In the number one priority, an offensive player without the puck has to create pressure towards the net. He has to move to a position, wherefrom he can immediately begin scoring, if the puck carrier can make a pass to him. (Westerlund 1997, 536; FIHA.) The playing skills needed in this are mainly game sense and skating skills. Other playing skills required from offensive player without the puck are blocking other players so that the puck carrier can shoot. When player is playing in role number two, he has to know how to play in front of the net effectively. The player has to be able to screen the goalie, deflect shots and be ready for rebounds. Right timing is essential for all of these aforementioned playing skills. (Rautakorpi 2010.)

When winning space, offensive player without the puck has to support the puck carrier with his positioning and movement. The player has to be positioned so that the puck carrier can make a pass when needed. Offensive player without the puck has to be able to read the game and react so that he can clear a lane, make a block or create two against one odd-man-plus offensive situation with the puck carrier. (Westerlund 1997, 536.) The player can create odd-man-plus situations and passing lanes by accelerating or slowing his movement in vertical or lateral direction (Koho & Luukkainen 2012, 143).

Offensive player without the puck has a critical role when making space. In this priority, the team is in a situation when puck carrier has no reasonable chance to win space, so offensive players without the puck have to position and move so that the puck carrier has a chance to make a pass laterally or diagonally towards his own net. The non-puck carriers in offence should move so that the puck carrier has one or more open lanes to make a pass. (FIHA.) Another option is to make a block, so the puck carrier can move laterally with the puck (Westerlund 1997, 536). The offensive player without the puck should move so that he is able to create two against one situation laterally by

accelerating or slowing his movement. He also has to have readiness to begin winning space or scoring when he gets the puck. (Koho & Luukkainen 2012, 144-147.)

In the last priority, an offensive player without the puck has to support the puck carrier by being ready to change into a defensive role, when the team loses the puck (Westerlund 1997, 536). The key points, for an offensive player without the puck, are positioning so that he is on defensive side of play, in other words between the puck and his own net, and being able to see and read the movement of the opponent that he should defend against. In defensive and neutral zones, he can't play too much and too quick towards offensive direction, when the puck carrier is under hard pressure. In offensive zone the player has to position on defensive side of play so that the opponent can't have an odd-man-plus offensive situation, if the puck is turned over. (Koho & Luukkainen 2012, 147-149.)

4.3 Defending the puck carrier

The first priority in defensive game is to prevent the opponent from scoring. In order to prevent scoring, the player needs to be between the opponent he is supposed to guard and his own net. The actual playing skills of preventing scoring are employed, when opponent team has the puck in the scoring area. (Koho & Luukkainen 2012, 149-150.) The playing skills for defender against the puck carrier, when preventing scoring, include blocking shots with his body or stick by positioning between his own net and the puck. One key point is to cooperate with goalie so that if the player can't block the shot by himself, he is able to pressure or angle the puck carrier to a less dangerous shooting spot or position (Westerlund 1997, 536). In this role, the player tries to also cover passing lanes to free offensive players in the scoring area. Depending on the situation (odd-man-plus, even-man or odd-man-minus) the puck carrier's defender has to make a decision whether he blocks the shot or covers the passing lanes by his positioning and stick. (Rautakorpi 2010.)

The second priority for a defender playing against puck carrier is to steal the puck to gain possession for his own team. This is the primary priority outside the scoring area. Stealing can be done by stick or body checking in one on one battles. The most effec-

tive way to steal a puck is to combine these two technical skills. The defender should to be able to initiate defensive pressure by skating. Good skating skills are also vital in remaining on the defensive side of the puck carrier. (Rautakorpi 2010.) The defender has to be able to read the situation correctly, and identify the opportunity for him initiate the steal. The defender attempts to steal only in odd-man-plus or even-man defending situations or when the puck carrier isn't aware of his surroundings and could be caught off-guard. The player defending the puck carrier should aim for steal as soon as and as far from own net that possible. (Koho & Luukkainen 2012, 152-154.)

In priority number three, the defender tries to prevent opponent's puck carrier from winning space towards net and especially to the scoring area. This priority supports priority number two. Preventing opponent from winning space is executed by positioning between the puck carrier and the net. The defender tries to prevent the opponent from winning space especially towards the middle, where he has the best chance to advance the play. (Koho & Luukkainen 2012, 150-152.) Playing skills required in this game situation are versatile skating in order, to pressure and angle the player to a smaller space, and the ability to cover passing lanes with the stick. In odd-man-plus and even-man defensive situations, the defender can actively take away the space of an opponent and aim for stealing the puck. In odd-man-minus defensive situation, the main objective is to protect the middle by positioning on defensive side between the offensive players so that they can't carry the puck or pass it through or to the middle. (Rautakorpi 2010.)

The fourth priority in defensive game doesn't aim directly for prevent opponent from scoring (Koho & Luukkainen 2012, 154.) Similar to the offensive game priority number four, this priority also requires readiness for a quick role change. The puck carrier's defender has to be ready to begin offensive game, when he steals the puck for his team. (Westerlund 1997, 536.) This requires that the player is positioned so that he can get the loose puck and his game stance makes it possible for him to skate with the puck or pass it. If he doesn't pick up the loose puck he has to be able to position so that he can offer a clear passing lane for the puck carrier. (Rautakorpi 2010.)

4.4 Defending the player without the puck

The priorities for a player defending the player without the puck are the same as for the player defending the puck carrier.

In priority number one, in even-man situations, the main objective is to find and defend an opponent and prevent him to get the puck from pass or rebounds, and that way scoring (Westerlund 1997, 536). If a loose puck occurs in the scoring area, the player defending the non-puck carrier should try to obtain possession, given that he has ensured that the man he is guarding is not in a position to get the puck. In odd-man-minus defensive situations, the player defending the non-puck carrier should position so that he covers the middle of the ice and passing lanes. Versatile skating and defending away the opponents stick are the most important playing skills in these situations. (Rautakorpi 2010.)

In priority two, defensive player has to help the player defending the puck carrier by creating odd-man-plus defensive situation on the puck. In situations where an odd-man-plus defensive situation clearly exists, the player can give lateral or backpressure to the puck carrier, so the other the player defending the puck carrier can initiate stealing the puck. The player defending the non-puck carrier has to be ready to win the loose puck, when the player defending the puck carrier can produce one. (Rautakorpi 2010.) In even-man situations, the first objective for the player defending the non-puck carrier is to position between his own net and the opponent he is defending. If the player defending the puck carrier can initiate a steal, the player defending the closest non-puck carrier should position himself in such a manner that he is able to pick up the possible ensuing loose puck or to continue stealing the puck, if the player he is guarding gets the puck. Other playing skills needed in this priority include the ability to cover passing lanes. (Westerlund 1997, 536.)

When preventing the opponent from winning space, the player defending a non-puck carrier has more or less the same objectives as in the previous priority. Positioning between the opponent and his own net, keeping the distance to the opponent such that it enables sustaining the defensive side and initiation of a steal if the guarded player gains

possession, covering possible passing lanes and supporting the player defending the puck carrier, are main objectives for the player defending a non-puck carrier. (Rautakorpi 2010.) When preventing opponent from winning space, it is essential to cover the middle of the ice. The player defending the non-puck carrier should play so that there is no space to play the puck to the middle lane or to the scoring area. (Koho & Luukkainen 2012, 150-152.) He has to be ready for swift transition in roles into a player defending the puck carrier. In odd-man-minus defensive situations, the main objective is to protect the middle of the ice and prevent lateral puck movement. (Westerlund 1997, 536.)

Like in the other game situation roles, the fourth priority isn't directly linked to scoring or prevent opponent from scoring (Koho & Luukkainen 2012, 154). Right positioning and readiness for offensive creates the possibility for the team to begin an attack. The player defending a player without the puck has to be ready to move to a free space to get the puck or pick up the loose puck. One option is to read and anticipate the opponent's pass correctly and intercept it. (Rautakorpi 2010.)

5 The Game Performance Assessment Instrument

The Game Performance Assessment Instrument (or GPAI) was first presented by Mitchell, Griffith and Oslin in 1994. It was created to measure “game performance behaviors that demonstrate tactical understanding, as well as physical ability to solve tactical problems by selecting and applying appropriate skills”. The initial idea for the GPAI was to create an instrument, which could be used to assess game performance of an individual, for example decision making, appropriate movement and skill execution. This instrument would provide information, to a teacher using a game-centered teaching model of games, such as TGfU, about the effectiveness of his lessons. The instrument initially tested to be applicable for three categories of games: field games, net games and invasion games. (Oslin et al 1998, 231- 233.)

5.1 The game components

The GPAI consists of seven different game components that are observed from the individual player's actions in the game. The game components (Oslin et al 1998, 233) are:

1. Base: Appropriate return of performer to a "home" or "recovery" position between skill attempts
2. Adjust: Movement of performer, either offensively or defensively, as required by the flow of the game
3. Decisions made: Making appropriate choices about what to do with the ball (or projectile) during the game
4. Skill execution: Efficient performance of selected skills
5. Support: Off-the-ball movement to a position to receive a pass (or throw)
6. Cover: Defensive support for player making a play on-the-ball or moving to the ball (or projectile)
7. Guard/mark: Defending an opponent may or may not have the ball (or projectile)

Although, the components are all related to game performance, they might not be applicable to all kinds of games. For example, "base" is hard to define and apply to an invasion game. Therefore, when using the GPAI, it's possible and appropriate to use only some of the game components. When initially testing the GPAI, the researchers used basketball and soccer to test the method in invasion games. The soccer version of the GPAI, only consisted of three game components, decision making, skill execution and support. The data sheet, used by the observer in this instance, is shown in figure 7. (Oslin et al 1998, 233-243.)

Category—Criteria for appropriate/efficient rating:

1. Decisions made: Player chooses to pass to an open teammate
Player chooses to shoot when appropriate
2. Skill execution: Reception—Control of pass and set up of the ball
Passing—Ball reaches target
Shooting—Ball stays below head height and is on target
3. Support: The player appeared to attempt to support the ball carrier by being in/moving to an appropriate position to receive a pass

Decision made		Skill execution		Support	
A	IA	E	IE	A	IA

Key: A = appropriate; IA = inappropriate; E = efficient; IE = inefficient.

Figure 7. The data sheet for the testing of GPAI in soccer (Oslin et al 1998, 243).

5.2 The tally system

The original way of getting a measure of game performance from the GPAI was the tally system. In the system the observer counts incidents of appropriate or inappropriate decision making or support and efficient or inefficient skill execution by a single player in a given time. From the data about these incidents, gathered from a soccer match or matches, five different measurements that assess game performance can be drawn. (Oslin et al 1998, 234; Memmert and Harvey 2008, 222.) The measurements are the following:

1. Game involvement = total appropriate responses + number of effective skill executions + number of inefficient skill executions + number of inappropriate decisions made
2. Decisions made index (DMI) = (number of appropriate decisions made)/(number of inappropriate decisions made)
3. Skill execution index (SEI) = (number of effective skill execution)/(number of ineffective skill execution)
4. Support index (SI) = (number of appropriate supporting movements)/(number of inappropriate supporting movements)
5. Game performance = (DMI + SEI + SI)/3
(Oslin et al 1998, 234.)

So, for example, a player, who made 25 appropriate decisions and 2 inappropriate ones, would score a $(25/2)$ 12,5 for his DMI.

