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Final Thesis

# Game analysis of rugby and its application in the management theories

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## **Abstract.**

Since my early childhood I have had a passion for sport, both as a keen participant and as a spectator. This interest continued all the way through my university studies, when I focused on management, and I combined my managerial learning with my rugby professional career.

This pathway gave me the chance to find a possible connection between the two things, trying to explain what characteristics of the game of rugby could be imported in the managerial and organizational world.

Rugby is based on three main pillars: respect of the rules, ethic and fairness, but it also represents a powerful programming model and it can contribute to create a cooperative climate in the team environment.

A rugby team is composed of fifteen players, and everyone must be ready to face every match not only from a physical side, but also from a technical, mental and motivational side. Moreover, players need a great amount of commitment, because the opposition will not concede “easy” points.

Therefore, each player should be balanced in the four fundamental aspects reported above, but should also be competitive. When the team-members play together they should have reciprocal respect and they should follow a strategy, which is set up in advance, even if it seems not to be working.

In the following pages I underlined the link between rugby and the “ideal” company, through the examination of different aspects.

In the first chapter I introduced briefly the historical origins, the principles and the techniques of the game, to further present some suggestions that could be translated into business dynamics.

In order to reach out this goal, I analyzed the teams’ results in eight years of Six Nation championship. The tournament is the European most important one and the participants are England, France, Ireland, Wales, Scotland and Italy. I analyzed the

teams' performances through a series of twenty-two performance indicators, with the help of SPSS statistical program.

Afterwards, I created a performance profile for each team, with a look on the team's organization and style of play. Then I shifted the most interesting results into a business/organizational view.

At first, I explicated some metaphors between the performance indicators and the organizational style. Suddenly I compared each team with a different organizational style.

In the final part of the thesis I made some additional considerations about rugby and management that cannot be measured analytically. Because of rugby's complexity, the metaphor cannot be reduced only to a quantitative analysis. So, in this section, I carefully analyzed those rugby's features that a company should import for being successful.

A "conclusions" section has been presented in order to review the main themes the study pointed out. Personal opinions and further developments of the research have also been included.

# Chapter 1. General introduction and literature review

## 1.1 The game of rugby

In 1823, in the College of Rugby, 50 km from Birmingham, some boys were playing a sport with the ball called football, during a break between classes. The same day, during an argument about the interpretation of a rule, an Irish boy grabbed the ball under his arms and ran until the opposition end-zone line. In this way rugby was born, as an act of insubordination during a boring afternoon.

Despite the turbulent birth, rugby was the first ball-sport that regulated the game with clear and solid rules. According to the rules of the game, physical contacts with the opponent players are frequent, unlikely other team sports. Although rugby seems to have odd rules such as passing only to people behind you, it is not an artificial or complex sport. The way of scoring points in rugby consists in taking the ball over the try line to the opposite border of the field after beating all the defenders, similarly of planting a flag behind the enemy's line.

When sociology started to follow and analyze the game, they soon noticed a key factor that comes along with rugby that is the ability to regulate the aggressiveness within the game, which always needs to remain under control. Moreover, the socializing purpose of this sport plays a big role in rugby. Born in England, rugby quickly started to spread universally from the beginning of the twentieth century, also as a result of the size of the British empire. The common international threads of rugby have always been the unique approach to the game, the willingness to sacrifice and the mutual respect for the opponents.

In the last few years, the training sector has shown an increasing interest in this game, emphasizing how strategies, behaviors and values of rugby offer inspiration and guidance to scholars of organizational theory. Indeed, team sports have often been used as an effective metaphor to describe how a team works and how the interpersonal relations occur. Expressions such as *team building*, *team working*, *role-playing*, and *outdoor playing*, derive from team sports.

## 1.2 Historical origin

Ball games have a really ancient origin, and they have changed many times depending on cultures, traditions and geography. Ruggiero (2012)<sup>1</sup> reports that in China, 2000 years B.C., there was a game called *tsu chu* (that literally means “kicking the leather ball with the feet”). The game expected two teams to kick the ball over a net. The game then expanded in Japan around the sixth century B.C. with the name of *shu kiku*: the objective of the game was passing the ball in a circle without letting it touch the ground.

In addition, there are more significant information from the ancient Greeks: l'*episkyros*, played by two teams of 14 players each, that had to contend the ball and bring it over the opposition line; the game, played especially in Sparta was very violent and it was only practiced by men. As reported by Ruggiero (2012), the game was then imported slightly modified by the Romans, which called it *harpastum*: those matches were very successful among the poorer people and played in the city's main squares. The game was very physical, especially the “one against one” to gain the possession of the ball, and the players were usually soldiers.

During the middle age, the game survived with some variations across Europe: for example the “calcio fiorentino”, which used to be played by the aristocracy during the carnival period, is still played in Florence. In England, the game of rugby was at first banned for his violence, and only in 1835 with the *Highway Act* has been decriminalized, but it was only permitted in close spaces.

During that period both the games of rugby and football grew up in the English major colleges but there were not established rules until 1848 when the University of Cambridge decided to organize a meeting with the colleges of Eton, Harrow, Rugby, Winchester, etc in order to define the basic rules and set up the British Football Association. Some years later, in 1863, the Association decided to change the rules, imposing to touch the ball only with the feet. These new rules were adopted from all the colleges apart from Rugby, which remained a supporter of a more physical game and with a special “ethic code”.

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<sup>1</sup> *Management e rugby: strategie vincenti*, Massimiliano Ruggiero, Milano 2012, Gruppo24ore.

As a consequence the British Football Association decided to found its own Association, that was the Rugby Football Union, in 1871.

Therefore, it is clear that the team sports arose in England in the 19th century, and its greatest contributor to its development was Thomas Arnold. Headmaster of Rugby College, he is considered the father of the modern physical education and one of the greatest social educators of all times: he developed the concept of athletics inside the college, pushing on the importance of reaching psychophysical, moral and social objectives. Arnold's greatest methodological innovation has been the self-government, in order to develop into the boys the sense of responsibility and self-discipline. For these reasons the sport practice became a way to increase the physical performance, but more important, to let the individual develop a system of moral and social values. In his vision, the sport was no more considered as leisure, but it became a cornerstone: knowing how to deal with the wins and with the defeats, it reinforces the emotional stability; it prepares to the social service, because it teaches how to follow established rules, to respect the opponents, to feel the belonging to a group and to accept the result of the game.

The Rugby experiment has been very successful in the Victorian period. The British saw in this game a special instrument to build up people characters and instill the uprightness in the new middle class generation, founding the potential for a new "national culture", capable to exercise the power in a more flexible and effective way.

### **1.3 Introduction to the rugby metaphor**

Rugby often seems chaotic and crazy, each team is formed by fifteen players, divided one from the other by an hypothetical line generated from the ball, "fighting" to bring the ball over the try line. The players try to gain ground together, meter after meter, and together they defend it, so that the self does not exist and you cannot play alone. The game imposes control, implies an interior rather than physical force and avoids craftiness and arrogance.

In fact, the game really fits as a metaphor of the team: every single player is responsible for the success and the defeat of its team and for the support of his teammates. The clearness of the shared vision in a winning team allows to reach the objective and to organize everything pushing on the complementary of each one. For that reasons the rugby model seems the most appropriate to build a positive behavior and purposes orientation in a team work, with each of the team members putting their forces together to reach a common objective, sharing their human and professional resources, and developing a strong sense of belonging.

The discipline is one of the cornerstones of the game: in order to break the defensive line, the game requires a physical strength and a lot of aggressiveness. Therefore, discipline is fundamental to avoid violent behavior that can compromise the match due to the penalties related and the risk of injuries. According to Carlo Bonini, “rugby does not have rules but laws”<sup>2</sup>. This linguistic detail reveal the relationship between the single player and the team, a law infringement is the least tolerated thing in rugby because it penalizes the whole team. Discipline is then a synonym of sportsmanship. This is complementary to the game spirit that requires players to be committed until the last minute of play: even if you have a great advantage, you play to score the maximum of points until the end. This means respect for the opposition, exactly the contrary of football.

Another important concept in rugby is the support, the players must support their team-mates during the action: when one is tackled from the defense, he has to be sure that another one will “help” him to maintain the ball possession. But this concept has also another meaning, i.e. the player who is in the right position to receive the pass and score. In other words, the support is one of principal expression of a team sport, based on the interaction and combination between the players.

It is interesting to note that it is used the word “support” instead of “help”. This is a big difference also in a business perspective. “Help” means that you are not able to do something and you need someone’s help. Instead “support” means peer

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<sup>2</sup> Carlo Bonini, *Il gioco*, in *Zavos, L’arte del rugby*, Einaudi, Torino 2007, pp.X-XI.

support: it is not that without someone's help you are not able to advance but in case you need help there is always someone behind you.

The last consideration implies another important characteristic of the game: the communication. Both on and off the ground, an effective communication contributes to the success of the team. It is not only useful to communicate your position and presence to another player (that sometimes has not the visual to see who is around him) but it is important to coordinate the action and to give information (for example to tell your teammate who are you defending on, so he can take on another).

The consideration reported above, emphasizes the importance that everyone has in a team both from a physical and mental point of view. If one of the fifteen player "leaves his head" in the changing room it is very difficult to win the match. The modern rugby has increased a lot the game speed, requiring that everyone is able to predict what his team mates and the opposition are doing: recognize who is around, understand if the player near you is ready to receive your pass or determine if you should kick, run or pass the ball. All these information have to be correlated to make intelligent decision. This complexity is also enhanced by the fact that the ball can be passed only backwards. It means that when we feel strong because we are advancing ball in hands inside the "enemies" territory, we are potentially weak. Right in the moment we think to have the situation under control, we realize that in order to complete the action, it could be better to make a turn in the running line, pass the ball or try to beat the defense, trying to save the meters we have conquered.

Finally, also on the game strategies and techniques, rugby demonstrate to preserve the concept of cooperation and solidarity: this strange way of going forward passing the ball backwards resume exactly the philosophy of the game. The group can achieve the result only if every single part cooperates, also protecting the vanguard, that cannot bear alone the defenders impact.

### 1.3.1 Rugby as a practice community

From the previous paragraph it is clearly understandable how rugby can be imported in other fields. Later on I will focus on the contents transferable to the company's world. For now it is better to focus on the transformation currently going on in this world and on the new forms of social cooperation. It is impossible to not refer to the Toyota labor organization (Ruggiero, 2012): it has been the first attempt to renovate a company following a cooperative approach and team-based inspired. The father of the *lean production* Taiichi Ohno, has been the first one to believe that the managers capacity and competences were no more sufficient to reach to objectives and the success of the company, but that was important to mobilize all the human resources available, at every level.

The so-called integrated approach expects a flexible, quick and precise organization. Ohno referred to baseball to explain his two pillars: the *just in time* and the *intelligent automation (jidoka)*. In fact there is a "just in time" and "jidoka" effect on individual skills, teams and the role of the supervisor as coach of these teams. The "just in time" is the effective linkage of various skills of the team members such as pitcher, catcher, and fielders in baseball. Every coach makes the whole system work, just like a winning baseball team. At the same time, "jidoka" is used to identify abnormalities against the standard work, just as individual baseball players may show weaknesses in their abilities and then receive intensive training by their coach. The role of the leader of teams is to balance team synchronization (just in time) with abnormality management and corrective action. In the production system this team involvement corresponds to the *just in time* that activates all the team members in an harmonic way.

This relationship is more evident in the game of rugby, that has the advantage of proceeding by processes like a company. The first step is the design of the game plan, implemented by the coordination among the players, while the coaches track the performance results, and if necessary, change the strategy.

The most useful theorist concept to explain rugby contents and values is the "community of practice" (CoP), i.e. a group of people who share an interest or a

passion. According to Etienne Wenger<sup>3</sup>, following a common passion they are able to learn from each other, and have an opportunity to develop themselves personally and professionally. This expression fits exactly the rugby world and should be used in every teamwork. The community of practice implies:

- Mutual engagement: through the participation in a community, members set up discussions, norms, and build cooperative relationship. Exactly what happens in rugby, where is not enough to know the plays and moves, but also the on and off field shared rules and values, directing them to reach the objective.

- The elaboration of the game plan resumes the complex synergy that once on the ground, has to be expressed harmonically. The communities of practice not only rely on a structured professional growth, but also on the experiences shared, on finding together the best practices and, on helping each other. In the same way a rugby team is a collective organization that improves its performances through the experiences in order to be more prepared for the following match.