According to Memmert and Harvey (2008, 244) this scoring system was later revised by Mitchell and his colleagues in 2006. The idea of the new tally system was that the index would always stay between 0 and 1. The formula for DMI, for example, was changed to a form of $A/(A + IA)$, A being the number of appropriate decisions and IA the number of inappropriate decisions. This meant that if a player made, for example, 30 appropriate decisions and 0 inappropriate ones, he would score a 1 for his DMI. Consequently, 20 appropriate decisions and 20 inappropriate decisions would lead to a DMI of 0,5. The same formula was applied to all the other indexes as well. With the new formula, the indexes could be changed to percentages by multiplying the index by a hundred. (Memmert and Harvey 2008, 224.)

5.3 The 1-5 Likert-like method

In addition to revising the tally system, Mitchell and his colleagues also introduced another method of using the GPAI to score game performance. The method resembled the Likert scale, and was called the 1-5 Likert-like method. In this method the observer would evaluate the player's performance with a grade of 1-5 according to the descriptions that he has given to each grade. (Memmert and Harvey

2008, 222.) Figure 8 shows an example of the descriptions for decision making in invasion games, when grading game performance with the 1-5 Likert-like method.

<p>5—Very Effective Performance</p> <p><i>When team/individual player HAS possession of the ball:</i> Player always makes correct decisions about what to do with the ball.</p> <p><i>When team/individual player DOES NOT HAVE possession of the ball:</i> Player always makes correct decisions about when to engage the player on the opposing team who has the ball when closest to the ball. Player always provides defensive help to teammates making a play on the ball, always defending proactively in order to intercept passes.</p>
<p>4—Effective Performance</p> <p><i>When team/individual player HAS possession of the ball:</i> Player most of the time makes correct decisions about what to do with the ball.</p> <p><i>When team/individual player DOES NOT HAVE possession of the ball:</i> Player most of the time makes correct decisions about when to engage the player on the opposing team who has the ball when closest to the ball. Player most of the time provides defensive help to teammates making a play on the ball and most of the time defends proactively in order to intercept passes.</p>
<p>3—Moderately Effective</p> <p><i>When team/individual player HAS possession of the ball:</i> Player sporadically makes correct decisions about what to do with the ball.</p> <p><i>When team/individual player DOES NOT HAVE possession of the ball:</i> Player sporadically makes correct decisions about when to engage the player on the opposing team who has the ball when closest to the ball. Player sporadically provides defensive help to teammates making a play on the ball and sometimes defends proactively in order to intercept passes.</p>
<p>2—Weak Performance</p> <p><i>When team/individual player HAS possession of the ball:</i> Player rarely makes correct decisions about what to do with the ball.</p> <p><i>When team/individual player DOES NOT HAVE possession of the ball:</i> Player rarely makes correct decisions about when to engage the player on the opposing team who has the ball when closest to the ball. Player rarely provides defensive help to teammates making a play on the ball and rarely looks to defend proactively in order to intercept passes.</p>
<p>1—Very Weak Performance</p> <p><i>When team/individual player HAS possession of the ball:</i> Player never makes correct decisions about what to do with the ball.</p> <p><i>When team/individual player DOES NOT HAVE possession of the ball:</i> Player never makes correct decisions about when to engage the player on the opposing team who has the ball when closest to the ball. Player never provides defensive help to teammates making a play on the ball and never defends proactively in order to intercept passes.</p>

Figure 8. Example of “Decision making assessment descriptors for invasion games” (Harvey 2007, 24).

The original idea behind the use of the 1-5 method was to give teachers a less laborious method of measuring players’ game performance in a fast-paced invasion game (Memmert and Harvey 2008, 222).

5.4 Reliability and validity

In research, the ability of a test or a method to create consistent results referred to as reliability. There are different kinds of reliability. In our opinion, the most interesting and crucial kinds of reliability for an assessment tool, such as the GPAI or our

instrument for analysing offensive game sense, are test-retest reliability and inter-rater reliability. Test-retest reliability refers to the testing methods ability to produce consistent results, when the test is repeated to the same sample group after a period of time. Inter-rater reliability, on the other hand, refers to the testing method producing similar results with different observers or judges. (Phelan & Wren 2006.)

Validity is another measurement for the purposefulness of scientific study. It refers to the ability of a test to measure the things that it is intended to measure. Similar to reliability, there are also different kinds of validity. The GPAI was originally tested in face, content, construct and ecological validity (Oslin et al 1998, 235-236). Face validity means that the test or method seems to be measuring its intended target. Although, face validity doesn't hold much scientific merit, it might be important for the motivation of the subject group. (Phelan & Wren 2006.) This was also why the face validity of the GPAI was assessed. The assessment was done with a questionnaire that asked, if the test subject's felt that the GPAI was a fair and appropriate way of measure their game performance. (Oslin et al 1998, 235.) Content and construct validity both refer to the test's actual ability to measure the variables it's intended to measure, where as ecological validity points out how well the test environment resembles the real-life situation, which is being assessed. (Phelan & Wren 2006) In the case of the GPAI, the content validity was verified by a panel of seasoned experts, who were asked to review the components of the GPAI. Construct validity was determined by asking the physical education specialists of the school group that was used as a subject group, to divide the students to low, medium and high skill groups depending on their perception of the students' game performance before the study. The medium group was disregarded and the results of the GPAI analysis were compared to the specialists' pre-test opinions. (Oslin et al 1998, 236.)

The GPAI was found to be valid and reliable tool in all the aforementioned ways for assessing all the three game components – decision making, skill execution and support – that were tested in invasion games (Oslin et al 1998, 239).

6 Empirical work

6.1 Project planning

Both of us, authors, were first introduced with the theoretical frame work of game priorities and game situation roles as well as the definition of game sense during our studies in Vierumäki. From then on, it took us five years of coaching experience in combined to get good enough grasp of what these theories actually meant in practice, in order to start teaching them to our players.

During his time as the head coach of the Pelicans U16 in Finnish National division 1 in the 2011-2012 season, Vesa started to teach his players game sense according to the aforementioned theoretical framework. Judging from the game results and what the game looked like, the results seemed inspiring. Nevertheless, during that season there was no way of actually measuring, if the individual's decisions on ice had actually improved.

For the 2012-2013 season, Anssi came along as an assistant coach and most of the previous season's U16 players moved up to Pelicans U18 team. With the renewed coaching staff and a new team of players, the main emphasis for the season was set on teaching game sense from the individual player's perspective. Furthermore, we wanted to focus, especially on increasing the efficiency of the decisions that the players make in offensive game situation roles. In other words, develop their offensive game sense.

We had a sound theoretical framework to teach the players, in order for them to make the decision that is most efficient regarding to the game's outcome. We also had good resources and facilities for educating the players, in terms of educational videos made from the previous season's games and the possibility of enhancing the learning of game sense by playing floorball in the summer season in addition to ice practices. However, we needed a more specific way of measuring an individual player's decisions in offence than how the game looked or what was the score on the scoreboard. We needed an instrument to assess the players' decisions also in the situations that didn't immediately result in a scoring chance.

So, in the fall of 2012, we started our search for such an instrument. The only instrument we found that seemed to somewhat fit our purposes, was the Game Performance Assessment Instrument (GPAI), which is described in detail in chapter 4 of this thesis.

Although, the GPAI was proven to be a valid and reliable instrument for analysing game performance, we we're not convinced that it would give us the kind of detailed information about our players' game sense in offence that we were yearning for. The GPAI was originally designed to be used in several types of games and, therefore, it was quite broad and non-specific. Out of the seven game components three were tested to be valid and reliable for invasion games: decision making, skill execution and support, but the descriptions for those components, as well, were non-specific. This lack of specificity, in our opinion, gave a lot of incidents to look for but very little information about the player's actions – apart from the perception of the decision being right or wrong. For example, the act of deciding to carry the puck instead of shooting in a scoring situation would, in the GPAI analysis, would be marked the same as the act of deciding to make a lateral pass in defensive zone to a player, who is pressured by the opponent. Although, the incidents are very different from one another, they would both be simply marked as inappropriate in the decision-made column.

After we had established the need for an instrument that identifies the incidents in the game more specifically than the GPAI, we needed to decide a way of grading the player's actions in those situations. The GPAI offered two different versions of grading: the tally system and the 1-5 Likert-like method. It was obvious that the tally system and the percentage values derived from it would better suit our quest of being able to grade a player's offensive game sense with a specific and objective numerical value. The 1-5 Likert-like method was quickly disregarded as too subjective and broad method of grading.

In order to narrow down and specify the incidents to analyse, we decided to focus on the moment the player gained possession of the puck. This meant that we would drop the support component used in the GPAI from our analysis and focus solely on the

player's actions as a puck carrier. However, in our opinion, the moment of gaining possession not only gives us excellent insight of the player's game sense as a puck carrier, but also speaks volumes about the player's actions in the previous game situation role. In other words, when the player gets possession he starts to play offence as a puck carrier and the effectiveness of his actions can immediately and easily be estimated. This effectiveness is often reduced by the player's readiness to play offence as a puck carrier. The player might, for example, receive the puck in an open space in the neutral zone with no-one preventing him from winning space, but he has not been able to anticipate the play and move so that he would get the puck facing the opponents net. Instead, he has done a bad job as a non-puck carrier in offence and is moving towards his own net at the time of gaining possession. In a fast paced game, such as ice hockey, the time that it would take for him to turn towards the opponents net after gaining possession, would result in there being no space to be won. Therefore, the player is forced to settle for a less effective objective with the puck, such as making space. In the aforementioned scenario, the player wasn't able to play as efficient offence as a puck carrier as possible, because of poor performing in the role of non-puck carrier in offence.

Now that we had the incidents to look for in a game – the moment a player gains possession of the puck – and the scoring system for them – we knew we wanted percentage values for the player's actions – next step was to think what we actually wanted to analyse. We decided to focus on the decision making and disregard the skill execution. This meant, for example, that if a player tries to score from the scoring area and fans on the shot, the action is marked as correct, because he tried to score. Another good example would be that a player wins space with a pass forward to an open man, but misses the blade of the stick and the play results in an icing. This would also be considered to be a right decision. At this point our tool was exactly the same as using only the decision making game component of the GPAI. Our initial idea of getting a tool that would not only assess but also analyse the decisions made as a puck carrier, needed us to focus on finding specific variables for what the player could do with the puck.

We used game priorities, explained in detail in chapter 4, as a basis for game understanding. According to the priorities we were able to come up with a list of 16 variables for a player's actions as a puck carrier, 5 of which are considered to be effective and 11 ineffective. Variables 14 and 15 were later combined and descriptions for some of the variables changed, after and during the implementation of the project, thus making the amount of variables in the final product 15 – five effective and ten ineffective. The variables are explained in detail in the product description chapter of this thesis. We wanted the variables to be non-specific in terms of the applied skill in order to analyse and assess only decision making as purely as possible. In other words, the variables don't take into account, for example, whether the player uses skating or passing to win space.

We planned to test our instrument with some players from the Pelicans U16 team. With these plans it was time to start implementing the project of producing an analysing tool for offensive game sense.

6.2 Project implementation

We started implementing the project in January 2013 by first designing the first edition of the result sheet – the sheet that calculates the percentages of different actions. During the trial phase of our product, this result sheet was found to be very descriptive and sufficiently easy to use. However, a few changes that made the large amount of numerical values easier to dissect were made to it. In order to gather the information we also made an information gathering sheet, which worked flawlessly in the trial phase and, therefore, stayed virtually the same during the whole product development.