- Joint enterprise: Through their interactions, they create a shared understanding of what hold them together. The joint enterprise is re-discussed by its members and is sometimes referred to as the 'domain' of the community. The loyalty is fundamental in the game: if a player can count on the support of a team mate, the whole team will benefits from, and it will contribute to develop the *empowerment* capacity. The achievement of the resources control/opportunity offers, must pass through the achievement that everyone will do his best in the best way. So the responsibility assumption is a *sine qua non* condition for the success, both on a rugby field and in a company. In this perspective errors can occur, but they are tolerate because they are seen as a way of improve the learning process of the single player and obviously of the team.

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<sup>3</sup> Etienne Wenger, *comunità di pratica*, Raffaello Cortina, Milano 2006.

- Shared repertoire: The community, as part of its practice, produces a set of common resources, that represent their shared repertoire; this is used in the pursuit of their joint enterprise and can include both literal and symbolic meanings. In a rugby team, in fact, there are not only fifteen players but a practice community, dynamically structured in his relationships, languages and roles. It is a kind of collective identity.

According to Wenger thought, the collective identity is a kind of link between the individual and the group, cannot be dissociated from our identity of team member. The set of identities are dimensions that create a path inside the community and among the different practice communities. This trajectory implies a continuous movement: Every time a team plays against another it renegotiates his identity, and at the end of the match will be for sure different from the beginning of the match. So each match adds more incentives and competences to the team, improving the awareness of being part of the group.

- learning as social interaction: learning in rugby is quite easy because it figures a cognitive apprenticeship process. Every player, even the one that will never play during the season, feels legitimate to be part of the group, share resources, experiences and interact with older players.

## Chapter 2. Performance analysis

### 2.1 What is game analysis

The scientific analysis of different sporting codes by various means has brought a widely varying degree of success over the years. Some sports are naturally more complex than others and thus much harder to approach analytically. For example, rugby is known for its system of laws and unique game structures, which makes research from other sports largely inapplicable. The degree of complexity (or perhaps variability) of a sport derives, amongst other things, by the number of active participants (e.g. individual & team sports), the environment in which the game is played (e.g. indoor & outdoor sports), the game length (e.g. Test match & One Day Cricket), and the number of different ways of scoring.

Game analysis is based on comprehensive analysis of the behavioral aspects of sports performance, attempting to objectively record critical game events in a consistent and reliable manner. This serves two purposes:

- Provide a direct and specific feedback system for players, who can view summaries of their match statistics and performance, and watch video replays of specific events (or passages of play) in order to evaluate techniques, successes and errors etc.

- Collect detailed match information for coaches who can then use this in order to review and assess player performance, and to inform decision making, strategy and tactics.

Both forms of feedback are fundamental in the process of improving performance, and in an ideal situations could even lead the team or franchise to gain a competitive advantage.

An example of the kind of success that can be achieved through the application of scientific analysis to sport was recently described in Lewis' book "Moneyball"<sup>4</sup>. Due to the increasing wealth inequality in baseball at the end of the '90, the most

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<sup>4</sup> Michael Lewis, *Moneyball, the art of inning an unfair game.*

common feeling was that the game was ending to be a sporting competition and instead becoming more a financial one. The richest teams could outbid everyone else in order to buy the best players, and the poorer teams seemed destined to fail. However, the Oakland Athletics baseball team changed this perception when for many year, they won more regular season games than any other team of the league, despite being one of the poorest teams in Major League Baseball. The book describes the team's success, attributing it to a re-thinking of the approach to players selection, inspired by Oaklands Athletic general manager Billy Beane.

He decided to choose the players following an “on-base percentage”, the percentage that shows the number of time a player gets to a base without the help of a penalty. Finding players with an high OBP but with other characteristics that has lead the recruiters to drop them out, Beane has been able to build a more powerful team than the financial potential of Athletics would allow.

The book is useful to demonstrate the huge potential of performance analysis, and the related statistical analysis in particular, to be successfully applied to sport.

In many team sports, for example baseball, the coaching and selection process have traditionally been almost entirely based on subjective observations of players by the coaching staff. Though more objective analysis methods have been applied to some sports over time, it seems the opinion of the coaches is still heavily influential in many professional sporting disciplines, and quite naturally, especially in complex sports like rugby where scientific analysis is refractory.

In team sports such as football and rugby, one of the most important decisions in which the coaching staff is involved in on ongoing basis is the selection of players for the required positions within the squad. This is another area where the information provided by notational analysis is of use.

## **2.2 Performance analysis in rugby**

In August 1995 the International Rugby Board decided that the game of Rugby Union had become professional, removing all restrictions on payments or benefits to those connected with the game. The game has thus undergone major change

over the past fifteen years as the sport has adjusted to its professional structure, and the level of competition between teams and franchises has increased exponentially. However, despite this, the academic study of rugby has developed fairly slowly, particularly in comparison to soccer, golf, cricket, and various racket sports.

While rugby has been given attention in the literature across various sub-disciplines of sports science, namely sports medicine, physiology, psychology and biomechanics, I will focus here on the primary area of quantitative research in rugby, which is performance analysis.

### **2.3 Study design and Data sample**

I decided to analyze the Six Nations Championship because the information available to the public were the most detailed and complete if compared to all the other International competitions. The structure of the Tournament is simple: played annually, each team plays only once against the other teams, with home field advantage alternating every other year. It means that one year a team has three home field games and the following year only two. Two points are awarded for a win, one for a draw and none for a loss and unlike most other rugby union competitions the bonus point system (one point more if you win scoring more than four tries and one point if you lose with less than seven points) is not used. Victory in every single game results in a 'Grand Slam' and back-to-back Grand Slams have been won on five occasions. Wales achieved the first one in 1908 and 1909, England have done it three times in 1913 and 1914, 1923 and 1924 and 1991 and 1992 while France did it in 1997 and 1998. England has the record for the number of Grand Slams won with twelve, followed by Wales with eleven, France with nine, Scotland with three and Ireland with two.

Victory by any Home Nation (Wales, England, Scotland and Ireland) over the other three Home Nations constitutes as a 'Triple Crown'. England holds the record for the number of Triple Crowns won with 23, followed by Wales with 20 and Scotland and Ireland both with ten.

Meanwhile, the last-placed nation at the end of the tournament is said to have won a purely figurative *Wooden Spoon*.

Several individual competitions take place under the umbrella of the Six Nations tournament. The oldest is the Calcutta Cup, which has been running since 1879 and is contested annually between England and Scotland. The Millennium Trophy has been awarded to the winner of the game between England and Ireland with the first presented in 1989, and in the same year, the Centenary Quaich was contested between Ireland and Scotland for the first time. Since 2007, France and Italy have also contested for their own silverware - the Giuseppe Garibaldi Trophy. It was created to honor the 200th anniversary of the birth of Giuseppe Garibaldi, who helped unify Italy and was also a French military general.

Italy only joined the tournaments in 2000 after some big wins in the previous year's test-matches against France and Ireland.

The other major championships like the Rugby World Cup and the rugby Championship were not too much significant because the first is played only once every four years and data were not much easy to have access and most important, the number of teams was too large and it changes in every edition. The second, commonly said Four Nation, it is the most important championship played in the southern hemisphere. It is now played by New Zealand, Australia and South Africa and Argentina. The biggest problem is that Argentina only joined the tournament 3 years ago, so it does not make sense to analyze it, since its composition changed recently with the new entrance.

Archival data were gathered from the RBS Six Nations competition. The data were collected from the official web page of the Six Nations tournament ([www.rbs6nations.com](http://www.rbs6nations.com)). Data collection was carried out by the SAS Software Ltd until the 2011 edition, while it was carried out by Accenture from 2012 to 2014([www.accenture-rugby.com](http://www.accenture-rugby.com)).

I have analyzed 120 matches played between 2007 and 2014.

Data registry was done at twice (40 matches per team). The data from each game were passed to a spreadsheet (Microsoft Excel) and were then exported to the SPSS 20.0 statistical program for analysis.

The raw data feeds are provided by OPTA, one of the world's largest suppliers of sports data, during every Championship match.

The analyses presented are those used by the analysts, coaches and players in their preparations for competitions.

The aim of this study was to exploit the unique opportunity of a large dataset, in order to analyze the teams different performances.

## **2.4 The performance indicators (P.I.)**

A performance indicator, as defined by Hughes and Bartlett, is “a selection or combination of action variables that aims to define some or all aspects of a performance, and should obviously relate to successful performance or outcomes in order to be useful. Performance indicators are used to assess aspects of individual or team performance and can be used for comparison with opposition players, teams etc, or in isolation as a measure of the performance of a team or individual alone”<sup>5</sup>.

Interestingly it has been noted that the performance indicators used by analysts within each of the three categories of formal games are very similar. The categories of formal games as classified by Read and Edwards in the Hughes and Bartlett publication are: net and wall games which are score dependent, invasion games which are time dependent, and striking games which are innings dependent. Since there are of course a number of different sports within each category, and a wide variety of game and rule variations around the world, it thus appears that the common primary objective is what drives the selection of similar key performance indicators for sports within each category of games.

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<sup>5</sup> Hughes and Bartlett, *The use of performance indicators in performance analysis*, Journal of Sport Science, Volume 20, Issue 10, 2002

Rugby falls within the class of invasion games, amongst others like American football, basketball, soccer, and hockey for example. In invasion games the purpose is to invade the opponents territory while attempting to score points and keep the opposing team's points to a minimum, within a limited time period. Thus common performance indicators for this class of game involve data on tackles, passes, runs with the ball, and loss of ball control, despite differences in the way these physical activities are actually carried out in each sport.

### **2.4.1 Team performance indicators**

I have decided to use the most common and meaningful indicators.

The studied variables were divided into three groups. The first group of variables, "*points scored*", describes the number of points scored and the way in which the points were scored; the second group of variables, "*phases of play*", describes the way teams obtained the ball and how the team used it; and the third group of variables, "*game development*", describes technical and tactical aspects.

#### **Variables related to points scored**

- Points scored: they are the sum of all the points scored by a team in a match;
- Points suffered: they are the points conceded by a team in a match;
- Points difference: it is the difference between points scored and points suffered;
- Tries scored: It is the primary method of scoring. A try is worth five points. It is scored when a player places the ball on the ground with downward pressure in the in-goal area between (and including) the goal-line and up to, but not including, the dead ball line of the opposition's half. The average of tries scored during the period considered is around 3,5 tries per match;
- Tries suffered: tries suffered by the teams;
- Successful kicks: there are three ways of kicking at posts. The first is the try conversion, if a team scores a try, they have the opportunity to "convert" it

gaining two additional points by kicking the ball between the posts and above the crossbar - that is, through the goal. The kick is taken at any point of the field of play in line with the point that the ball was grounded for the try parallel to the touch-lines. So it is advantageous to score a try nearer to the posts, as it is easier to convert it. The second is the penalty kick; if a side commits a *penalty* infringement the opposition can take the option of a *place kick* at goal from where the infringement occurred. This is called a penalty kick. If successful, it is worth three points. The third method is the drop-kick: A drop kick happens when a player kicks the ball from hand and the ball touches the ground between being dropped and kicked. If a drop kick goes through a goal then it results in a *drop goal*;

### **Variables related to phases of play**

- Lineout won on opposite throw: this variable indicates the number of lineout that a team is able to “steal” from the opposite team. It is pretty important because reverse a dangerous defensive situation into the possibility to attack a non ready defense straightaway and gain the possession of the ball;
- Handling errors: it includes all the times the ball is not controlled by the player and falls into the ground. It could happen as a result of a poor pass (too low, too high, too powerful) or due to a lack of skills of the player who received the pass. Handling errors cost a loss of ball possession and the game restarts from a scrum for the other team;
- Minutes in possession. They are all the minutes in which a team is able to retain the ball;
- Minutes in opposite half: they are all the minutes a team spends in the opposite half both with and without the ball possession. Generally the team who has the greater possession is more able the score points and prevents the opposition of scoring points;
- Penalties conceded: is anything a player does within the playing enclosure that is against the letter and spirit of the Laws of the Game. It includes

obstruction, unfair play, repeated infringements, dangerous play and misconduct which is prejudicial to the game. The penalties conceded in the home half are generally kicked into the posts to gain three points.

- Yellow cards: ruthless or repeated penalties can imply a yellow card. Differently from soccer, in rugby a yellow card involves the exclusion of the guilty player for ten minutes, so his team plays in fourteen for this period. A team who collects more than two yellow cards usually faces bad problems in order to win the match.

### **Variables related to game development**

- Tackles made: it is the sum of all the tackles made by a team during the match. It is related to the time the team stays in defense;
- Tackles missed: it is the sum of all the tackles missed by a team during a match. It is an indicator of the quality of the defense;
- Percentage tackles completed: it is obtained through a simple formula:  $1 - (\text{tackle missed} / \text{tackle made})$ . It stands for the effectiveness of the defense. The average tackles performances are around 90%, so every ten tackles attempted nine are made in the right way and one is missed;
- Turnover won: When a team concedes possession of the ball, particularly in a ruck situation, it is said to have turned the ball over to the other team. This can happen due to defending players stealing the ball from an isolated attacker, *counter rucking*, a *knock on*, an intercepted pass or the ball not emerging from a maul (where in the referee awards the scrum feeds to opposing team);
- Passes: A pass means to transfer the ball to a teammate by throwing it. Passes in rugby cannot travel forwards. There are different kind of pass, including the flat, direct spin pass; the short, and the floated pass - a long pass which an advancing player can run onto at pace.

- Offloads: it is a short pass made by a player being tackled before he reaches the ground, usually by turning to face a team-mate and tossing the ball into the air for a team-mate to catch;
- Possession kicked: it represents how many times per match the ball is kicked;
- Percentage possession kicked: it is the percentage of ball kicked once a side has the ball in hands. This variable is exactly the opposite of the minutes in ball possession and explains how much a team is more inclined towards a kicking strategy. This strategy is based on taking up the opposite half through long kicks and playing on the opponent's errors;
- Kicking errors: it includes all the errors made while kicking the ball. It includes for example a straight kick into touch from inside our 22 meters or a very short ground gain. Consequently to what said before a kicking error may imply that you are not taking a field advantage so you will play in your half but giving the possession to the opposition;
- Linebreaks: Action by which the player with the ball gets through the opponent's defensive line without being tackled. If there is insufficient cover by the defense, or the player has support, linebreaks can often become tries. I consider effective linebreaks the ones in which the player runs at least 20/25 meters.

#### **2.4.2 Individual performance indicator**

One of the main issues with the use of performance indicators in rugby (and many other invasion games), is that most of the contributions by individual players are not easily related to the success of the team, due to the complex interactive nature of the behavior required in order to score points. This is by contrast happens with sports like cricket or baseball, where a batter's contribution to the team success can be measured by considering the number of runs he has scored and the number of

runs he has directly assisted his team mates in scoring. In a rugby game, players can perform really well without scoring any points themselves.

There are clearly a few factors which cause this variability in match statistics: the variable conditions in which different matches are played (e.g. home & away games, weather conditions, etc), which can affect game strategy and tactics, and the volatility of individual performance itself. However, the biggest problem in order to do this analysis is the lack of data. Six nation individual performance analysis have only been made in 2012 so there are not enough numbers necessary to build a significant database. For this reason, I decided to not go further with this analysis.

In the future, with more data available, individual performance analysis will be more useful for the players' selection. Team selection in a professional environment has a key importance for the overall performance of the team, and also it has a significant financial impact on the individuals involved. When selecting a squad, the coaching staff and/or selection committee have to take into account a number of different factors, but the primary factor influencing their decision is expected to be how good the players are (bearing in mind that this will always be to some extent a subjective measure). Additional factors such as player fitness and tactical considerations are used subsequently in order to further discern between players.

## Chapter 3. Results

In this chapter are reported the results of the teams' performances. First I made a descriptive analysis of teams position in the eight years, then I made several statistical analyses of the overall performances from a general and team point of view.

### 3.1 Descriptive analysis per year

The numbers in the tables below summarize the five matches played by each team for every year. I made a descriptive analysis of the trend of the teams.

#### 2007

2007	position	points sco	points suf	points dif	tries score	tries suffe	succ. kick	lineout w	handling €	mins in p	mins in o	penalties
england	3	119	115	4	10	9	26	7	73	134	192	53
ireland	2	149	84	65	17	5	25	9	70	150	226	39
wales	5	86	113	-27	7	9	15	7	77	121	202	50
france	1	155	86	69	15	9	31	12	78	142	252	37
scotland	6	95	153	-58	7	15	22	7	88	119	234	49
italy	4	94	147	-53	9	18	17	10	72	133	233	58

2007	position	yellow ca	tackles	missed ta	% tackles	turnover	passes	offloads	poss kick	% poss ki	kicked err	line break
england	3	4	326	23	93%	21	609	44	126	16,8	12	30
ireland	2	5	358	29	92%	35	639	68	139	17,6	12	33
wales	5	2	437	56	86%	34	543	53	133	21	30	20
france	1	1	484	58	88%	38	644	40	144	18,2	14	26
scotland	6	7	433	35	92%	26	582	40	101	14,4	13	14
italy	4	5	465	54	88%	38	511	26	156	24,2	21	9

**Table 1.** Summary of the matches' statistics of 2007, (source: rbssixnations.com, personal elaboration)

#### France

In broad terms there were "two different Frances" playing in this year's RBS 6 Nations. There was the France of the first four matches and then came the France of the final game which was quite different from the others. The circumstances of this game were exceptional. Unlike almost all other matches, a win was not enough. The target was to score as many tries as possible and in order to achieve

it, the strategy, that day, was to pass the ball. In that match France made fifty more passes than any other game, and with the result they became the highest passing team in the championship. If France made the same number of passes as they did in their earlier 4 matches, they would have been the fourth highest passing team which reflects the position in recent years. They were indeed not a high passing team but they were a relatively high rucking team, but, after making a notional adjustment for the last game, were third. They were also the second highest kicking team but they still managed to score tries somehow.

All in all, France was not a team who stood out statistically in any particular aspect of the game. They were not the biggest hand errors makers, kickers, obtainers of possession, line breakers, off-loaders.

However they did manage to convert minutes in the opposite half and lineouts won on opposite throw into points.

## *Ireland*

In the 6 Nations 2007 Ireland remained a high-passing team, maintaining a high number of passes in all five of their games as the past years. They kept more possession than their opponents in 4 out of 5 games. They were also very effective in both attack and defense, scoring the greatest number of tries and suffering only 5 in the whole tournament, but they had an average success at kicking at posts, losing some important points. Although they finished second, they were the most effective team in turning possession into tries and also the most efficient in preventing their opponents from scoring tries making the lowest number of handling errors. The great numbers of tries scored may derive from the fact that the Irish had the greatest performances in the number of offloads and line-breaks.

## *England*

What remained tough for England in this edition was to turn the possession into points. Their try count went down (as it did in each of the last years); for only the second time in 7 years (2006 being the first), England scored fewer tries than penalty goals. England average scoring performance could be explained by the short time they spent in the opposite half, even if they are the second top performer as line-breakers. Even if the English have the best tackling rate they suffered 9 tries and they are worst in turnovers made. The remaining P. I. are at an average rate.

## *Italy*

Italy still conceded more tries than any other team however, being the total this year 4 times more than any other team. They did, on the other hand, score more tries this year with 3 of their 9 coming in the first 6 minutes of their game against Scotland. These came from Scottish errors and explain the fact that of

the 8 tries in the championship that came from turnovers and errors, Italy accounted for 50% of them. Of Italy's 9 tries, and as already noted, 3 were scored in the opening 6 minutes of one game while 4 were scored in the second half stoppage time. This means that in the 350 or so minutes between these two periods, just 2 tries were scored in five matches.

With regard to activity, Italy passed less than any other team, but kicked more than any other and at the highest rate. Regarding the set piece, they were nearly the most successful team on opposition lineout with 10 lineouts stolen. They were also the most effective team at gaining turnovers but due to the high kicking-rate, they don't have a lot of possession. They did however nearly have the least successful kick at goal rate, highest numbers of penalties conceded and they are the worst off-loaders and line-breakers.

### *Wales*

Fifth, the Welsh proved hard to come by in 2007. What resulted difficult again this year was turning possession into points, especially because they are nearly the worst in keeping the ball on opposite half. Wales' try-count was less this year than last, having gone down in the last 3 years from 17 to 9 to 7. Furthermore, they were also the least successful team at the set piece. At lineout their retention rate was less than the other teams' one and they were also the least successful team on opposite lineouts. In addition they conceded a lot of penalties and they have the worst tackle success rate.

### *Scotland*

Arriving last in this edition, the Scottish collected the worst performances: they scored fewer tries than last year and were again the least effective team in turning possession into points, even if they have the best ball retention in opposite half.

They were also the least effective team in preventing their opponents from scoring tries. Again, they collected the highest number of yellow card, and they made the highest number of handling errors.

## 2008

2008	position	points sco	points suf	points dif	tries score	tries suffe	succ. kick	lineout w	handling e	mins in p	mins in o	penalties
england	2	115	76	39	9	4	26	15	57	114	200	49
irealand	4	93	99	-6	9	10	18	8	68	131	212	41
wales	1	141	73	68	12	3	31	12	80	142	266	43
france	3	103	93	10	11	7	19	10	82	163	213	44
scotland	5	69	123	-54	3	13	17	12	78	135	215	38
italy	6	74	131	-57	6	13	16	8	72	146	201	34

2008	position	yellow ca	tackles	missed ta	% tackles	turnover	passes	offloads	poss kick	% poss ki	kicked er	line break
england	2	3	445	38	91%	13	500	26	135	21	8	15
irealand	4	10	472	44	90%	19	577	39	142	20,8	11	26
wales	1	5	446	25	94%	28	596	50	149	20,2	25	39
france	3	1	442	28	94%	14	656	50	121	15,4	18	17
scotland	5	1	472	44	91%	12	590	49	128	19,2	16	9
italy	6	7	483	52	89%	15	521	16	140	22,2	25	13

**Table 2.** Summary of the matches' statistics of 2008, (source: rbsixnations.com, personal elaboration)

### England

Out of the 6 participating teams, England was the only team that arrived in the competition with a positive World Cup behind them. Despite this, however, try scoring had proved difficult. England scored just 9 tries in 5 matches which continued their declining try count over the years since 2001.

This declining try-count happened even if England routinely obtained more possession than any other team in the championship. However, this changed in 2008.

England obtained less possession than any other team in 6 Nations 2006 which explains why, not surprisingly, England made fewer passes. Nevertheless, their defense remained strong, and they conceded only 4 tries in the 5 matches which was half of those conceded in 2007. They still have the

greatest lineout but unusually they made lot of handling errors and they collected the highest number of penalties.

### *Wales*

When wales won the Grand Slam in 2005, they showed a number of characteristics that were different from other teams. What was interesting this year was to see if those characteristics are valid also for this year. A number did.

- They put the ball into touch significantly less than any other team kicking always on the ground
- They scored more tries from turnovers

There were, on the other hand, a number of substantial differences.

The major difference was in defense. From conceding 9 tries in 2007, they conceded just 3 in this year's campaign, the lowest ever achieved in the 6 Nations championship. This great defense was supported by one of the highest successful tackles percentage in the 6 nations history, reaching 94%.

They achieve also a try scoring success, scoring 12 tries, more than anyone else. It was then implemented by high kick success rate. A 100% conversion success rate made every try worth 7 points.

Another area showed a noticeable change. From being the team that obtained the least overall possession in 2007, they increased it by almost 35% this year and became the second highest in 2008. Such increased possession helped Wales becoming the team who spent more time in opposite half. More than that, they are by far the best in making turnovers, offloads and line-breaks.

### *Ireland*

Ireland saw a significant change in fortune compared with 2007. Last year they were the most successful team in turning possession into points, and were also the most efficient in preventing their opponents from scoring tries. This

changed in 2008. While in the previous tournament they scored 17 tries, this year Ireland managed just to score 9. Along with this was the fact that the 10 tries they conceded were twice as many as they conceded in 2007.

Another Ireland historical characteristic has been their high rate of passing. In 2007 for example, they passed at almost a higher rate than any other team. In 2008 they reduced it a lot, passing around 80 balls in the matches. All other indicators are pretty weak.

### *Italy*

Historically, Italy have consistently conceded high number of tries, i.e. 18 last year. One of their objective this year was therefore to reduce the number of tries suffered, and move to a more competitive level hoping that they could equal, if not improve, their performance in last year's 6 Nations when they won twice. Part of the plan was achieved. Even though only one win was recorded, five fewer tries were conceded bringing the 2007 total down from 18 to 13. On the other hand, however, Italy and Wales were the only teams to score a try in all 5 matches.

Italy performed well in other characteristics: they had more possession than their opponents in 3 of their 5 games and they conceded the fewest penalties. On the contrary, they collected quite a lot yellow cards (7), they had the lowest % of successful tackles and the lowest number of offloads.