The instrument was initially designed to be used from video footage. Analysing offensive game sense in the context of a live game was never the purpose. In order to try out the instrument, we decided to use four players from the Pelicans U16 team. We wanted to test the applicability of the instrument to all skater playing positions in ice hockey, so we picked two defensemen, one winger and one center. The test subjects were all picked from the top two lines of the team. This was done in order to ensure a large enough sample size of incidents from a reasonable amount of games. After all, a

first-liner is on the ice and touches the puck significantly more during a game than a fourth-liner. We also felt that the test subjects had distinguishable patterns in their decision making. Some of which were negative to the efficiency of their game, some of which were positive. We were hoping for our product to verify those patterns with a numerical value.

We started picking up the video footage for the trial by editing the Jokerit-Pelicans U16 SM-league game, played on November 10th, 2012, into 15 second clips. Each clip contained one possession by one of our test subjects. The editing was done so that the clip would start approximately 5 seconds before the player gains possession and finish approximately 10 seconds after the possession was gained. After editing the first game, we had a sample size of 41, 38, 39 and 34 puck possessions for our four test subjects. We concluded that a sample size of 350-400 per player was large enough for the purpose of trying out the instrument, so we decided to get clips of the puck possessions of these four players from a total of ten games.

The games, shown in table 3, were chosen a period ranging from September 2012 to November 2012. They can chronologically be easily divided into two distinct groups, group 1 ranging from September 2nd to October 7th, and group 2 from November 3rd to November 24th. The original idea behind this division was to get an assessment of the development of the players. The results showed a decrease in the percentage of efficient decisions made and in the efficiency index, which are both explained further in the product description section of this thesis, with three subjects and an increase with one. There are number of factors contributing to the result. Those factors and significance of the changes in the values are further explained in the discussion part of this thesis.

We used STEVA Hockey DVD software to pick up the necessary clips from the game videos and compose a single video file from the possessions of one player in one game, so 10 games equaled 10 files for each subject. The files varied in length from 2 minutes and 40 seconds to 8 minutes and 40 seconds. The amount of possessions in game by a subject varied from 15 to 52. The editing, starting from downloading the game footage

to the computer and finishing with the video file with the necessary clips, proved the most laborious part of utilizing this instrument. It took us approximately 2,5 hours per game. The analysing of the player's decisions from the video file took approximately 30 seconds per each possession, 15 of which been the length of the clip.

Table 3. The games used to trial the instrument for analyzing offensive game sense.

Group 1	
Date	Game
2.9.2012	Pelicans-HPK (Pre-season game)
27.9.2012	HIFK-Pelicans (SM Qualifiers)
30.9.2012	SaPKo-Pelicans (SM Qualifiers)
6.10.2012	Pelicans-Blues (SM Qualifiers)
7.10.2012	Pelicans-SaPKo (SM Qualifiers)
Group 2	
Date	Game
3.11.2012	Pelicans-Jokerit (SM Preliminary league)
4.11.2012	Pelicans-KalPa (SM Preliminary league)
7.11.2012	Pelicans-JYP (SM Preliminary league)
10.11.2012	Jokerit-Pelicans (SM Preliminary league)
24.11.2012	HIFK-Pelicans (SM Preliminary league)

When analysing the players' decisions, we encountered a problem with categorizing the some of the actions taken by the players. The tricky situations were ones, where player first played to one priority for a second or two and then started to play to another. For example, a defender might get the puck in the defensive zone with his teammates in the neutral zone skating towards their own net. In such situation, the puck carrier might drop back a bit towards his own net, the priority being making space, in order to give his teammates time to turn towards the opponent's net, and then start winning space in the same rhythm with the non-puck carriers, therefore making a 2 on 1 situation on the puck possible. So, in this situation the player successfully made space for a second in order to win space. If we would look solely at situation when the player gained possession, we would categorize this decision to be successful space making

(variable 10). However, this would give a distorted view the player's decision since he was able to win space within a few from the start of his possession. Another such problematic situation could be one, where the player gets the puck in the scoring area, but decides to carry the puck for a second before starting to attempt scoring. Is it a case of winning space in a scoring situation (variable 4, a negative variable) or trying to score in a scoring situation (variable 1, a positive variable)? To make this distinction, we needed to establish a time limit for the actions analysed starting from gaining possession. The analysed time needed to be long enough for clearly establishing the player's intent, but short enough for the player's action to specifically fit one of the fifteen variables. After we had analysed approximately a hundred clips each, we decided to draw the line at three seconds after gaining possession.

6.3 Product description

Our product is an instrument for analysing a player's offensive game sense in ice hockey. The idea of the instrument is to give a numerical value to a player's game sense as well as give the observer specific information about the decisions the player makes. The instrument consists of an information gathering sheet and a result sheet. The instrument is meant to be used by a single observer analysing the actions of a single player from previously recorded video footage.

The instrument has 15 variables for the player's actions. The variables are based on the game priorities presented in chapter 4 of this thesis. The subject of analysis is only the player's decisions that can or cannot be concluded from his actions. Skill execution following the decision is excluded from the analysis. In other words, the observer is analysing the intent, not the result. The incidents of which the analysis is made, are the first three seconds of each puck possession by the player. Each possession results in one analysable incident. Therefore, the game priority, which the player intends to obtain, is observed at the end of this three seconds. In other words, if the player attempts to shoot within the three seconds, the intent is perceived to be scoring. If the player attempts keep the possession within his team and move the puck so that it is closer to the opponents net after the three seconds than what it was when the possession was gained, the intent is perceived to be winning space. If the player

attempts to keep the possession within his team and move the puck so that it is not closer to the opponents net after the three seconds than what it was when the possession was gained, the intent is perceived to be making space. If the player attempts to put the puck into a position, where the other team will pick up the loose puck and gain possession, the intent is perceived to be dumping the puck.

The instrument also separates the incidents by the zone in, which they occur. This zone is established by looking at where the player is at the moment of gaining possession.

6.3.1 The variables

There are 15 variables (table 4.), identified simply by numbers from 1 to 15, for the player's actions. The numbering of the variables corresponds to the game priorities – numbers 1-6 are actions involving scoring, numbers 7-9 are variables for the action of winning space outside the scoring area, numbers 10-12 are variables for making space outside the scoring area, numbers 13-14 are variables for dumping the puck and number 15 is the variable for no action or action with no intent.

Table 4. The variables for the player's actions according to the instrument of analyzing offensive game sense.

Variable	Description	Category (subcategory)
1	The player tries to score from the scoring area, or from outside the scoring area with his teammates supporting the scoring by being in motion towards the net for a rebound and/or screening the goalie	Right decision (The most efficient decision)
2	The player tries to score from outside the scoring area, because an attempt to win or make space would result in the puck carrier being in an odd-man-minus situation and under pressure from the opponent	Right decision (The most efficient decision)
3	The player tries to score from outside the scoring area in a situation, where his teammates are not supporting scoring but enabling a better scoring change to be created by winning or making space	Forcing the play

4	The player tries to win space instead of scoring in the scoring area	Settling
5	The player tries to make space instead of scoring in the scoring area	Settling
6	The player tries to dump the puck instead of scoring in the scoring area	Settling
7	The player tries to win space outside of the scoring area. The decision would result in gaining a scoring chance or a 2 on 1 situation to be maintained or created on the puck	Right decision (The most efficient decision)
8	The player tries to win space outside of the scoring area. The other nine skaters on the ice are situated so that a 2 on 1 situation is possible to be maintained or created by winning space, but the player decides to try to win space to a situation where there would be an odd-man-minus situation and pressure on the puck	Forcing the play
9	The player tries to win space outside of the scoring area, though the other nine skaters on the ice are situated so that an immediate access to the scoring area is denied or to maintain or create a 2 on 1 situation on the puck. The player's decision would result in an odd-man-minus situation and pressure on the puck	Forcing the play
10	The player tries to make space outside of the scoring area, because the other nine skaters are situated so that an immediate access to the scoring area is denied and making space is the only decision that would result in maintaining or creating a 2 on 1 situation on the puck	Right decision (Sensible decision)
11	The player tries to make space outside of the scoring area, in a situation, where the other nine skaters are situated so that there would be a chance to immediately access the scoring area or maintain or create a 2 on 1 situation by winning space	Settling
12	The player tries to make space outside of the scoring area, in a situation, where the other nine skaters on the ice are situated so that immediate access to the scoring area is denied and a 2 on 1 situation is possible to be maintained or created only by making space, but the player decides to try to make space to a situation where there would be an odd-man-minus situation and pressure on the puck	Forcing the play
13	The player is outside the scoring area and tries to dump the puck, because the other nine skaters are situated so that he is under pressure and has no chance of immediately accessing the scoring are or creating a 2 on 1 situation on the puck by winning or making space.	Right decision (Sensible decision)
14	The player is outside the scoring area and tries to dump the puck, although there is a chance of immediately accessing the scoring area or creating a 2 on 1 situation by winning or making space	Settling
15	No apparent aim can be observed from the player's actions	Freezing

Out of the 15 variables, 5 correspond to actions that are perceived to be efficient and 10 inefficient. This perception of efficiency is based on our interpretation of the Finnish Ice Hockey Association's Meidän peli theory for teaching the game. According to our interpretation a player should always attempt to play according to the highest possible game priority in any given situation. However, with the exception of getting the puck into the scoring area and thus creating an immediate scoring chance, the player's actions should lead to a situation, where his team has the chance of creating a 2 on 1 situation on the puck. If there is no action that would create such situation, the efficient thing to do is to dump the puck into a position, wherefrom the opponent has the longest possible distance to travel in order to reach the scoring area, and start defending. An even-man situation, for example 2 on 2, on the puck, is considered a chance to create a 2 on 1, unless the puck carrier is under imminent pressure from the opponent and in clear danger of losing the puck.

The variables are pooled into four bigger categories: right decisions, forcing the play, settling and freezing. The variables within a category all refer to the same kind of decisions. The right decision category, consisting of variables 1,2,7,10 and 13, has all the actions that are considered to be most efficient in the situation they were manifested. This category is further divided into two subcategories: the most efficient decisions and the sensible decisions. The most efficient decisions are related to scoring and winning space, whereas the sensible decisions are making space and dumping the puck in situations, where those are the highest priority possible to obtain. The forcing-the-play category, on the other hand, refers to incidents, where the player attempted to play to excessively high priority and, therefore, created a situation of low offensive efficiency and possibly high offensive risk for his team. A good example of such situation would be a player attempting to win space without the support of his teammates and ending up in a 1 on 2 or a 1 on 3 situation. The variables in this category are 3,8,9 and 12. Settling refers to the act of not attempting to play to the highest priority the situation enables, therefore settling for a play that is less than optimal in terms of efficiency. A good example of such incident could be a defender getting a lateral pass from his defensive partner in the defensive zone with a lot of free space in front of him, and not winning the space, but opting to wait for the opponent

to pressure him and then playing the puck back to the other side with another lateral pass. Opting to pass to a worse placed teammate when you are 1 on 1 with the opponents goalie is another typical example of settling. Variables 4,5,6,11 and 14 are considered settling. The category of freezing consists of only one variable and refers to the act of not acting at all or acting without a clear intent.

6.3.2 The measurements

The instrument gives a lot of specific information to the observer about the players actions. The result sheet offers the percentage share of each variable in each of the three zones of the ice. It also gives the percentage shares of the different categories, explained in the previous chapter, per each zone. In addition, the percentage shares of each category from all the incidents in all zones can also be found on the result sheet. The most crucial and comprehensive of these percentages is the percentage of right decisions. This numeric value can also be considered to be the grade for the player's game sense. These percentages help the observer to paint a specific profile of the player's decisions in the game. It allows the observer to get a grasp of how the player sees the game – what kind of patterns does he cling to in the fast pace of the game.