### *Scotland*

In 6 Nations 2008 the Scottish did not have big changes. Last year, 7 tries were scored. This year, Scotland arranged to score just 3 tries in 135 minutes' possession, thus needing almost 44 minutes possession to score a try. The result was that out of all Scotland's points, just 22% were accounted for by tries. Conceding tries also remained a problem. Along with Italy, the 13 tries conceded were the highest in the tournament.

Scotland was also quite successful in obtaining opposition ball at the lineout. Despite this, try scoring remained a major problem. Line-breaks well represent the problem with only 9 in all the tournament.

### France

Third in 2008 France was one of the 6 Nations' teams that had a new coach. Interesting was seeing how their approach would look like since evidence suggests that there are two different French playing styles. There is the relatively conservative approach, typical of recent years, where kicking has been more significant than passing, an approach that contrasted dramatically with the game strategy utilized by France in the match against Scotland in 2007. This involved a constant recycling of the ball that produced an approach that was seen by some as more typical French, but that brought the consequence of a higher number of handling errors.

Certainly, an element of this second playing style appeared at times throughout the tournament.

-10 of their 11 tries were scored by backs

-5 tries were scored from turnovers out of a tournament total of 11

### 2009

2009	position	points sco	points suf	points dif	tries score	tries suffe	succ. kick	lineout w	handling e	mins in p	mins in o	penalties
england	2	124	70	54	16	5	17	13	60	142	231	67
irealand	1	121	73	48	12	3	24	17	61	145	243	48
wales	4	100	81	19	8	7	22	7	68	130	197	49
france	3	124	101	23	14	11	20	5	70	156	241	48
scotland	5	79	102	-23	4	9	21	6	81	119	215	46
italy	6	49	170	-121	2	21	13	8	65	125	200	49

2009	position	yellow ca	tackles	missed ta	% tackles	turnover	passes	offloads	poss kickt	% poss kii	kicked err	line break
england	2	6	441	32	93%	31	812	36	178	17,8	19	22
irealand	1	6	375	41	90%	24	698	22	174	19,8	20	21
wales	4	6	498	42	91%	14	697	40	144	16,4	15	20
france	3	3	392	29	92%	14	771	39	135	14,6	14	29
scotland	5	1	521	43	92%	15	778	55	133	14,8	16	11
italy	6	6	496	63	88%	13	677	21	181	19,4	14	11

**Table 3.** Summary of the matches' statistics of 2009, (source: rbssixnations.com, personal elaboration)

## *Ireland*

Ireland won the Grand Slam for the first time after 60 years and they achieved with an uncommon style of play.

No more high passing rate or low kicking rate, that was distinctive of Ireland's play in recent years.

This approach was implemented by these major factors:

- In one match it made only 82 passes
- It conceded only 3 tries
- It was the most successful team in gaining possession on opposition's lineouts
- It was the least penalized team
- It obtained more possession than their opponents and they were most of the times on their ground.

## *England*

England was the top try scoring team with its 16 tries, exceeding also the number of tries scored by Ireland. There was also another major difference from last year performance. Last year, England had fewer possession than any other team in the championship, while this year the position was totally reversed, despite England exceeded their opponent's possession in only one game.

Not to be surprised, with more possession, England made more passes than any other team and passed at the second highest rate.

England was by far the most penalized team in the tournament and it also suffered 6 yellow cards, one more than the remaining 5 teams received between them. Nevertheless, England's defense remained strong, only 5 tries were conceded in comparison to last year's four.

## *France*

In 2008, France chose over 30 players for the 5 matches. This could explain why no clear and consistent pattern of play emerged during the tournament. After last year, it would have been premature to draw too many conclusions. The suggestion was that the subject-matters would become somewhat clearer in this year's tournament.

This did not happen – a statistical analysis of France's matches this year did not match France with any particular style of play. They did not stand out in any of the performance indicators, but neither did they fail. It was also almost impossible to recognize any recurring characteristics of French play.

The statistical breakdown showed that their percentage of possession was around average; they were not the leading try scoring team, and they kicked an average number of penalty goals. Their passes was not particularly high nor low, and at the end of the tournament they ended up in third position.

Anyhow, they did have the lowest kicking rate as well as having the least successful percentage kick rate.

## *Wales*

When Wales won the Grand Slam in 2008, it showed a number of characteristics that were different from other teams. What was interesting this year was to see if those characteristics still applied. Only of them did, It still kicked on the ground far

more than the others, but they no longer scored a large proportion of tries from opponents' handling errors and opponents kicks.

One of the results of these differences was that Wales scored just 8 tries this year compared with the 12 of last year while the conceded 7 to last year's 3. Wales did not manage to replicate two of last year's defining features – i.e. a huge defensive success combined with an ability to score tries from broken

play and from play starting inside their own half would have been a feature frequently found in successful teams.

Another difference was that Wales this year was also less successful in gaining possession of the ball and the last for minutes in the opposite half.

In addition, from a 100% conversion success rate in 2008 that made every try worth 7 points, this year's success was just 3 out of 8 or 38%. The Wales of 2009 was, therefore a lot different from the Wales that won the Grand Slam in 2008.

### *Scotland*

Scotland's performance in 6 Nations 2009 expressed very little difference from their performances in 2008 and 2007. In each of the last 3 years it won just one game. It remained one of the least effective teams in turning possession into points, as well as being one of the least successful team in preventing their opponents from scoring tries. There was little change in 6 Nations 2009.

Overall, Scotland had less possession than any of the other teams, gaining more possession than their opponents in just one of their 5 matches, despite kicking less than any other team and at a lower rate.

### *Italy*

As usual, Italy have consistently conceded a considerable number of tries and this characteristic came up again in 2009 when it conceded 21 in its 5 matches. Italy did not suffer from lack of possession despite being the highest kicking team. It did however experience difficulties in the lineout.

More than that, they made the fewest passes and consequently the fewest offloads. Finally, their tackling rate was still low and so were the line-breaks.

## 2010

2010	position	points sco	points suf	points dif	tries score	tries suffe	succ. kick	lineout w	handling €	mins in p	mins in o	penalties
england	3	88	76	12	6	5	21	10	51	133	202	47
irealand	2	109	92	17	11	6	19	21	59	134	194	56
wales	4	113	117	-4	10	11	24	6	84	131	241	41
france	1	135	69	66	13	6	25	11	67	126	238	41
scotland	5	83	100	-17	3	8	23	15	52	136	191	46
italy	6	69	137	-68	5	12	16	6	55	124	198	60

2010	position	yellow ca	tackles	missed ta	% tackles	turnover	passes	offloads	poss kick€	% poss ki	kicked err	line break
england	3	1	383	49	86%	7	653	30	157	45,2	9	15
irealand	2	6	401	33	91%	16	638	34	150	48	12	20
wales	4	4	379	42	89%	9	904	60	143	39	11	17
france	1	1	474	54	89%	19	607	45	156	41,2	7	21
scotland	5	2	462	42	91%	15	759	44	130	40,4	10	12
italy	6	3	490	44	91%	16	546	36	174	50,6	21	9

**Table 4.** Summary of the matches' statistics of 2010, (source: rbssixnations.com, personal elaboration)

### *France*

This year the French won the championship making the grand slam. Differently from last year, the coach used less players and the statistics show very interesting and significant results: they had the top performance in points made, tries made, successful kicks, they have been able to break the defense line more than the other teams and it had the highest number of turnover. What impressed the most is the great reduction of tries suffered going from 11 of 2009 to 6 of this year. They reduced their possession time but they maintained their presence in the opposite half. Like the past years they had a good discipline collecting only one yellow card and they conceded the fewest number of penalties.

### *Ireland*

The Irish nearly confirmed last year's result arriving seconds. They still had a good attack and a pretty good defense and they continued to stand out for the great number of stolen lineout. Unfortunately their loss of discipline cost

them 6 yellow cards and the highest number of penalties conceded. All others P.I: step back at an average level from last year result.

### *England*

England, third this year, suffered from big attack problems: it only scored 6 tries overall from the 16 scored last year. They have not been able to convert into points the good possession and the good number of line-breaks they made. More than that, they had the lowest number of handling errors and yellow cards.

### *Wales*

The Welsh this year show a controversial performance: they finished fourth this year but they are the best in several aspects: they performed well in attack, scoring 2 tries more than last year and being the best for minutes spent in the opposite half, they made over 900 passes and 60 offloads, the highest ever in the 6 nations history. On the contrary, due to the high number of passes, they made 84 handling errors, way more than everyone. Then they suffered 11 tries, 4 more than last year.

### *Scotland*

This year the Scottish finished fifth again, they had big difficulties in transforming possession into points, in fact they had the greatest number of minutes in possession but they scored even less than last year, scoring only 3 tries in 5 matches. The other performances seems pretty much the same as last year.

## Italy

Winning at least against Scotland, the Italians slightly improved their performance: they halved the tries suffered passing from 21 to 12, they kicked with a better rate, they scored nearly 50% more points than last year. However, the others P.I. remain negative: they passed the ball less than any other team, they kicked the most and worst than everyone, they had the lowest ball possession, they made very few line-breaks and they are the most penalized team.

## 2011

2011	position	points sco	points suf	points dif	tries score	tries suffe	succ. kick	lineout w	handling €	mins in p	mins in o	penalties
england	1	132	81	51	13	5	26	16	70	165	237	51
irealand	3	93	81	12	10	4	17	7	66	142	216	48
wales	4	95	89	6	6	8	24	7	50	141	213	59
france	2	117	91	26	10	8	25	12	62	130	236	46
scotland	5	82	109	-27	6	11	19	12	52	131	208	46
italy	6	70	138	-68	6	15	14	3	54	138	225	41

2011	position	yellow ca	tackles	missed ta	% tackles	turnover v	passes	offloads	poss kick	% poss ki	kicked err	line break
england	1	7	471	19	96%	16	902	54	92	31,8	6	28
irealand	3	1	505	20	96%	22	778	39	124	39,4	12	19
wales	4	4	571	39	93%	11	725	46	134	44,2	11	12
france	2	0	521	44	92%	11	759	58	97	38	6	12
scotland	5	2	561	45	92%	13	889	63	128	41,4	16	10
italy	6	1	548	40	93%	15	785	37	88	30,6	9	10

**Table 5.** Summary of the matches' statistics of 2011, (source: rbsixnations.com, personal elaboration)

## England

England won the tournament losing only against Ireland. They scored the highest number of points and tries (13 and 8 of them were against Italy), they obtained the highest ball possession and they spent most of the time in the opposite half. Connected to this stats, they made the highest number of

passes (902) and line-breaks (28). They stole 16 lineouts, being also the most effective in tackles (96%) and they made just a few kicking errors.

### *France*

France arrived second this year, but for the first time ever in the championship it lost against Italy 22-21 in Rome. There are not too many differences from last year grand slam but they leveled more or less all the P.I. evidences show a reduction in the number of tries scored, maybe due to a big decrease in the number of line-breaks and turnovers.

### *Ireland*

Thanks to its big defense, Ireland managed to concede only 4 tries with a high 96% of tackles completed, but it has not been so consistent in attack, scoring only 17 kicks, even if it scored 10 tries and made 19 line-breaks. What stand out this year is the poor number of lineout stolen: from 21 in 2010 to 7 this year. This is impressive.

### *Wales*

Wales changed again its playing style: unlike last year they passed less than everyone (so they had the lowest number of handling errors) and they kicked more than last year. A negative note came from the discipline, indeed they collected 59 penalties, 12 per match. All the other indicators do not show any clear difference from last year and they are pretty average.

### *Scotland*

Scotland won a match this year against Italy but lost all the others. There is no big difference with past years performances. They remained last for

possession and minutes in opposite half, but it is quite interesting that they passed the ball much more than other times and consequently much more offloads. This shows clearly their incapacity in scoring tries.

### Italy

Italy had the worst performance despite the unpredictable win over France: they score the least, they conceded more than everyone, they had the worst kicking performance and the worst lineouts. Differently from last year, they kicked less than the others and they made more passes, but this new strategy did not lead to any sort of improvement.