6.3.3 The gathering sheet

The gathering sheet is meant to be first printed out and used manually by simply tallying the amount of incidents per each variable. Each variable is further divided into the three zones of an ice hockey rink: the defensive zone, neutral zone and offensive zone. Therefore, if a player, for example, tries to score from the scoring area (variable 1), it is marked on the information gathering sheet in location illustrated in figure 9.

Name: Player 1

Game: Pelicans vs Blues

	Defensive zone	Neutral zone	Offensive zone
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			

Figure 9. A player’s attempt to score from the scoring area is tallied and marked in the box with the red circle.

After the printed paper version of the gathering sheet has been used to analyse and tally the incidents from the video footage, the results are then typed onto the electronical version of the sheet. Figure 10 shows an example of a gathering sheet with the data of 10 games in it. When the data is typed into the information gathering sheet, it automatically transfers also onto the result sheet.

Name: Player 1

Game: Summary of all 10 games

	Defensive zone	Neutral zone	Offensive zone
1	0	0	24
2	0	0	6
3	0	0	2
4	0	0	0
5	0	0	0
6	0	0	0
7	85	13	15
8	28	5	1
9	14	2	0
10	70	17	7
11	7	2	0
12	8	1	0
13	25	3	4
14	21	4	1
15	14	0	1

Figure 10. An example of an information gathering sheet with the data from 10 games on it.

6.3.4 The result sheet

The result sheet (figure 11) is the most visible and, therefore, the most important part of our instrument. It has all the percentage shares of each variable out of all the incidents in each separate zone. It also has the percentage shares of each of the categories of decision out of all the incidents.

An instrument for analysing hockey sense in offence, result sheet

	Variable	D-zone	%	% Tot.	N-zone	%	% Tot.	O-Zone	%	% Tot.	Total % of all incidents in all zones	Percentage of right decisions	
The most efficient decisions	1	0	0,00	31,25	0	0,00	22,81	24	39,34	73,77	36,67		72
	2	0	0,00		0	0,00		6	9,84				
	7	85	31,25		13	22,81		15	24,59				
Sensible decisions	10	70	25,74	34,93	17	29,82	52,63	7	11,48	18,03	34,87		
	13	25	9,19		13	22,81		4	6,56				
Percentage of right decisions				66,18	% of right decisions		75,44	% of right decisions		91,80	71,54		
Forcing the play	3	0	0,00	18,38	0	0,00	14,04	2	3,28	4,92	15,64		
	8	28	10,29		5	8,77		1	1,64				
	9	14	5,15		2	3,51		0	0,00				
	12	8	2,94		1	1,75		0	0,00				
Percentage of forcing the play				18,38	% of forcing the play		14,04	% of forcing the play		4,92	15,64		
Settling	4	0	0,00	10,29	0	0,00	10,53	0	0,00	1,64	8,97		
	5	0	0,00		0	0,00		0	0,00				
	6	0	0,00		0	0,00		0	0,00				
	11	7	2,57		2	3,51		0	0,00				
	14	21	7,72		4	7,02		1	1,64				
Percentage of settling				10,29	% of settling		10,53	% of settling		1,64	8,97		
Freezing	15	14	5,15	5,15	0	0,00	0,00	1	1,64	1,64	3,85		
% of freezing					5,15	% of freezing		0,00	% of freezing			1,64	3,85

Figure 11. An example of the result sheet with data from 10 games on it.

If you go through the result sheet from left to right, the first column has all the categories of decision in it (figure 12). The right decisions category is formed by its two sub-categories: the most efficient decisions and sensible decisions. The next column has all the variables listed in an order that corresponds to the categories in the adjacent column.

An instrument for analysing hockey sense in offence, result sheet

	Variable	D-zone	%	% Tot.	N-zone	%	% Tot.	O-Zone	%	% Tot.	Total % of all incidents in all zones	Percentage of right decisions
The most efficient decisions	1	0	0,00	31,25	0	0,00	22,81	24	39,34	73,77	36,67	
	2	0	0,00		0	0,00		6	9,84			
	7	85	31,25		13	22,81		15	24,59			
Sensible decisions	10	70	25,74	34,93	17	29,82	52,63	7	11,48	18,03	34,87	
	13	25	9,19		13	22,81		4	6,56			
Percentage of right decisions				66,18	% of right decisions		75,44	% of right decisions		91,80	71,54	
Forcing the play	3	0	0,00	18,38	0	0,00	14,04	2	3,28	4,92	15,64	
	8	28	10,29		5	8,77		1	1,64			
	9	14	5,15		2	3,51		0	0,00			
	12	8	2,94		1	1,75		0	0,00			
Percentage of forcing the play				18,38	% of forcing the play		14,04	% of forcing the play		4,92	15,64	
Settling	4	0	0,00	10,29	0	0,00	10,53	0	0,00	1,64	8,97	
	5	0	0,00		0	0,00		0	0,00			
	6	0	0,00		0	0,00		0	0,00			
	11	7	2,57		2	3,51		0	0,00			
	14	21	7,72		4	7,02		1	1,64			
Percentage of settling				10,29	% of settling		10,53	% of settling		1,64	8,97	
Freezing	15	14	5,15	5,15	0	0,00	0,00	1	1,64	1,64	3,85	
% of freezing					5,15	% of freezing		0,00	% of freezing			1,64

Figure 12. The categories are marked on the far left column of the result sheet.

The data of each zone highlighted with a different background colour in order to make the sheet easier to read. The defensive zone data has a light green back ground, the neutral zone has blue and the offensive zone turquoise back ground. The totals of all to zones put together are marked on the yellow background. The first column on the left in each of the zones marks the number of incidents per variable in that zone. Figure 13 shows, where the number of incidents, when the player efficiently won space in the defensive zone (variable 7), is marked. Figure 14, on the other hand, shows where the number of incidents of efficiently attempting to score (variable 1) is marked. As previously explained in the information gathering sheet chapter, these numbers are transferred to the right place in the result sheet, when they are correctly typed onto the information gathering sheet. Therefore, nothing should be typed onto the result sheet.

An instrument for analysing hockey sense in offence, result sheet

	Variable	D-zone	%	% Tot.	N-zone	%	% Tot.	O-Zone	%	% Tot.	Total % of all incidents in all zones	Percentage of right decisions
The most efficient decisions	1	0	0,00	31,25	0	0,00	22,81	24	39,34	73,77	36,67	
	2	0	0,00		0	0,00		6	9,84			
	7	85	31,25		13	22,81		15	24,59			
Sensible decisions	10	70	25,74	34,93	17	29,82	52,63	7	11,48	18,03	34,87	
	13	25	9,19		13	22,81		4	6,56			
Percentage of right decisions				66,18	% of right decisions		75,44	% of right decisions		91,80	71,54	
Forcing the play	3	0	0,00	18,38	0	0,00	14,04	2	3,28	4,92	15,64	
	8	28	10,29		5	8,77		1	1,64			
	9	14	5,15		2	3,51		0	0,00			
	12	8	2,94		1	1,75		0	0,00			
Percentage of forcing the play				18,38	% of forcing the play		14,04	% of forcing the play		4,92	15,64	
Settling	4	0	0,00	10,29	0	0,00	10,53	0	0,00	1,64	8,97	
	5	0	0,00		0	0,00		0	0,00			
	6	0	0,00		0	0,00		0	0,00			
	11	7	2,57		2	3,51		0	0,00			
Percentage of settling				10,29	% of settling		10,53	% of settling		1,64	8,97	
Freezing	15	14	5,15	5,15	0	0,00	0,00	1	1,64	1,64	3,85	
% of freezing					5,15	% of freezing		0,00	% of freezing			1,64

Figure 13. The number of incidents for variable 7 in the defensive zone.

An instrument for analysing hockey sense in offence, result sheet

	Variable	D-zone	%	% Tot.	N-zone	%	% Tot.	O-Zone	%	% Tot.	Total % of all incidents in all zones	Percentage of right decisions
The most efficient decisions	1	0	0,00	31,25	0	0,00	22,81	24	39,34	73,77	36,67	
	2	0	0,00		0	0,00		6	9,84			
	7	85	31,25		13	22,81		15	24,59			
Sensible decisions	10	70	25,74	34,93	17	29,82	52,63	7	11,48	18,03	34,87	
	13	25	9,19		13	22,81		4	6,56			
Percentage of right decisions				66,18	% of right decisions		75,44	% of right decisions		91,80	71,54	
Forcing the play	3	0	0,00	18,38	0	0,00	14,04	2	3,28	4,92	15,64	
	8	28	10,29		5	8,77		1	1,64			
	9	14	5,15		2	3,51		0	0,00			
	12	8	2,94		1	1,75		0	0,00			
Percentage of forcing the play				18,38	% of forcing the play		14,04	% of forcing the play		4,92	15,64	
Settling	4	0	0,00	10,29	0	0,00	10,53	0	0,00	1,64	8,97	
	5	0	0,00		0	0,00		0	0,00			
	6	0	0,00		0	0,00		0	0,00			
	11	7	2,57		2	3,51		0	0,00			
Percentage of settling				10,29	% of settling		10,53	% of settling		1,64	8,97	
Freezing	15	14	5,15	5,15	0	0,00	0,00	1	1,64	1,64	3,85	
% of freezing					5,15	% of freezing		0,00	% of freezing			1,64

Figure 14. The number of incidents for variable 1 in the offensive zone.

After the data is typed onto the information gathering sheet, and thus transferred also onto the result sheet, the result sheet automatically calculates the all the percentage shares shown on the sheet. On the sheet, there are three columns for each zone. The column in the middle illustrates the percentage share of the incidents of the variable on

the same row, compared to the total amount of incident in the zone. For example, the player in figure 15 has been able to efficiently win space 31,25 % of the possessions he gained in the defensive zone.

An instrument for analysing hockey sense in offence, result sheet

	Variable	D-zone	%	% Tot.	N-zone	%	% Tot.	O-Zone	%	% Tot.	Total % of all incidents in all zones	Percentage of right decisions
The most efficient decisions	1	0	0,00	31,25	0	0,00	22,81	24	39,34	73,77	36,67	
	2	0	0,00		0	0,00		6	9,84			
	7	85	31,25		13	22,81		15	24,59			
Sensible decisions	10	70	25,74	34,93	17	29,82	52,63	7	11,48	18,03	34,87	
	13	25	9,19		13	22,81		4	6,56			
	Percentage of right decisions		66,18		% of right decisions			75,44	% of right decisions			91,80
Forcing the play	3	0	0,00	18,38	0	0,00	14,04	2	3,28	4,92	15,64	
	8	28	10,29		5	8,77		1	1,64			
	9	14	5,15		2	3,51		0	0,00			
	12	8	2,94		1	1,75		0	0,00			
Percentage of forcing the play		18,38		% of forcing the play		14,04	% of forcing the play		4,92	15,64		
Settling	4	0	0,00	10,29	0	0,00	10,53	0	0,00	1,64	8,97	
	5	0	0,00		0	0,00		0	0,00			
	6	0	0,00		0	0,00		0	0,00			
	11	7	2,57		2	3,51		0	0,00			
	14	21	7,72		4	7,02		1	1,64			
Percentage of settling		10,29		% of settling		10,53	% of settling		1,64	8,97		
Freezing	15	14	5,15	5,15	0	0,00	0,00	1	1,64	1,64	3,85	
% of freezing		5,15			% of freezing			0,00	% of freezing			1,64

Figure 15. The percentage share of variable 7 in the defensive zone is shown in the cell highlighted with the red circle.