## 2012

2012	position	points sco	points suf	points dif	tries score	tries suffe	succ. kick	lineout w	handling €	mins in p	mins in o	penalties
england	2	98	71	27	7	4	23	5	59	144	220	48
irealand	3	121	94	27	13	8	22	8	46	148	209	54
wales	1	109	58	51	10	3	22	6	48	173	241	55
france	4	101	86	15	8	8	21	8	57	158	212	33
scotland	6	56	108	-52	4	11	13	9	54	171	224	52
italy	5	53	121	-68	4	12	11	14	59	143	191	49

2012	position	yellow ca	tackles	missed ta	% tackles	turnover	passes	offloads	poss kicke	% poss ki	kicked err	line break
england	2	2	504	45	91,2%	21	581	20	136	40,6	11	10
irealand	3	3	473	38	91,7%	22	647	26	112	42,6	9	20
wales	1	3	502	42	92,1%	16	863	32	127	38,8	9	17
france	4	0	493	37	92,5%	21	686	37	109	34,4	9	15
scotland	6	6	445	40	91,1%	17	939	51	92	28,8	5	15
italy	5	2	448	40	91,2%	23	671	34	112	35,4	10	10

**Table 6.** Summary of the matches' statistics of 2012, (source: rbssixnations.com, personal elaboration)

### General view

At this point, I want to make a general analysis of the evolution of the game. Rugby is always subject to changes. These change may be expected or unexpected, stable or unstable.

It is a given that the winning margin are reducing. In this year tournament, it appear clear the difficulty of the teams in scoring tries. The overall tries scored per game was 3,1, the lowest in the 6 nations' history.

Therefore, it should not surprise the fact that Wales, winner of the tournament, scored fewer tries than any other previous champion. At the same time the Welsh conceded fewer tries.

Year	Grand Slam winner	Tries scored	Tries conceded
2002	FRANCE	15	7
2003	ENGLAND	18	4
2004	FRANCE	14	5
2005	WALES	17	8
	<b>Total</b>	<b>64</b>	<b>24</b>
2008	WALES	13	2
2009	IRELAND	12	3
2010	FRANCE	13	6
2012	WALES	10	3
	<b>Total</b>	<b>48</b>	<b>14</b>

**Table 7.** Tries scored difference in the two periods, (source: [www.worldrugby.com](http://www.worldrugby.com))

There are many reasons that explain this scarcity of tries. They include better organized defenses and the introduction of specialized defense coaches. A further suggestion is that the constant increase in physical size and fitness of current international players has reduced the opportunities that can arise from physical differences between players. The average weight of players of each of the six teams in this year's Championship, was as follows:

- Wales: 106 kg
- Scotland: 104 kg
- Ireland: 103 kg
- France: 102 kg
- Italy: 102 kg

- England: 101 kg

In order to better how the player's physicality has changed, I reported below a table which gives the weight of the Welsh centers and wings.

In previous decades, it was not rare for international teams to have players in such positions who were around 25kgs lighter.

<b>player</b>	11	12	13	14
<b>weight (kgs)</b>	104	110	103	104

**Table 8.** *Welsh players weight* (source: rbssixnations.com, personal elaboration)

The teams performances are reported above.

### *Wales*

Quite impressively Wales won all the matches; it had the best defense, conceding only three tries and obtaining the most possession and the most opponents occupation, even if its lineout did not steal much balls and it was the most penalized team.

### *England*

England, second this year, nearly halved the tries scored, scoring only 7 tries, partly compensated by the high number of penalties kicked. They also reduced the number of lineouts stolen, from 16 to 5. The remaining P.I. are at an average level.

### *Ireland*

The Irish' attack was the most effective of the tournament: 13 tries scored with a great kicking goals performance, the lowest ball possession and a significant presence in the opposite half. In fact, Ireland was the team who made the highest number of turnovers and line-breaks, and with an high incidence of kicking game during the matches. Unfortunately, the Irish made a lot of fouls.

### *France*

France's performance follow pretty much the same path of last year, apart from their outstanding discipline: it only conceded 33 penalties (4 in a match) and zero yellow cards. Moreover, the number of turnovers overcame the other team but it has not been capable of transforming them into points.

### *Italy*

Italy, fifth this year after beating Scotland in the last game, shows again the same negative statistics: it scored the fewest points and tries, it had the worst performance at kicking at posts, it conceded the usual high number of tries and it had the fewest minutes in possession and in the opposite half. Despite this negative performance, it had the greatest number of lineouts stolen.

### *Scotland*

The Scottish had the most unsuccessful tournament so far. They finished last losing all the matches. They scored only 56 points overall, the lowest result in the last 6 years. Their strategy was completely different from last year: many passes, minutes in possession, offloads, but just a few line-breaks and too many yellow cards.

## 2013

2013	position	points sco	points suf	points dif	tries score	tries suffe	succ. kick	lineout w	handling e	mins in p	mins in o	penalties
england	2	94	78	16	5	6	24	9	53	131	190	50
irealand	3	72	81	-9	5	5	17	11	46	147	218	58
wales	1	122	66	56	9	3	28	7	48	144	196	44
france	6	73	91	-18	6	6	16	11	61	125	187	41
scotland	5	98	107	-9	7	9	23	13	86	102	119	65
italy	4	83	115	-32	6	6	15	11	67	136	190	56

2013	position	yellow ca	tackles	missed ta	% tackles	turnover	passes	offloads	poss kick	% poss ki	kicked err	line break
england	2	3	627	80	86,9%	9	658	43	139	31	6	18
irealand	3	5	518	56	89,8%	8	527	15	137	42,6	8	11
wales	1	1	521	45	91,6%	12	637	21	123	28	6	21
france	6	1	522	60	88,5%	7	647	43	139	32,8	9	16
scotland	5	2	645	83	87,3%	5	362	26	139	45,8	13	17
italy	4	4	496	63	86,2%	6	713	53	127	36,6	12	17

**Table 9.** Summary of the matches' statistics of 2013, (source: rbssixnations.com, personal elaboration)

### General view

In the 2013 Six Nations Wales won again the championship, this time on points difference, denying England a Grand Slam in the final match of the tournament, with Scotland reaching its highest place finish since 2006. Italy had a great tournaments and it finished fourth for the second time in Six Nations history, while Ireland and France achieved their lowest ever finishing positions.

The number of tries has decreased again passing from 46 to 37, i.e. an average of 2.5 tries per match. It is the lowest result in the six nations history.

### Wales

Wales impressive defense conceded only 3 tries. It also had the best tackles effectiveness. The welsh kicked less than any other and more precisely.

## *England*

Second again, the British missed the possibility to win the tournament losing their last match against Wales. The P.I. are at an average value.

## *Ireland*

Ireland, third, shows the poorest attack, scoring only 5 tries overall. It was the team with the highest possession and time in opposite ground, but it was unable to make points. The Irish made few handling errors, they got 5 yellow cards and they kicked the most.

## *Italy*

Italy impressed everyone arriving fourth, beating France and also Ireland. It scored the higher number of points since 2007. The new coach strategy was based on passing a lot and kicking only if necessary. They made many linebreaks, many offloads and the other P.I. are at an average level and not the worst as usual.

## *Scotland*

The Scottish, fifth, changed completely their playing style once again: they made only 362 passes and they kicked nearly the 50% of the balls played. This has lead Scotland to have the best performance in possession and in field occupation.

## *France*

Very rarely France has finished last in his tournament history. This year they win only against Scotland, scoring the least number of points in their recent

history. All other P.I. are under the normal recent results. Despite this their discipline is still the best.

## 2014

2014	position	points sco	points suf	points dif	tries score	tries suffe	succ. kick	lineout w	handling €	mins in p	mins in o	penalties
england	2	138	65	73	14	5	27	12	52	153	228	45
irealand	1	132	49	83	16	4	21	10	42	158	230	36
wales	3	122	79	43	11	6	25	7	61	125	164	59
france	4	101	100	1	9	10	21	7	64	126	151	44
scotland	5	56	133	-77	4	15	10	16	71	125	147	60
italy	6	63	172	-109	7	21	11	5	83	104	124	56

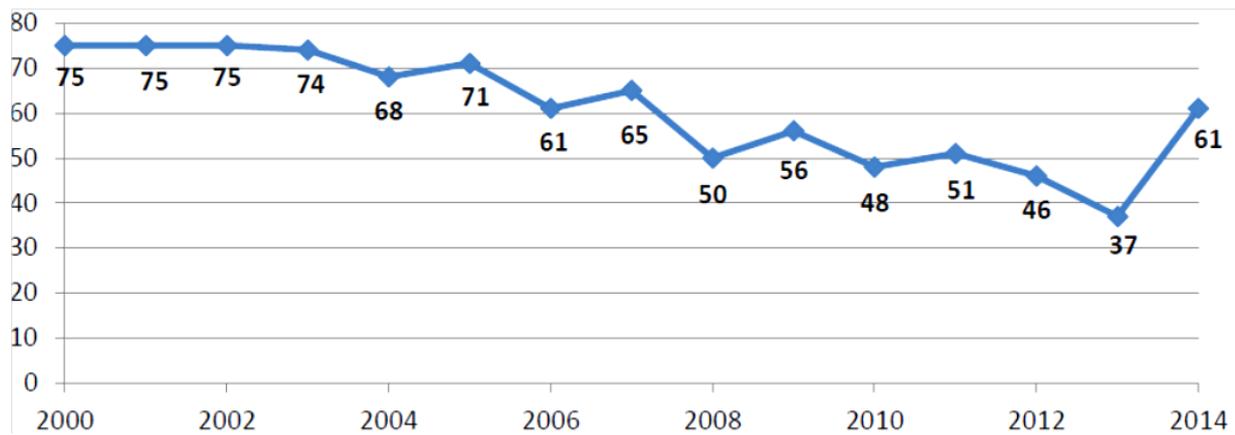
2014	position	yellow ca	tackles	missed ta	% tackles	turnover \	passes	offloads	poss kick€	% poss ki	kicked err	line break
england	2	0	598	81	87%	39	794	64	134	38,4	10	41
irealand	1	0	599	78	86%	45	832	27	137	27,2	6	34
wales	3	3	624	84	87%	35	666	45	125	38,8	10	37
france	4	3	555	81	86%	39	632	84	117	36,8	11	28
scotland	5	2	599	91	84%	36	675	45	110	30,2	16	16
italy	6	3	772	108	85%	35	576	49	87	25,4	13	18

**Table 10.** Summary of the matches' statistics of 2014, (source: rbssixnations.com, personal elaboration)

### General view

This was a big turnaround for Ireland who won only one match in last year's Six Nations, beating Wales, the eventual champions, before losing to England, Scotland and Italy and drawing with France.

The following table shows that in the 2014 Six Nations there were 61 tries scored, producing an average of 4.1 tries per match, a level last reached in 2007.



**Table 11.** Tries scored evolutionary path, (source: [www.worldrugby.com](http://www.worldrugby.com))

A feature of the 2014 Six Nations was defense. Ireland conceded just two tries in their first four matches, while England conceded only two in their last four. This contrasts with Scotland and Italy who, in total, conceded four times as many tries as Ireland and England.

		<b>TRIES CONCEDED IN ROUNDS 1 – 5</b>
	<b>Ireland</b>	0,0,1,1,2 = 4
	<b>England</b>	3,0,1,0,1 = 5
	<b>Wales</b>	2,2,0,2,0 = 6
	<b>France</b>	2,1,2,2,3 = 10
	<b>Scotland</b>	3,2,2,1,7 = 15
	<b>Italy</b>	2,3,2,7,7 = 21

**Table 12.** Tries conceded in 2014, (source: [www.worldrugby.com](http://www.worldrugby.com))

### *Ireland*

Ireland won four out of five matches, scoring 16 tries, an average of over three tries per match. They scored the most and they conceded the least. They obtained the highest proportion of possession and the highest field occupation. They had the highest passing rate, the lowest handling errors and they are the best turnover maker. They had the lowest number of penalties. They did not concede any yellow card.

### *England*

In 2014 England had the second best try scoring rate and try conceding rate. It had the highest kick at goal success and together with Ireland, it obtained the second highest proportion of possession and occupation. England had the second most successful lineout on opposite throw and did not concede any yellow or red cards.

### *Wales*

Having lost only one match in the previous two Six Nations, Wales lost their two away matches to England and Ireland in 2014. Together with England, they had the highest kick at goal success. They had less possession than their opponents but they had the highest kicking rate and they are the second linebreakers.

### *France*

France had an chance of winning the title on the last round but eventually finished fourth behind Wales. They had the lowest passing rate and the second highest kicking rate. They were the second least successful at

opposition lineouts. Unusually, they conceded three yellow cards and one red card.

### *Scotland*

Scotland, fifth, won only one match against Italy. They scored the lowest number of points and tries, and they had the lowest kick at goal success but they were most successful on the opposition lineouts. They were the most penalized team and the worst linebreakers.