The column on the far right in each of the zones illustrates the percentage share of the corresponding category out of all the incidents in the zone in question. For example, figure 16 shows the percentage of right decisions in the defensive zone. Figure 17, on the other hand, illustrates the percentage of forcing the play in the neutral zone and figure 18 tells the reader that the player freezes up in 5,15 % of all possessions gained in the defensive zone.

An instrument for analysing hockey sense in offence, result sheet

	Variable	D-zone	%	% Tot.	N-zone	%	% Tot.	O-Zone	%	% Tot.	Total % of all incidents in all zones	Percentage of right decisions
The most efficient decisions	1	0	0,00	31,25	0	0,00	22,81	24	39,34	73,77	36,67	
	2	0	0,00		0	0,00		6	9,84			
	7	85	31,25		13	22,81		15	24,59			
Sensible decisions	10	70	25,74	34,93	17	29,82	52,63	7	11,48	18,03	34,87	
	13	25	9,19		13	22,81		4	6,56			
Percentage of right decisions				66,18	% of right decisions		75,44	% of right decisions		91,80	71,54	
Forcing the play	3	0	0,00	18,38	0	0,00	14,04	2	3,28	4,92	15,64	
	8	28	10,29		5	8,77		1	1,64			
	9	14	5,15		2	3,51		0	0,00			
	12	8	2,94		1	1,75		0	0,00			
Percentage of forcing the play				18,38	% of forcing the play		14,04	% of forcing the play		4,92	15,64	
Settling	4	0	0,00	10,29	0	0,00	10,53	0	0,00	1,64	8,97	
	5	0	0,00		0	0,00		0	0,00			
	6	0	0,00		0	0,00		0	0,00			
	11	7	2,57		2	3,51		0	0,00			
Percentage of settling				10,29	% of settling		10,53	% of settling		1,64	8,97	
Freezing	15	14	5,15	5,15	0	0,00	0,00	1	1,64	1,64	3,85	
% of freezing					5,15	% of freezing		0,00	% of freezing			1,64

Figure 16. Percentage of right decisions in the defensive zone is illustrated in the cell highlighted by the red circle.

An instrument for analysing hockey sense in offence, result sheet

	Variable	D-zone	%	% Tot.	N-zone	%	% Tot.	O-Zone	%	% Tot.	Total % of all incidents in all zones	Percentage of right decisions
The most efficient decisions	1	0	0,00	31,25	0	0,00	22,81	24	39,34	73,77	36,67	
	2	0	0,00		0	0,00		6	9,84			
	7	85	31,25		13	22,81		15	24,59			
Sensible decisions	10	70	25,74	34,93	17	29,82	52,63	7	11,48	18,03	34,87	
	13	25	9,19		13	22,81		4	6,56			
Percentage of right decisions				66,18	% of right decisions		75,44	% of right decisions		91,80	71,54	
Forcing the play	3	0	0,00	18,38	0	0,00	14,04	2	3,28	4,92	15,64	
	8	28	10,29		5	8,77		1	1,64			
	9	14	5,15		2	3,51		0	0,00			
	12	8	2,94		1	1,75		0	0,00			
Percentage of forcing the play				18,38	% of forcing the play		14,04	% of forcing the play		4,92	15,64	
Settling	4	0	0,00	10,29	0	0,00	10,53	0	0,00	1,64	8,97	
	5	0	0,00		0	0,00		0	0,00			
	6	0	0,00		0	0,00		0	0,00			
	11	7	2,57		2	3,51		0	0,00			
Percentage of settling				10,29	% of settling		10,53	% of settling		1,64	8,97	
Freezing	15	14	5,15	5,15	0	0,00	0,00	1	1,64	1,64	3,85	
% of freezing					5,15	% of freezing		0,00	% of freezing			1,64

Figure 17. The percentage share of incidents, where the player tries to force the play, out of all incidents in the neutral zone is illustrated in the cell highlighted by the red circle.

An instrument for analysing hockey sense in offence, result sheet

	Variable	D-zone	%	% Tot.	N-zone	%	% Tot.	O-Zone	%	% Tot.	Total % of all incidents in all zones	Percentage of right decisions
The most efficient decisions	1	0	0,00	31,25	0	0,00	22,81	24	39,34	73,77	36,67	
	2	0	0,00		0	0,00		6	9,84			
	7	85	31,25		13	22,81		15	24,59			
Sensible decisions	10	70	25,74	34,93	17	29,82	52,63	7	11,48	18,03	34,87	
	13	25	9,19		13	22,81		4	6,56			
Percentage of right decisions				66,18	% of right decisions		75,44	% of right decisions		91,80	71,54	
Forcing the play	3	0	0,00	18,38	0	0,00	14,04	2	3,28	4,92	15,64	
	8	28	10,29		5	8,77		1	1,64			
	9	14	5,15		2	3,51		0	0,00			
	12	8	2,94		1	1,75		0	0,00			
Percentage of forcing the play				18,38	% of forcing the play		14,04	% of forcing the play		4,92	15,64	
Settling	4	0	0,00	10,29	0	0,00	10,53	0	0,00	1,64	8,97	
	5	0	0,00		0	0,00		0	0,00			
	6	0	0,00		0	0,00		0	0,00			
	11	7	2,57		2	3,51		0	0,00			
	14	21	7,72		4	7,02		1	1,64			
Percentage of settling				10,29	% of settling		10,53	% of settling		1,64	8,97	
Freezing	15	14	5,15	5,15	0	0,00	0,00	1	1,64	1,64	3,85	
% of freezing					5,15	% of freezing		0,00	% of freezing			1,64

Figure 18. The subject of the analysis freezes up in 5,15 % of all possessions gained in the defensive zone.

The column with the yellow background, on the far right hand side of the sheet, shows the total percentage shares of each category out of all the incidents. For example, the player has settled for a play with less than optimal efficiency in 8,97 % of all possessions gained, as figure 19 illustrates. The most important of all the percentages, the total percentage of right decisions out of all the analysed possessions, can be found, with the precision of two decimal places, from the column with the yellow background. This percentage value is rounded to the precision of ones for number that can be considered to be the grade for player’s game sense. This number is illustrated in the top right corner of the sheet (figure 20) and has significantly larger font size. Therefore, it’s easy for the reader to find the most crucial information on the sheet.

An instrument for analysing hockey sense in offence, result sheet

	Variable	D-zone	%	% Tot.	N-zone	%	% Tot.	O-Zone	%	% Tot.	Total % of all incidents in all zones	Percentage of right decisions
The most efficient decisions	1	0	0,00	31,25	0	0,00	22,81	24	39,34	73,77	36,67	72
	2	0	0,00		0	0,00		6	9,84			
	7	85	31,25		13	22,81		15	24,59			
Sensible decisions	10	70	25,74	34,93	17	29,82	52,63	7	11,48	18,03	34,87	
	13	25	9,19		13	22,81		4	6,56			
Percentage of right decisions				66,18	% of right decisions		75,44	% of right decisions		91,80	71,54	
Forcing the play	3	0	0,00	18,38	0	0,00	14,04	2	3,28	4,92	15,64	
	8	28	10,29		5	8,77		1	1,64			
	9	14	5,15		2	3,51		0	0,00			
	12	8	2,94		1	1,75		0	0,00			
Percentage of forcing the play				18,38	% of forcing the play		14,04	% of forcing the play		4,92	15,64	
Settling	4	0	0,00	10,29	0	0,00	10,53	0	0,00	1,64	8,97	
	5	0	0,00		0	0,00		0	0,00			
	6	0	0,00		0	0,00		0	0,00			
	11	7	2,57		2	3,51		0	0,00			
	14	21	7,72		4	7,02		1	1,64			
Percentage of settling				10,29	% of settling		10,53	% of settling		1,64	8,97	
Freezing	15	14	5,15	5,15	0	0,00	0,00	1	1,64	1,64	3,85	
% of freezing					5,15	% of freezing		0,00	% of freezing			1,64

Figure 19. The percentage share of settling out of all the incidents can be found from the cell highlighted by the red circle

An instrument for analysing hockey sense in offence, result sheet

	Variable	D-zone	%	% Tot.	N-zone	%	% Tot.	O-Zone	%	% Tot.	Total % of all incidents in all zones	Percentage of right decisions
The most efficient decisions	1	0	0,00	31,25	0	0,00	22,81	24	39,34	73,77	36,67	72
	2	0	0,00		0	0,00		6	9,84			
	7	85	31,25		13	22,81		15	24,59			
Sensible decisions	10	70	25,74	34,93	17	29,82	52,63	7	11,48	18,03	34,87	
	13	25	9,19		13	22,81		4	6,56			
Percentage of right decisions				66,18	% of right decisions		75,44	% of right decisions		91,80	71,54	
Forcing the play	3	0	0,00	18,38	0	0,00	14,04	2	3,28	4,92	15,64	
	8	28	10,29		5	8,77		1	1,64			
	9	14	5,15		2	3,51		0	0,00			
	12	8	2,94		1	1,75		0	0,00			
Percentage of forcing the play				18,38	% of forcing the play		14,04	% of forcing the play		4,92	15,64	
Settling	4	0	0,00	10,29	0	0,00	10,53	0	0,00	1,64	8,97	
	5	0	0,00		0	0,00		0	0,00			
	6	0	0,00		0	0,00		0	0,00			
	11	7	2,57		2	3,51		0	0,00			
	14	21	7,72		4	7,02		1	1,64			
Percentage of settling				10,29	% of settling		10,53	% of settling		1,64	8,97	
Freezing	15	14	5,15	5,15	0	0,00	0,00	1	1,64	1,64	3,85	
% of freezing					5,15	% of freezing		0,00	% of freezing			1,64

Figure 20. The percentage share of right decisions is illustrated with the precision of two decimal places in the yellow column and rounded to the precision of ones and illustrated in the right top corner of the sheet. This can be considered the player's grade for his game sense.

7 Summary and discussion

The objective of our project was to create an analysing and assessment instrument for offensive game sense in ice hockey. In addition to the instrument, the project resulted in a user manual for the instrument. The instrument focuses on analysing the individual's decisions in the game situation role of the puck carrier. The analysis is done post-game by analysing the first three seconds of each puck possession by the player from video footage. The subject of analysis is the player's decision, which is concluded from the intent of his actions. In other words, the successfulness of skill execution is disregarded. The separation of skill execution and decision making is a common setting in the research about game sense and decision making in sports.

Some prior instruments, such as the GPAI, have been created for assessing decision making in sports. In relation to most of these instruments, especially the GPAI, we wanted to create an instrument that would give us more specific information about the player's decisions – an instrument for analysing, not only assessing. In order to achieve this goal, we made our instrument as detailed as possible, while staying within the boundaries of manageability. Therefore, the instrument includes 15 variables for the player's actions. These variables were further grouped into four categories: right decisions, forcing the play, settling and freezing. The variables are based on the theoretical framework of the game of ice hockey, introduced by the Finnish Ice Hockey Association in 2010, called Meidän Peli. This theoretical framework has been commonly accepted as the norm for teaching individual game sense in Finnish ice hockey. In order to be able to implement our instrument, as such, the observer needs to possess a basic understanding of this theory regarding the game. Efficient use of the instrument would also require the team that the analysed player is playing for to base their game on a game theory similar to Meidän Peli. Although, by using only the categories and not the variables, the instrument might be applied to any sort of theory of the game or team strategy, since it would give the observer more freedom to decide, which actions belong to which category.

The instrument was tested by analysing the first three seconds of all the possessions of four U16 elite level players in 10 competitive games. A total of 1321 possessions were analysed. Each possession was considered to include one decision. The amount of possessions varied from 380 to 311 among the subject players. The information was then inserted to the instrument, which consists of an electrical information gathering sheet and an electrical result sheet. These sheets are Microsoft Office Excel sheets. The result sheet provides the observer with a number of percentage shares. These shares can be used to elaborately analyse the player's game sense. If an assessment of player's game sense is needed, the percentage share of right decisions out of all the decisions made gives a comprehensive idea about the player's game sense. With the sample size of ten games, 380-311 clips, we were able to identify patterns of action that we had previously seen in our subjects' game. Therefore, gaining concrete numerical assurance to our feeling about how the player plays. For example, a winger, who has quick feet, but somewhat lack the ability to keep his head up with the puck in full stride, showed a high percentage of winning space to a situation that resulted in an odd-man-minus situation and increased offensive risk. On the other hand, a defender, who is confident with his ability as a puck carrier, was able to attempt scoring on a high percentage of possessions gained in the offensive zone. In order to gain such accurate insights about the player's game sense, a sample size of at least ten games is recommended. The amount of different variables, the dynamic nature of the game and the subjectivity of the observer is bound to create some deviancy from the descriptions of the variables in the analysing process. The effect of such an error on the end result is minimized by using a sample size that is sufficiently large.

The ten games analysed were divided into two distinctive groups, with the games within a group being played in a time span of 36 and 22 days, respectively, and the time span between the last game of the first group and first game of the second group being 27 days. The results indicated that the game sense of one of the subjects had developed, whereas three of the subjects had suffered a regression in game sense. Although, it is theoretically possible that the training process has led to this outcome, it is highly unlikely since decision making is an implicit skill that is largely based on accumulation of experience from similar situations and nothing was done to significantly change the

training process during the trial of the instrument. The more probable reasons for such an outcome include increase in the level of the opponents – SaPKo, which was played twice in the first group of games finished 27th in the country, whereas all the teams in the second group of games finished in the top-six – and the small sample size of only five games. The effect of an opponent to the result of the analysis is substantial, since assessing game sense means that we are assessing the player's ability perceive his surroundings and find the most effective course of action, according to the rules and priorities of the game, that the situation presents. Therefore, a team with superior pace and collaboration between players in defence, makes it significantly harder for the player to find the correct option for action from his surroundings. The effect of the opponent on the end result of the analysis can be reduced by using large enough sample size – ten games proved to be somewhat sufficient – or choosing to analyse games that are played against opponents with homogeneous level of play.

The notion, presented in the decision making chapter of this thesis, that decisions are made in a fast paced game, such as ice hockey, with the emotional parts of the brain and that decision making is, therefore, an implicit attribute that derives from the subconscious, is interesting in light of the detailed information the instrument has to offer. In other words, a player makes his decisions on ice based on his intuition – which is formed by past experiences in similar situations – and, therefore, largely without employing his rational brain, and we, as coaches, try to create a tool that gives us a huge amount of information about these decisions to be processed mainly with our rational brains. However, we don't see that this “controversy” would have any significance from the coach's perspective – the coach needs to obtain a vast amount of detailed information in order to form the big picture he presents to the players. In other words, it is vital for the coach to carefully think, how he presents the data provided by the instrument to the player. Science suggests that too much and too detailed information lead to poor decision making in game situations and the correct way of verbally influencing the player's decision making could be through phrases that describe how the correct act with general adjectives and metaphors, rather than imposing every detail, observed from the video, on the player. The essential thing, in order to facilitate implicit learning of game sense, is to put the players in practice into situations, where they

are constantly forced to make decisions. The regularity of these situations, often defined in ice hockey context by the team's principles of cooperation or team play systems, is vital for efficient acquisition of experience that will help the individual to improve his decision making. In other words, frequently experiencing similar situations will help the player to create implicit ways of making the most efficient decision in those situations.

The scientific reliability and validity of our instrument hasn't been confirmed. However, judging from a common sense perspective, there seems to be quite strong evidence of face, construct, content and ecological validity, since the variables of the instrument are based on a commonly accepted game theory and the actual analysis is done from video footage of a competitive game situation.

In order for the instrument to become commonly used in analysing offensive game sense further development is needed. The primary issue of development would be establishing inter-rater and test-retest reliability. Developing the instrument towards a tool, that would give the same detailed information with fewer variables, would also increase the chances of it becoming the norm for analysing offensive game sense.

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Attachments

Attachment 1. The user manual of the instrument.

An instrument for analyzing offensive game sense in ice hockey

The User Manual

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2013

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1. Introduction

This is the user manual for an instrument for analysing a player's offensive game sense in ice hockey. The idea of the instrument is to give a numerical value to a player's offensive game sense as well as give the observer specific information about the decisions the player makes. The instrument consists of an information gathering sheet and a result sheet. The instrument is meant to be used by a single observer analysing the actions of a single player from previously recorded video footage.

The instrument has 15 variables for the player's actions. The variables are based on the game's offensive priorities in ice hockey. Out of the 15 variables, 5 correspond to actions that are perceived to be efficient and 10 inefficient. This perception of efficiency is based on the instrument's creators' interpretation of the Finnish Ice Hockey Association's Meidän peli theory for teaching the game

Offensive priorities in ice hockey:

- Scoring
- Winning space
 - The puck is moving towards opponent's net
- Making space
 - The puck isn't moving towards opponent's net
- Defensive readiness
 - Dumping the puck further from own net

The subject of analysis is only the player's decisions that can or cannot be concluded from his actions. Skill execution following the decision is excluded from the analysis. In other words, the observer is analysing the intent, not the result. The incidents of which the analysis is made, are the first three seconds of each puck possession by the player. Each possession results in one analysable incident. Therefore, the game priority, which the player intends to obtain, is observed at the end of this three seconds. In other words, if the player attempts to shoot within the three seconds, the intent is perceived to be scoring. If the player attempts to keep the possession within his team and move the puck so that it is closer to the opponents net after the three seconds than what it was when the possession was gained, the intent is perceived to be winning space. If the player attempts to keep the possession within his team and move the puck so that it is not closer to the opponents net after the three seconds than what it was when the possession was gained, the intent is perceived to be making space. If the player attempts to put the puck into a position, where the other team will pick up the loose puck and gain possession, the intent is perceived to be dumping the puck.

The instrument also separates the incidents by the zone in which they occur. This zone is established by looking at where the player is at the moment of gaining possession.

2. The variables

There are 15 variables identified simply by numbers from 1 to 15, for the player's actions. The numbering of the variables corresponds to the game priorities – numbers 1-6 are actions involving scoring, numbers 7-9 are variables for the action of winning space outside the scoring area, numbers 10-12 are variables for creating space outside the scoring area, numbers 13-14 are variables for dumping the puck and number 15 is the variable for no action or action with no intent.

The variables are:

1. The player tries to score from the scoring area, or from outside the scoring area with his teammates supporting the scoring by being in motion towards the net for a rebound and/or screening the goalie.
Category: **Right decision (subcategory: The most efficient decisions)**
2. The player tries to score from outside the scoring area, because an attempt to win or make space would result in the puck carrier being in an odd-man-minus situation and under pressure from the opponent.
Category: **Right decision (subcategory: The most efficient decisions)**
3. The player tries to score from outside the scoring area in a situation, where his teammates are not supporting scoring but enabling a better scoring change to be created by winning or making space
Category: **Forcing the play**
4. The player tries to win space instead of scoring in the scoring area.
Category: **Settling**
5. The player tries to make space instead of scoring in the scoring area.
Category: **Settling**
6. The player tries to dump the puck instead of scoring in the scoring area.
Category: **Settling**
7. The player tries to win space outside of the scoring area. The decision would result in gaining a scoring chance or a 2 on 1 situation to be maintained or created on the puck.
Category: **Right decision (subcategory: The most efficient decisions)**
8. The player tries to win space outside of the scoring area. The other nine skaters on the ice are situated so that a 2 on 1 situation is possible to be maintained or created by winning space, but the player decides to try to win space to a situation where there would be an odd-man-minus situation and pressure on the puck.

Category: **Forcing the play**

9. The player tries to win space outside of the scoring area, though the other nine skaters on the ice are situated so that an immediate access to the scoring area is denied or to maintain or create a 2 on 1 situation on the puck. The player's decision would result in an odd-man-minus situation and pressure on the puck.

Category: **Forcing the play**

10. The player tries to make space outside of the scoring area, because the other nine skaters are situated so that an immediate access to the scoring area is denied and making space is the only decision that would result in maintaining or creating a 2 on 1 situation on the puck.

Category: **Right decision (subcategory: Sensible decisions)**

11. The player tries to make space outside of the scoring area, in a situation, where the other nine skaters are situated so that there would be a chance to immediately access the scoring area or maintain or create a 2 on 1 situation by winning space.

Category: **Settling**

12. The player tries to make space outside of the scoring area, in a situation, where the other nine skaters on the ice are situated so that immediate access to the scoring area is denied and a 2 on 1 situation is possible to be maintained or created only by making space, but the player decides to try to make space to a situation where there would be an odd-man-minus situation and pressure on the puck.

Category: **Settling**

13. The player is outside the scoring area and tries to dump the puck, because the other nine skaters are situated so that he is under pressure and has no chance of immediately accessing the scoring area or creating a 2 on 1 situation on the puck by winning or making space.

Category: **Right decision (subcategory: Sensible decisions)**

14. The player is outside the scoring area and tries to dump the puck, although there is a chance of immediately accessing the scoring area or creating a 2 on 1 situation by winning or making space.

Category: **Settling**

15. No apparent aim can be observed from the player's actions.

Category: **Freezing**

According to our interpretation a player should always attempt to play according to the highest possible game priority in any given situation. However, with the exception of getting the puck into the scoring area and thus creating an immediate scoring chance, the player's actions should lead to a situation, where his team has the chance of creating a 2 on 1 situation on the puck. If there is no action that would create such situation, the efficient thing to do is to dump the puck into a position, wherefrom the opponent has the longest possible distance to travel in order to reach the scoring area, and start defending. An even-man situation, for example 2 on 2, on the puck, is considered a chance to create a 2 on 1, unless the puck carrier is under imminent pressure from the opponent and in clear danger of losing the puck.

The variables are pooled into four bigger categories: right decisions, forcing the play, settling and freezing. The variables within a category all refer to the same kind of decisions. The right decision category, consisting of variables 1,2,7,10 and 13, has all the actions that are considered to be most efficient in the situation they were manifested. This category is further divided into two subcategories: the most efficient decisions and the sensible decisions. The most efficient decisions are related to scoring and winning space, whereas the sensible decisions are making space and dumping the puck in situations, where those are the highest priority possible to obtain. The forcing-the-play category, on the other hand, refers to incidents, where the player attempted to play to excessively high priority and, therefore, created a situation of low offensive efficiency and possibly high offensive risk for his team. A good example of such situation would be a player attempting to win space without the support of his teammates and ending up in a 1 on 2 or a 1 on 3 situation. The variables in this category are 3,8,9 and 12. Settling refers to the act of not attempting to play to the highest priority the situation enables, therefore settling for a play that is less than optimal in terms of efficiency. A good example of such incident could be a defender getting a lateral pass from his defensive partner in the defensive zone with a lot of free space in front of him, and not winning the space, but opting to wait for the opponent to pressure him and then playing the puck back to the other side with another lateral pass. Opting to pass to a worse placed teammate when you are 1 on 1 with the opponents goalie is another typical example of settling. Variables 4,5,6,11 and 14 are considered settling. The category of freezing consists of only one variable and refers to the act of not acting at all or acting without a clear intent.