### *Italy*

Italy won the wooden spoon, who lost all the matches. Analyzing the performances, Italy present the second lowest kick at goal success. Together with Ireland, it had the highest passing rate and it kicked less than any other team. Differently from the past years, they were the least for winning opposition lineout.

### 3.2 Descriptive statistics.

In this section I will explain the overall descriptive statistics. The table below reports the variables descriptive statistics. For each variable I calculated the number of cases analyzed, the minimum, the maximum, the average, the standard deviation and the variance.

**Table 13.** *Descriptive statistics*, (source: www.rbssixnations.com, personal elaboration using SPSS Descriptive statistics)

	N	Minimo	Massimo	Media	Deviazione std.	Varianza
points_diff	240	-48,00	48,00	,1000	16,77685	281,463
points_scored	240	,00	59,00	19,8542	10,07626	101,531
points_suffered	240	,00	59,00	19,7792	10,14524	102,926
tries_scored	240	,00	8,00	1,7292	1,57570	2,483
tries_suffered	240	,00	8,00	1,7167	1,56950	2,463
successful_kicks	240	,00	9,00	4,0958	1,79352	3,217
lineouts_won_on_opp_throw	240	,00	9,00	1,9500	1,59942	2,558
handling_errors	240	4,00	28,00	12,8292	4,19802	17,623
min_in_possession	240	14,00	44,00	27,4625	5,69286	32,409
min_in_opp_half	240	18,00	65,00	41,7208	9,51200	90,478
penalties	240	1,00	19,00	9,7042	3,10351	9,632
yellow_cards	240	,00	3,00	,6417	,72948	,532
tackles	240	30,00	245,00	98,7208	28,99533	840,729
tackles_missed	240	,00	29,00	9,8292	5,71791	32,695
tackles_completed	240	75,41	100,00	90,1450	4,68407	21,940
turnovers	240	,00	14,00	4,0417	2,83993	8,065
passes	240	35,00	258,00	135,2167	40,35713	1628,698
offloads	240	,00	26,00	8,2292	4,75878	22,646
possession_kicked	240	10,00	53,00	26,3917	7,60180	57,787
percent_opp_kicked	240	7,00	82,00	30,3708	13,48329	181,799
kicking_errors	240	,00	11,00	2,5250	1,95755	3,832
linebreaks	240	,00	16,00	3,7958	2,83064	8,013
Validi (listwise)	240					

### **3.2.1 Teams descriptive statistics**

In this paragraph I analyzed in a more deeper way the teams statistics.

From the Appendix A, I notice that England has several top performances: it has the best points difference and the best defense. More than that, it has the most successful lineout and the lesser kicking errors. The other performance are not the best but overall they are always very good.

France has the best attack with the highest average of points and tries scored, even if they are only fourth for line-breaks. So they are the best team converting them into points. Moreover, they are the most disciplined and they have the highest rate of tackle success, even if they are only fourth as points conceded. It can be read that the tackles they missed are heavier.

Ireland has the possession for most of time and they are often in the opposite half but they are only fourth as points scored and first as tries scored, line-breaks and turnover. This mean that these three variables combined promote an high number of tries. The problem for the Irish is that their kicking performance is not so good. They also make fewer handling errors.

Wales has an impressive rate of successful kicks and nearly the best rate of passes and line-breaks, while all the other variables are in the average. This can suggest that even if they won three tournaments on eight years, the other years they arrived in average positions, so they are not constant in the period considered.

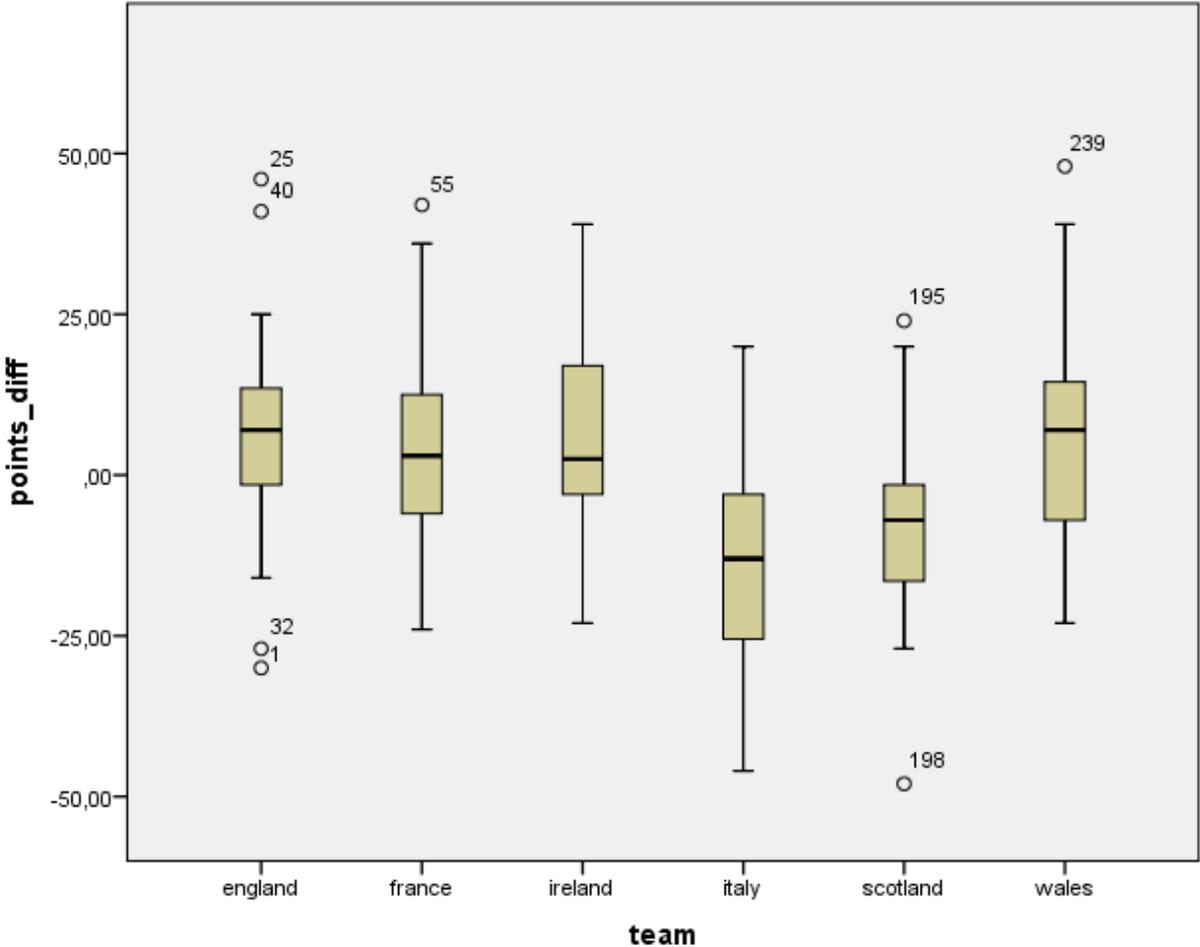
Scotland has the worst attack and consequently the lowest turnover rate. It is also the highest passer and the lowest kicker. Despite this it has a very good lineout performance.

Italy has the worst attack, defense and kicking performance. There are pretty much the same bad results in all the other variables considered. This explains well the fact that Italy is always among the last positions.

In order to understand better the teams' trend over the years, I have made a box plot of the points difference and two graphs that shows the tournament positions over the eight years and the average position.

It is interesting to notice that there is a relation between the position in the tournament and the points difference. England is the most constant team and it is the only team that never went below the third place; Wales is the most unstable, while Italy is always in the last two positions, and only twice reached the fourth place.

In the average position graph I notice that there is an exact correlation between the position and points difference.



**Table 14.** Points difference scatter plot, (source: www.rbssixnations.com, personal elaboration using SPSS Scatter plot)

## Tournament positions 2007-2014

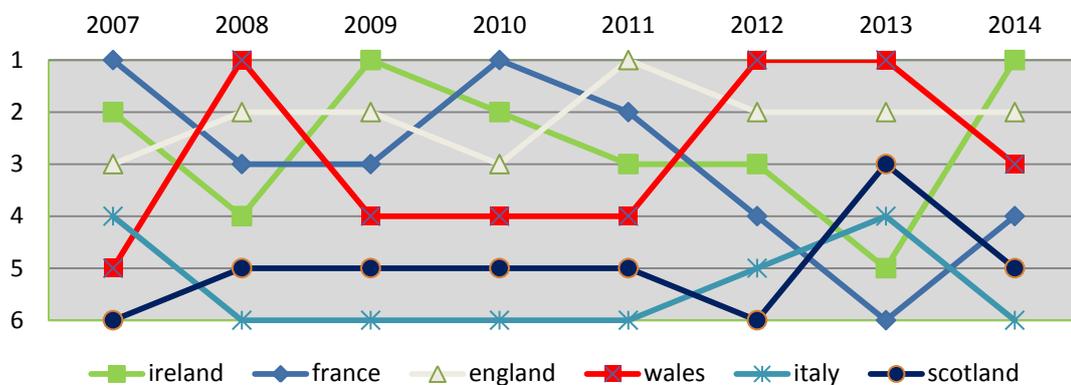


Table 15. Tournament ranking 2007-2014, (source: rbssixnations.com, personal elaboration)

## Average Position

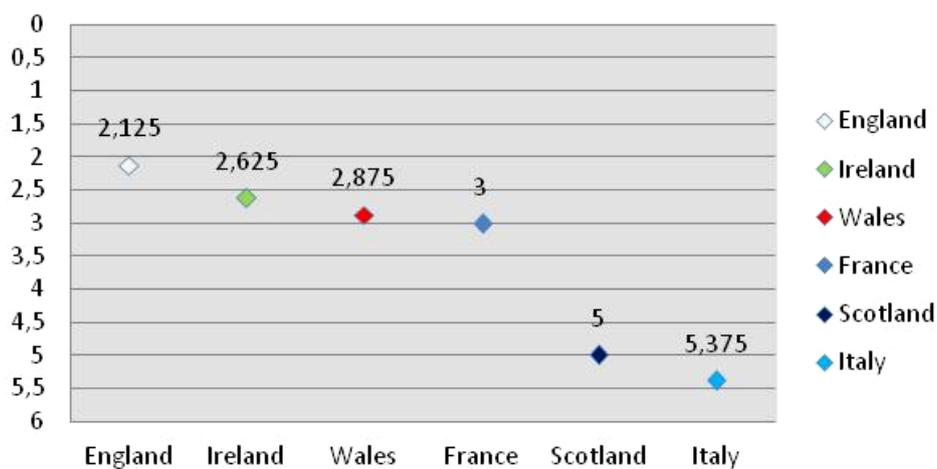


Table 16. Average ranking 2007-2014, (source: rbssixnations.com, personal elaboration)

### 3.3 Performance indicators correlations

In the following table I will analyze the general correlations between the variables. They are painted in three different colors: the yellow cells are just significant, because they have an alpha value lesser than ,05. The green cells show a pretty meaningful correlation, while the red cells show a great one.

In the analysis, are not considered the most obvious as between points scored, tries scored and successful kicks and similar.

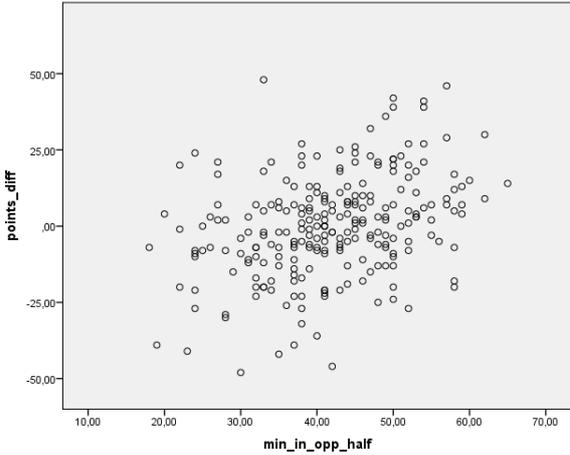
I decided to focus on the most meaningful variables that are:

- Points difference: it is positively correlated to lineout won on opposite throw, handling errors, minutes in possession, minutes in opposite ground and line-breaks.
- Tries scored: shows pretty good correlations with to lineout won on opposite throw, handling errors, minutes in possession, minutes in opposite ground and line-breaks.
- Minutes in possession: minutes in opposite half, tackles, passes.
- Minutes in opposite half: tackles, tackles missed, passes.
- Linebreaks: offloads.