3. The measurements

The instrument gives a lot of specific information to the observer about the players actions. The result sheet offers the percentage share of each variable in each of the three zones of the ice. It also gives the percentage shares of the different categories, explained in the previous chapter, per each zone. In addition, the percentage shares of each category from all the incidents in all zones can also be found on the result sheet. The most crucial and comprehensive of these percentages is the percentage of right decisions. This numeric value can also be considered to be the grade for the player's game sense. These percentages help the observer to paint a specific profile of the player's decisions in the game. It allows the observer to get a grasp of how the player sees the game – what kind of patterns does he cling to in the fast pace of the game.

4. The gathering sheet

The gathering sheet is meant to be first printed out and used manually by simply tallying the amount of incidents per each variable. Each variable is further divided into the three zones of an ice hockey rink: the defensive zone, neutral zone and offensive zone. Therefore, if a player, for example, tries to score from the scoring area (variable 1), it is marked on the information gathering sheet in location illustrated in figure 1.

An instrument for analysing hockey sense in offense, information gathering sheet

Name: Player 1

Game: Pelicans vs Blues


	Defensive zone	Neutral zone	Offensive zone
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			

Figure 1. A player's attempt to score from the scoring area is tallied and marked in the box with the red circle.

After the printed paper version of the gathering sheet has been used to analyse and tally the incidents from the video footage, the results are then typed onto the electrical version of the sheet. Figure 2 shows an example of a gathering sheet with the data of 10 games in it. When the data is typed into the information gathering sheet, it automatically transfers also onto the result sheet.

Name: Player 1

Game: Summary of all 10 games

	Defensive zone	Neutral zone	Offensive zone
1	0	0	24
2	0	0	6
3	0	0	2
4	0	0	0
5	0	0	0
6	0	0	0
7	85	13	15
8	28	5	1
9	14	2	0
10	70	17	7
11	7	2	0
12	8	1	0
13	25	3	4
14	21	4	1
15	14	0	1

Figure 2. An example of an information gathering sheet with the data from 10 games on it.

5. The result sheet

The result sheet (figure 3) is the most visible and, therefore, the most important part of our instrument. It has all the percentage shares of each variable out of all the incidents in each separate zone. It also has the percentage shares of each of the categories of decision out of all the incidents.

An instrument for analysing hockey sense in offence, result sheet

	Variable	D-zone	%	% Tot.	N-zone	%	% Tot.	O-Zone	%	% Tot.	Total % of all incidents in all zones	Percentage of right decisions
The most efficient decisions	1	0	0,00	31,25	0	0,00	22,81	24	39,34	73,77	36,67	72
	2	0	0,00		0	0,00		6	9,84			
	7	85	31,25		13	22,81		15	24,59			
Sensible decisions	10	70	25,74	34,93	17	29,82	52,63	7	11,48	18,03	34,87	72
	13	25	9,19		13	22,81		4	6,56			
Percentage of right decisions				66,18	% of right decisions		75,44	% of right decisions		91,80	71,54	72
Forcing the play	3	0	0,00	18,38	0	0,00	14,04	2	3,28	4,92	15,64	
	8	28	10,29		5	8,77		1	1,64			
	9	14	5,15		2	3,51		0	0,00			
	12	8	2,94		1	1,75		0	0,00			
Percentage of forcing the play				18,38	% of forcing the play		14,04	% of forcing the play		4,92	15,64	
Settling	4	0	0,00	10,29	0	0,00	10,53	0	0,00	1,64	8,97	
	5	0	0,00		0	0,00		0	0,00			
	6	0	0,00		0	0,00		0	0,00			
	11	7	2,57		2	3,51		0	0,00			
Percentage of settling				10,29	% of settling		10,53	% of settling		1,64	8,97	
Freezing	15	14	5,15	5,15	0	0,00	0,00	1	1,64	1,64	3,85	72
% of freezing					5,15	% of freezing		0,00	% of freezing			

Figure 3. An example of the result sheet with data from 10 games on it.

If you go through the result sheet from left to right, the first column has all the categories of decision in it (figure 4). The right decisions category is formed by its two subcategories: the most efficient decisions and sensible decisions. The next column has all the variables listed in an order that corresponds to the categories in the adjacent column.

An instrument for analysing hockey sense in offence, result sheet

	Variable	D-zone	%	% Tot.	N-zone	%	% Tot.	O-Zone	%	% Tot.	Total % of all incidents in all zones	Percentage of right decisions
The most efficient decisions	1	0	0,00	31,25	0	0,00	22,81	24	39,34	73,77	36,67	72
	2	0	0,00		0	0,00		6	9,84			
	7	85	31,25		13	22,81		15	24,59			
Sensible decisions	10	70	25,74	34,93	17	29,82	52,63	7	11,48	18,03	34,87	
	13	25	9,19		13	22,81		4	6,56			
Percentage of right decisions				66,18	% of right decisions		75,44	% of right decisions		91,80	71,54	
Forcing the play	3	0	0,00	18,38	0	0,00	14,04	2	3,28	4,92	15,64	
	8	28	10,29		5	8,77		1	1,64			
	9	14	5,15		2	3,51		0	0,00			
	12	8	2,94		1	1,75		0	0,00			
Percentage of forcing the play				18,38	% of forcing the play		14,04	% of forcing the play		4,92	15,64	
Settling	4	0	0,00	10,29	0	0,00	10,53	0	0,00	1,64	8,97	
	5	0	0,00		0	0,00		0	0,00			
	6	0	0,00		0	0,00		0	0,00			
	11	7	2,57		2	3,51		0	0,00			
	14	21	7,72		4	7,02		1	1,64			
Percentage of settling				10,29	% of settling		10,53	% of settling		1,64	8,97	
Freezing	15	14	5,15	5,15	0	0,00	0,00	1	1,64	1,64	3,85	
% of freezing					5,15	% of freezing		0,00	% of freezing			1,64

Figure 4. The categories are marked on the far left column of the result sheet.

The data of each zone highlighted with a different background colour in order to make the sheet easier to read. The defensive zone data has a light green back ground, the neutral zone has blue and the offensive zone turquoise back ground. The totals of all to zones put together are marked on the yellow background. The first column on the left in each of the zones marks the number of incidents per variable in that zone. Figure 5 shows, where the number of incidents, when the player efficiently won space in the defensive zone (variable 7), is marked. Figure 6, on the other hand, shows, where the number of incidents of efficiently attempting to score (variable 1) is marked. As previously explained in the information gathering sheet chapter, these numbers transfer to the right place in the result sheet, when they are correctly typed onto the information gathering sheet. Therefore, nothing should be typed onto the result sheet.

An instrument for analysing hockey sense in offence, result sheet

	Variable	D-zone	%	% Tot.	N-zone	%	% Tot.	O-Zone	%	% Tot.	Total % of all incidents in all zones	Percentage of right decisions
The most efficient decisions	1	0	0,00	31,25	0	0,00	22,81	24	39,34	73,77	36,67	72
	2	0	0,00		0	0,00		6	9,84			
	7	85	31,25		13	22,81		15	24,59			
Sensible decisions	10	70	25,74	17	29,82	7	11,48					
	13	25	9,19	13	22,81	4	6,56					
Percentage of right decisions				66,18	% of right decisions		75,44	% of right decisions		91,80	71,54	
Forcing the play	3	0	0,00	18,38	0	0,00	14,04	2	3,28	4,92	15,64	
	8	28	10,29		5	8,77		1	1,64			
	9	14	5,15		2	3,51		0	0,00			
	12	8	2,94		1	1,75		0	0,00			
Percentage of forcing the play				18,38	% of forcing the play		14,04	% of forcing the play		4,92	15,64	
Settling	4	0	0,00	10,29	0	0,00	10,53	0	0,00	1,64	8,97	
	5	0	0,00		0	0,00		0	0,00			
	6	0	0,00		0	0,00		0	0,00			
	11	7	2,57		2	3,51		0	0,00			
	14	21	7,72		4	7,02		1	1,64			
Percentage of settling				10,29	% of settling		10,53	% of settling		1,64	8,97	
Freezing	15	14	5,15	5,15	0	0,00	0,00	1	1,64	1,64	3,85	
% of freezing					5,15	% of freezing		0,00	% of freezing			1,64

Figure 5. The number of incidents for variable 7 in the defensive zone.

An instrument for analysing hockey sense in offence, result sheet

	Variable	D-zone	%	% Tot.	N-zone	%	% Tot.	O-Zone	%	% Tot.	Total % of all incidents in all zones	Percentage of right decisions
The most efficient decisions	1	0	0,00	31,25	0	0,00	22,81	24	39,34	73,77	36,67	72
	2	0	0,00		0	0,00		6	9,84			
	7	85	31,25		13	22,81		15	24,59			
Sensible decisions	10	70	25,74	17	29,82	7	11,48					
	13	25	9,19	13	22,81	4	6,56					
Percentage of right decisions				66,18	% of right decisions		75,44	% of right decisions		91,80	71,54	
Forcing the play	3	0	0,00	18,38	0	0,00	14,04	2	3,28	4,92	15,64	
	8	28	10,29		5	8,77		1	1,64			
	9	14	5,15		2	3,51		0	0,00			
	12	8	2,94		1	1,75		0	0,00			
Percentage of forcing the play				18,38	% of forcing the play		14,04	% of forcing the play		4,92	15,64	
Settling	4	0	0,00	10,29	0	0,00	10,53	0	0,00	1,64	8,97	
	5	0	0,00		0	0,00		0	0,00			
	6	0	0,00		0	0,00		0	0,00			
	11	7	2,57		2	3,51		0	0,00			
	14	21	7,72		4	7,02		1	1,64			
Percentage of settling				10,29	% of settling		10,53	% of settling		1,64	8,97	
Freezing	15	14	5,15	5,15	0	0,00	0,00	1	1,64	1,64	3,85	
% of freezing					5,15	% of freezing		0,00	% of freezing			1,64

Figure 6. The number of incidents for variable 1 in the offensive zone.

After the data is typed onto the information gathering sheet, and thus transferred also onto the result sheet, the result sheet automatically calculates the all the percentage shares shown on the sheet. On the sheet, there is three columns for each zone. The column in the middle illustrates the percentage share of the incidents of the variable on the same row, compared to the total amount of incident in the zone. For example, the player in figure 7 has been able to efficiently win space 31,25 % of the possessions he gained in the defensive zone.

An instrument for analysing hockey sense in offence, result sheet

	Variable	D-zone	%	% Tot.	N-zone	%	% Tot.	O-Zone	%	% Tot.	Total % of all incidents in all zones	Percentage of right decisions
The most efficient decisions	1	0	0,00	31,25	0	0,00	22,81	24	39,34	73,77	36,67	
	2	0	0,00		0	0,00		6	9,84			
	7	85	31,25		13	22,81		15	24,59			
Sensible decisions	10	70	25,74	17	29,82	7	11,48	18,03	34,87			
	13	25	9,19	13	22,81	4	6,56					
Percentage of right decisions				66,18	% of right decisions		75,44	% of right decisions		91,80	71,54	
Forcing the play	3	0	0,00	18,38	0	0,00	14,04	2	3,28	4,92	15,64	
	8	28	10,29		5	8,77		1	1,64			
	9	14	5,15		2	3,51		0	0,00			
	12	8	2,94		1	1,75		0	0,00			
Percentage of forcing the play				18,38	% of forcing the play		14,04	% of forcing the play		4,92	15,64	
Settling	4	0	0,00	10,29	0	0,00	10,53	0	0,00	1,64	8,97	
	5	0	0,00		0	0,00		0	0,00			
	6	0	0,00		0	0,00		0	0,00			
	11	7	2,57		2	3,51		0	0,00			
	14	21	7,72		4	7,02		1	1,64			
Percentage of settling				10,29	% of settling		10,53	% of settling		1,64	8,97	
Freezing	15	14	5,15	5,15	0	0,00	0,00	1	1,64	1,64	3,85	
% of freezing					5,15	% of freezing		0,00	% of freezing			1,64

Figure 7. The percentage share of variable 7 in the defensive zone is shown in the cell highlighted with the red circle.

The column on the far right in each of the zones illustrates the percentage share of the corresponding category out of all the incident in the zone in question. For example, figure 8 shows the percentage of right decisions in the defensive zone. Figure 9, on the other hand, illustrates the percentage of forcing the play in the neutral zone and figure 10 tells the reader that the player freezes up in 5,15 % of all possessions gained in the defensive zone.

An instrument for analysing hockey sense in offence, result sheet

	Variable	D-zone	%	% Tot.	N-zone	%	% Tot.	O-Zone	%	% Tot.	Total % of all incidents in all zones	Percentage of right decisions
The most efficient decisions	1	0	0,00	31,25	0	0,00	22,81	24	39,34	73,77	36,67	
	2	0	0,00		0	0,00		6	9,84			
	7	85	31,25		13	22,81		15	24,59			
Sensible decisions	10	70	25,74	17	29,82	7	11,48	18,03	34,87			
	13	25	9,19	13	22,81	4	6,56					
Percentage of right decisions				66,18	% of right decisions		75,44	% of right decisions		91,80	71,54	
Forcing the play	3	0	0,00	18,38	0	0,00	14,04	2	3,28	4,92	15,64	
	8	28	10,29		5	8,77		1	1,64			
	9	14	5,15		2	3,51		0	0,00			
	12	8	2,94		1	1,75		0	0,00			
Percentage of forcing the play				18,38	% of forcing the play		14,04	% of forcing the play		4,92	15,64	
Settling	4	0	0,00	10,29	0	0,00	10,53	0	0,00	1,64	8,97	
	5	0	0,00		0	0,00		0	0,00			
	6	0	0,00		0	0,00		0	0,00			
	11	7	2,57		2	3,51		0	0,00			
	14	21	7,72		4	7,02		1	1,64			
Percentage of settling				10,29	% of settling		10,53	% of settling		1,64	8,97	
Freezing	15	14	5,15	5,15	0	0,00	0,00	1	1,64	1,64	3,85	
% of freezing					5,15	% of freezing		0,00	% of freezing			1,64

Figure 8. Percentage of right decisions in the defensive zone is illustrated in the cell highlighted by the red circle.

An instrument for analysing hockey sense in offence, result sheet

	Variable	D-zone	%	% Tot.	N-zone	%	% Tot.	O-Zone	%	% Tot.	Total % of all incidents in all zones	Percentage of right decisions
The most efficient decisions	1	0	0,00	31,25	0	0,00	22,81	24	39,34	73,77	36,67	72
	2	0	0,00		0	0,00		6	9,84			
	7	85	31,25		13	22,81		15	24,59			
Sensible decisions	10	70	25,74	17	29,82	7	11,48					
	13	25	9,19	13	22,81	4	6,56					
Percentage of right decisions				66,18	% of right decisions		75,44	% of right decisions		91,80	71,54	
Forcing the play	3	0	0,00	18,38	0	0,00	14,04	2	3,28	4,92	15,64	
	8	28	10,29		5	8,77		1	1,64			
	9	14	5,15		2	3,51		0	0,00			
	12	8	2,94		1	1,75		0	0,00			
Percentage of forcing the play				18,38	% of forcing the play		14,04	% of forcing the play		4,92	15,64	
Settling	4	0	0,00	10,29	0	0,00	10,53	0	0,00	1,64	8,97	
	5	0	0,00		0	0,00		0	0,00			
	6	0	0,00		0	0,00		0	0,00			
	11	7	2,57		2	3,51		0	0,00			
	14	21	7,72		4	7,02		1	1,64			
Percentage of settling				10,29	% of settling		10,53	% of settling		1,64	8,97	
Freezing	15	14	5,15	5,15	0	0,00	0,00	1	1,64	1,64	3,85	
% of freezing					5,15	% of freezing		0,00	% of freezing			1,64

Figure 9. The percentage share of incidents, where the player tries to force the play, out of all incidents in the neutral zone is illustrated in the cell highlighted by the red circle.

An instrument for analysing hockey sense in offence, result sheet

	Variable	D-zone	%	% Tot.	N-zone	%	% Tot.	O-Zone	%	% Tot.	Total % of all incidents in all zones	Percentage of right decisions
The most efficient decisions	1	0	0,00	31,25	0	0,00	22,81	24	39,34	73,77	36,67	72
	2	0	0,00		0	0,00		6	9,84			
	7	85	31,25		13	22,81		15	24,59			
Sensible decisions	10	70	25,74	17	29,82	7	11,48					
	13	25	9,19	13	22,81	4	6,56					
Percentage of right decisions				66,18	% of right decisions		75,44	% of right decisions		91,80	71,54	
Forcing the play	3	0	0,00	18,38	0	0,00	14,04	2	3,28	4,92	15,64	
	8	28	10,29		5	8,77		1	1,64			
	9	14	5,15		2	3,51		0	0,00			
	12	8	2,94		1	1,75		0	0,00			
Percentage of forcing the play				18,38	% of forcing the play		14,04	% of forcing the play		4,92	15,64	
Settling	4	0	0,00	10,29	0	0,00	10,53	0	0,00	1,64	8,97	
	5	0	0,00		0	0,00		0	0,00			
	6	0	0,00		0	0,00		0	0,00			
	11	7	2,57		2	3,51		0	0,00			
	14	21	7,72		4	7,02		1	1,64			
Percentage of settling				10,29	% of settling		10,53	% of settling		1,64	8,97	
Freezing	15	14	5,15	5,15	0	0,00	0,00	1	1,64	1,64	3,85	
% of freezing					5,15	% of freezing		0,00	% of freezing			1,64

Figure 10. The subject of the analysis freezes up in 5,15 % of all possessions gained in the defensive zone.

The column with the yellow background, on the far right hand side of the sheet, show the total percentage shares of each category out of all the incidents. For example, the player has settled for a play with less than optimal efficiency in 8,97 % of all possessions gained, as figure 11 illustrates. The most important of all the percentages, the total percentage of right decisions out of all the analyzed possessions, can be found, with the precision of two decimal places, from the column with the yellow background. This percentage value is rounded to the precision of ones for number that can be considered to be the grade for player's game sense. This number is illustrated in the top right corner of the sheet (figure

12) and has significantly larger font size. Therefore, it's easy for the reader to find the most crucial information on the sheet.

An instrument for analysing hockey sense in offence, result sheet

	Variable	D-zone	%	% Tot.	N-zone	%	% Tot.	O-Zone	%	% Tot.	Total % of all incidents in all zones	Percentage of right decisions
The most efficient decisions	1	0	0,00	31,25	0	0,00	22,81	24	39,34	73,77	36,67	72
	2	0	0,00		0	0,00		6	9,84			
	7	85	31,25		13	22,81		15	24,59			
Sensible decisions	10	70	25,74	34,93	17	29,82	52,63	7	11,48	18,03	34,87	
	13	25	9,19		13	22,81		4	6,56			
Percentage of right decisions				66,18	% of right decisions		75,44	% of right decisions		91,80	71,54	
Forcing the play	3	0	0,00	18,38	0	0,00	14,04	2	3,28	4,92	15,64	
	8	28	10,29		5	8,77		1	1,64			
	9	14	5,15		2	3,51		0	0,00			
	12	8	2,94		1	1,75		0	0,00			
Percentage of forcing the play				18,38	% of forcing the play		14,04	% of forcing the play		4,92	15,64	
Settling	4	0	0,00	10,29	0	0,00	10,53	0	0,00	1,64	8,97	
	5	0	0,00		0	0,00		0	0,00			
	6	0	0,00		0	0,00		0	0,00			
	11	7	2,57		2	3,51		0	0,00			
Percentage of settling				10,29	% of settling		10,53	% of settling		1,64	8,97	
Freezing	15	14	5,15	5,15	0	0,00	0,00	1	1,64	1,64	3,85	
% of freezing					5,15	% of freezing		0,00	% of freezing			1,64

Figure 11. The percentage share of settling out of all the incidents can be found from the cell highlighted by the red circle

An instrument for analysing hockey sense in offence, result sheet

	Variable	D-zone	%	% Tot.	N-zone	%	% Tot.	O-Zone	%	% Tot.	Total % of all incidents in all zones	Percentage of right decisions
The most efficient decisions	1	0	0,00	31,25	0	0,00	22,81	24	39,34	73,77	36,67	72
	2	0	0,00		0	0,00		6	9,84			
	7	85	31,25		13	22,81		15	24,59			
Sensible decisions	10	70	25,74	34,93	17	29,82	52,63	7	11,48	18,03	34,87	
	13	25	9,19		13	22,81		4	6,56			
Percentage of right decisions				66,18	% of right decisions		75,44	% of right decisions		91,80	71,54	
Forcing the play	3	0	0,00	18,38	0	0,00	14,04	2	3,28	4,92	15,64	
	8	28	10,29		5	8,77		1	1,64			
	9	14	5,15		2	3,51		0	0,00			
	12	8	2,94		1	1,75		0	0,00			
Percentage of forcing the play				18,38	% of forcing the play		14,04	% of forcing the play		4,92	15,64	
Settling	4	0	0,00	10,29	0	0,00	10,53	0	0,00	1,64	8,97	
	5	0	0,00		0	0,00		0	0,00			
	6	0	0,00		0	0,00		0	0,00			
	11	7	2,57		2	3,51		0	0,00			
Percentage of settling				10,29	% of settling		10,53	% of settling		1,64	8,97	
Freezing	15	14	5,15	5,15	0	0,00	0,00	1	1,64	1,64	3,85	
% of freezing					5,15	% of freezing		0,00	% of freezing			1,64

Figure 12. The percentage share of right decisions is illustrated with the precision of two decimal places in the yellow column and rounded to the precision of ones and illustrated in the right top corner of the sheet. This can be considered the player's grade for his game sense.

6. How to use the instrument

1. *Film a game*
2. *Choose a player you want to analyze*
3. *Pick up the incidents when the player gains the puck from the video and edit those clips into a single video clip. Clip of each possession should be 15 seconds long*
4. *Analyze the first three seconds of each possession and gather the information onto the paper version of the gathering sheet*
5. *Transfer the information gained onto the electric version of the gathering sheet*
6. *See the results from the result sheet*

An instrument for analysing hockey sense in offense, information gathering sheet

Name: _____

Game: _____

	Defensive zone	Neutral zone	Offensive zone
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			