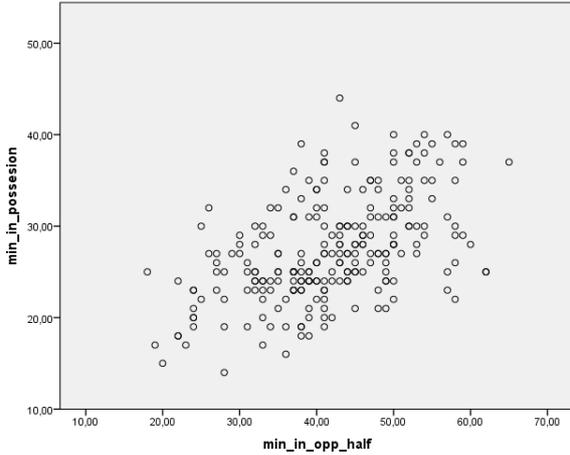
Correlations	points_s cored	suffere d	points_ diff	tries_sc ored	tries_s uffered	ul_kick s	n_opp_t _won_o	g_error s	_posse sion	opp_hal f	penaltie s	yellow_ cards	tackles	_misse d	_compl eted	turnov ers	passee s	offload s	ion_kic ked	t_poss _kicke	kicking_ errors
points_suffere d	1									alfa < 0,05											
points_diff	,828**	1							corr > 0,7												
tries_scored	,886**	,676**	1						corr > 0,3												
tries_suffered	-,238**	-,880**	-,676**	1																	
successful_kick s	,770**	-,438**	,727**	-,418**	1																
lineouts_won_ on_opp_throw	,269**	-,162**	,258**	,250**	-,107**	1															
handling_error s	-,136*	,229**	-,220**	-,063**	,172**	-,141*	1														
min_in_posse	,203**	-,230**	,261**	,218**	-,154**	,087**	1														
min_in_opp_h alf	,327**	-,257**	,349**	,249**	-,178**	,278**	1		,517**												
penalties	-,071	,056	-,078	,019	-,063	-,129*	1		-,236**	-,191**											
yellow_cards	-,093	,174**	-,160**	-,052	,123	-,082			-,081	-,054	1										
tackles	-,076	,071	-,090	-,036	,115	-,094			-,392**	-,479**	-,030	1									
tackles_misse d	-,145**	,190**	-,202**	-,101	,229**	-,170**			-,299**	-,385**	,005	,597**	1								
tackles_compl eted	,037	-,066	,062	-,003	-,072	,120			,095	,135*	-,103	,056	-,121	1							
turnovers	,161*	-,087	,148**	,191**	-,016	,051			,012	-,011	,016	-,118	,148*	-,127	1						
passes	,139*	-,044	,110	,183**	,018	,025			-,432**	,421**	-,171**	-,148*	-,276**	,050	-,034	1					
offloads	,299**	,032	,160*	,279**	,075	,186**			-,173**	,165**	-,160**	-,129*	-,126	-,029	,029	1					
possession_kic ked	-,037	-,223**	,110	-,106	-,247**	,082			,023	,063	-,029	,036	-,054	,019	,053	-,215**	1				
percent_posse sion_kicked	-,126	-,160*	,021	-,158**	-,207**	-,033			-,008	-,157*	,141*	-,132*	,114	,014	-,093	-,136**	-,085	1			
kicking_errors	-,087	,135*	-,136**	-,095	,102	-,070			-,069	-,052	-,038	,021	-,108	,026	,178**	-,146*	,025	-,304**	1		
linebreaks	,659**	-,211**	,522**	,706**	-,097	,347**			,267**	,224**	-,059	-,011	-,015	-,144*	,221**	,278**	,446**	-,098**	-,194**	1	

**Table 17.** General correlation among variables, (source: www.rbssixnations.com, personal elaboration using SPSS Correlation analysis)

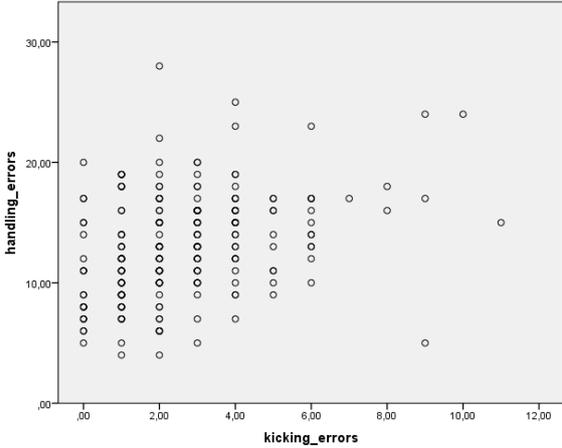
I also made a scatter-plot for the most meaningful variables, reporting below the correlation.



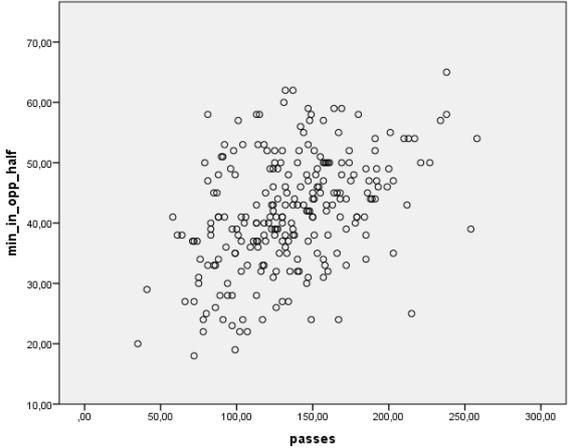
$\rho=,349$



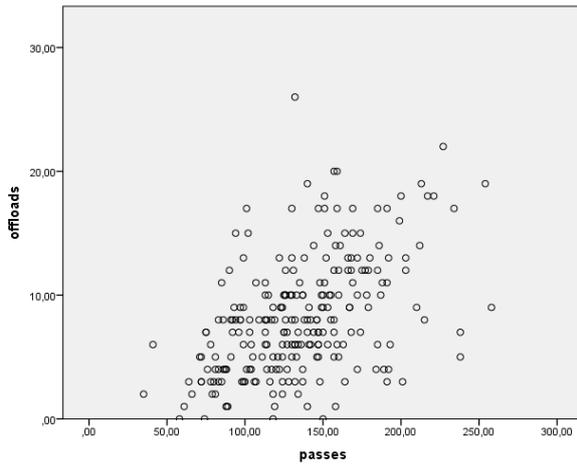
$\rho=,517$



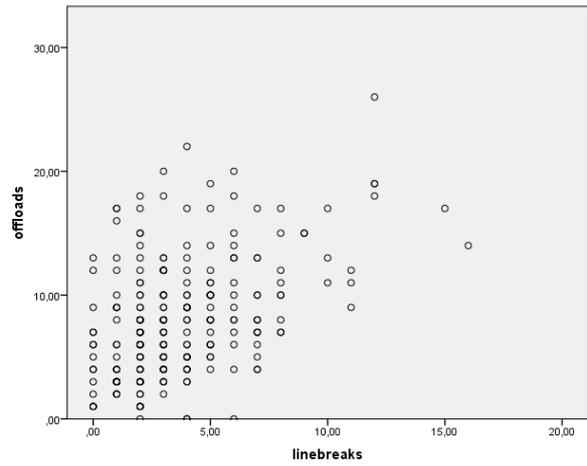
$\rho=,359$



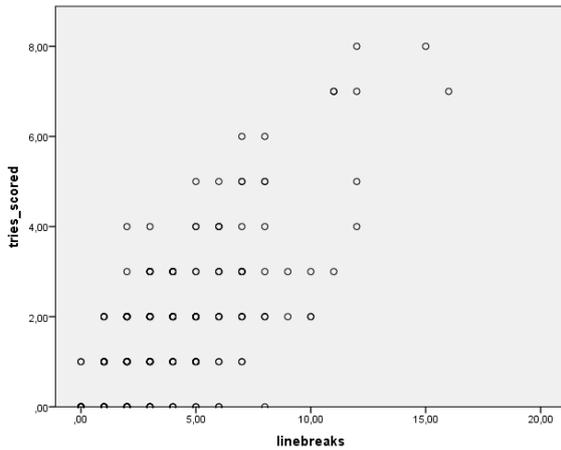
$\rho=,421$



$\rho=,487$



$\rho=,446$



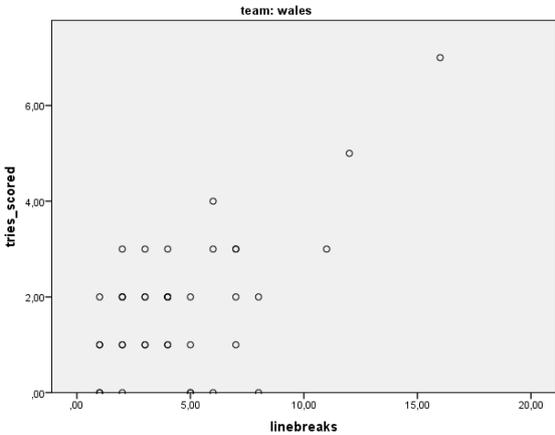
$\rho=,706$

The best correlated variables are the most predictable.

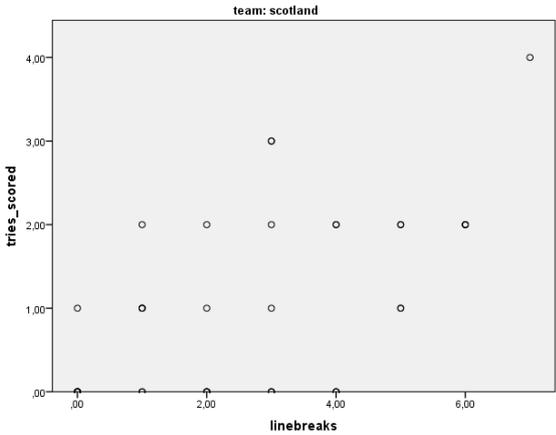
Looking at the Table 17, I observed some obvious correlations as points scored with tries scored ( $,886$ ), the successful kicks ( $,770$ ) and the points suffered with the tries suffered ( $,880$ ). The line-breaks are the variables that better represent the success of an attack organization, and so it is positively related with the tries scored ( $,706$ ). This means that line-breaks are the best predictors for tries scored. Similarly, minutes in opposite half, lead to an increase of chance of scoring. Other meaningful correlation are passes and offloads that generally are useful for scoring tries.

The most evident and predictable negative correlation are: points scored with handling errors, kicking errors, penalties and missed tackles. I have also observed that there is a negative correlation between the minutes in possession and in opposite half with the tackles made. This explain why a high number of tackles made, implies more time spent in defense.

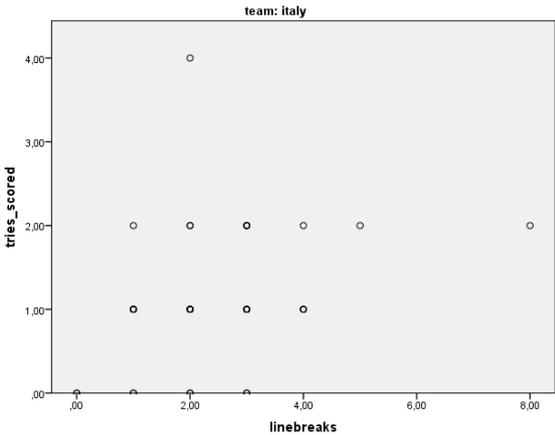
In the tables below are reported the correlations between the tries scored and line-breaks of each team. Actually the team recognized for scoring many tries have also the best correlations. This P.I. can be considered the second most important one after points difference.



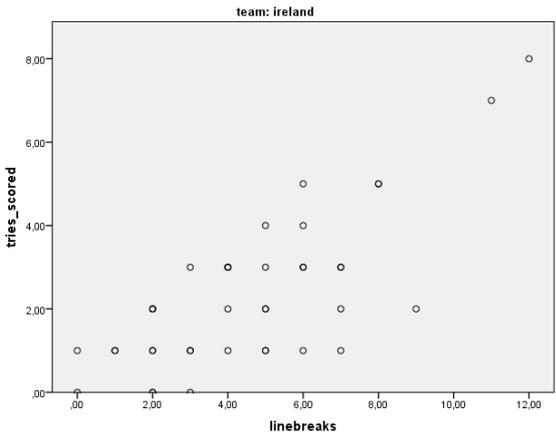
$\rho=,615$



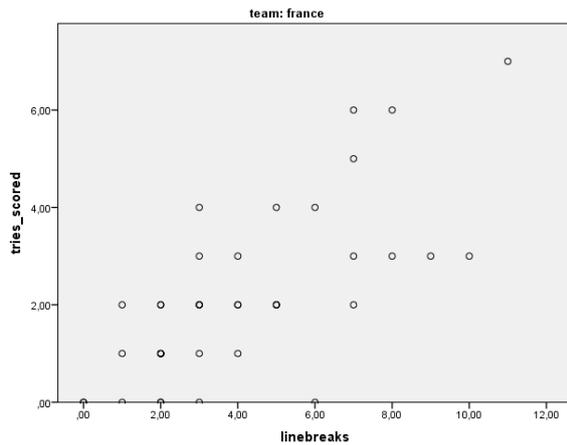
$\rho=,575$



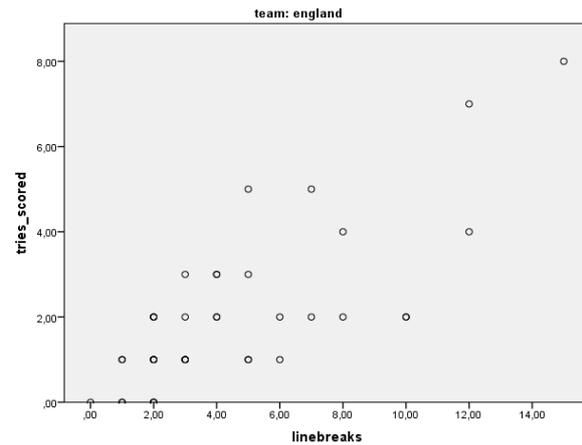
$\rho=,342$



$\rho=,755$



$\rho = ,721$



$\rho = ,765$

### 3.3.1 Correlations inside the teams

I have extrapolated the most significant correlations for each team. There are teams like England that show interesting results while others like Wales that don't.

england	min_in_posses	min_in_opp	passes	offloads	linebreaks	tackles	tackles miss
points diff	,447**	,655**	,386*	,370*	,609**		
tries scored	,399*	,507**	,464**	,500**	,765**		
min in possession	1	,693**	,649**	,413**	,511**		
min in opp half			,696**	,361*	,475**	-,354*	-,354*
passes					,608**		
offloads					,800**		

**Table 18.** England correlations, (source: www.rbssixnations.com, personal elaboration using SPSS Correlation analysis)

England is the team that shows the best results. It has the strongest correlations among all the teams. Its way of scoring tries is well defined by many variables: minutes in possession and in opposite half (also related with each other), passes, offloads and especially line-breaks. Passes and offloads are also well related to line-breaks, so it means that England has a clearly defined style of play in attack.

france	min_in_posses	min_in_opp	tackles_co	kicking_err	linebreaks	passes	tackles
points scored	0,178	0,240	,357 <sup>+</sup>	-,328 <sup>+</sup>	,579 <sup>***</sup>		
tries scored	0,241	0,262			,721 <sup>***</sup>	0,240	
min in possession	1	,444 <sup>***</sup>			,385 <sup>+</sup>		-,484 <sup>***</sup>
min in opp half	,444 <sup>***</sup>	1				,396 <sup>+</sup>	-,426 <sup>***</sup>
turnover					,339 <sup>+</sup>		

**Table 19.** France correlations, (source: www.rbssixnations.com, personal elaboration using SPSS Correlation analysis)

France has the same correlation tries scored/line-breaks but no other correlation like England does. This suggests that it does not need to do many passes, offloads or staying in the opposite half to score tries, maybe because they are enough cynic, or they are able to convert the turnover won quickly to set up a try, or they have better individualities. The scoring points system is also related to the tackles completed and negatively to the kicking errors. The first could be explained from an emotional point of view, in fact the more you defend well the more you feel confident to attack. Secondly, the kicking errors can imply a loss of meters gained and the risk to play more inside the home half and in defense.

ireland	handling_err	min_in_po	min_in_op	tackles_co	linebreaks	passes	offloads	tackles	turnover
points diff	-,385 <sup>+</sup>	0,171	,420 <sup>***</sup>	-,0224	,645 <sup>***</sup>			,330 <sup>+</sup>	
tries scored		0,228	0,218		,755 <sup>***</sup>		,446 <sup>***</sup>		
min in possession					0,268	,392 <sup>+</sup>	0,274		0,278
min in opp half					,378 <sup>+</sup>	,346 <sup>+</sup>		-,0302	
passes							0,291		
offloads					,590 <sup>***</sup>				

**Table 20.** Ireland correlations, (source: www.rbssixnations.com, personal elaboration using SPSS Correlation analysis)

Ireland is similar to France. It has the strongest tries scored/line-breaks correlation and also with offloads. So the Irish are able to exploit the offloads and break the line. Another interesting correlation is the one between the points difference and tackles. The more you make tackles in a match, the more probability to win arise.

scotland	handling err	min_in_opp	tackles mi	linebreaks	passes	offloads	tackles	poss kick	penalties
points diff	-0,286		0,236					,541**	
tries scored				,575**					
min in possession		,554**			,556**	,398*	-,532**		-,362*
min in opp half			-,579**		,526**	,404**	-,657**		-,350*
passes						,741**			
offloads				,360*					

**Table 21.** *Scotland correlations*, (source: www.rbssixnations.com, personal elaboration using SPSS Correlation analysis)

Scotland's relation between line-breaks and tries scored is pretty clear and it is also influenced by the offloads. Evident is the relation among the points difference and the handling errors, which are negatively correlated, as with the possession kicked. This explain why the Scottish do many passes and offloads but they do not win. They have more probabilities of winning when they kick a lot and when they are very disciplined.

wales	handling er	min_in_po	min_in_op	tackles mi	linebreaks	passes	offloads	tackles	penalties
points diff		0,195	0,154		,491**			0,251	
tries scored					,615**		,328*		
min in possession			,468**			,364*		-,0293	
min in opp half				-,316*		0,255		-,376*	-,315*
passes							,372*		
offloads					,437**				

**Table 22.** *Wales correlations*, (source: www.rbssixnations.com, personal elaboration using SPSS Correlation analysis)

Wales' correlations are not so significant. There is a good correlation between the points difference line-breaks and offloads, like in other teams. The other P.I. are not so relevant.

italy	min_in_pos	min_in_op	tackles mi	kicking err	linebreaks	passes	offloads	tackles	turnover
points diff	,320*	,331*	-,365*						
tries scored					,342*	-,0276			,327*
min in possession		,625**	-,464**			,387*		-,520**	-,0262
min in opp half			-,582**			,325*		-,641**	
passes							,454**		
offloads					,438**				

**Table 23.** *Italy correlations*, (source: www.rbssixnations.com, personal elaboration using SPSS Correlation analysis)

Italy has weakest correlation between points difference and line-breaks, but the first are quite well related to minutes of possession, in the opposite half and negatively correlated with tackles missed. This means that, generally, Italy does not has so much of possession during play and suffers many missed tackles. Its tries do not come from passes but from turnover won, mauls or repetitive rucks. The high correlation between tackles and minutes in opposite half could be read as when they arrive to spend some time in the opposite half, it means that they have the possession and so they score tries.

### **3.4 Factor analysis**

After examining the correlations, I tried to reduce the number of variables using the factor analysis.

The idea that lies beneath the of factor analysis is to synthesize the variables chosen to analyze the data and represent them graphically in a Cartesian plane,

in order to understand how and how much variability is explained in the data.

The factor analysis is particularly useful when a certain aspect is not directly quantifiable, but there are multiple indicators of it.

The communalities for all the variables are computed by taking the sum of the squared loadings for that variable.

**Comunalità**

	Iniziale	Estrazione
points_scored	1,000	,928
points_suffered	1,000	,833
points_diff	1,000	,974
tries_scored	1,000	,792
tries_suffered	1,000	,751
successful_kicks	1,000	,711
lineouts_won_on_opp_th row	1,000	,619
handling_errors	1,000	,564
min_in_possesion	1,000	,634
min_in_opp_half	1,000	,646
penalties	1,000	,708
yellow_cards	1,000	,596
tackles	1,000	,700
tackles_missed	1,000	,642
tackles_completed	1,000	,540
turnovers	1,000	,505
passes	1,000	,697
offloads	1,000	,688
possession_kicked	1,000	,575
percent_poss_kicked	1,000	,624
kicking_errors	1,000	,698
linebreaks	1,000	,754

Metodo di estrazione: Analisi componenti principali.

**Table 24.** *Communalities*, (source: www.rbssixnations.com, personal elaboration using SPSS Factor analysis)

**Varianza totale spiegata**

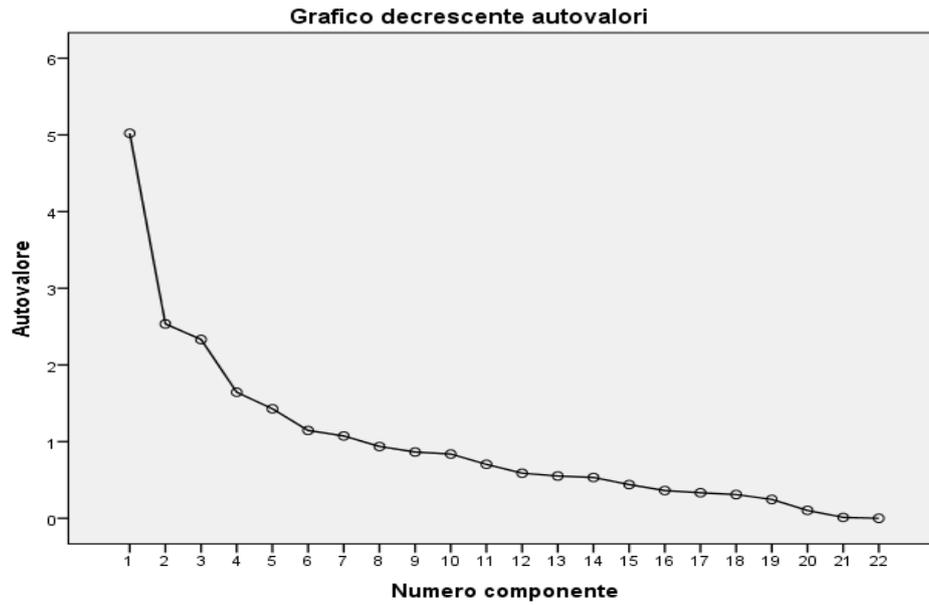
Componente	Autovalori iniziali			Pesi dei fattori non ruotati			Pesi dei fattori ruotati		
	Totale	% di varianza	% cumulata	Totale	% di varianza	% cumulata	Totale	% di varianza	% cumulata
1	5,021	22,825	22,825	5,021	22,825	22,825	3,990	18,138	18,138
2	2,535	11,522	34,347	2,535	11,522	34,347	2,723	12,377	30,515
3	2,332	10,600	44,947	2,332	10,600	44,947	2,674	12,156	42,670
4	1,644	7,471	52,418	1,644	7,471	52,418	1,699	7,724	50,394
5	1,428	6,492	58,910	1,428	6,492	58,910	1,465	6,658	57,052
6	1,146	5,207	64,117	1,146	5,207	64,117	1,428	6,491	63,543
7	1,074	4,882	68,999	1,074	4,882	68,999	1,200	5,456	68,999
8	,937	4,258	73,257						
9	,864	3,929	77,186						
10	,838	3,809	80,995						
11	,704	3,199	84,194						
12	,588	2,674	86,868						
13	,551	2,506	89,374						
14	,533	2,422	91,796						
15	,440	1,998	93,794						
16	,362	1,646	95,440						
17	,333	1,512	96,952						
18	,309	1,406	98,359						
19	,246	1,118	99,477						
20	,103	,469	99,945						
21	,012	,054	99,999						
22	,000	,001	100,000						

Metodo di estrazione: Analisi componenti principali.

**Table 25.** *Total variance explained*, (source: www.rbssixnations.com, personal elaboration using SPSS Factor analysis)

Unfortunately, the results of the table above are not satisfying. In order to reach a satisfactory variance, I should take into consideration at least 6/7 eigenvalues<sup>6</sup>. Also looking to the graph below, there are only the first 3 or 4 eigenvalues that have some relevance, while the others add only a few portion of variance.

<sup>6</sup> An eigenvalue is a vector that points in a direction which is invariant under the associated linear transformation



**Table 26.** *Eigenvalues graph*, (source: [www.rbssixnations.com](http://www.rbssixnations.com), personal elaboration using SPSS Factor analysis)

**Matrice di componenti<sup>a</sup>**

	Componente						
	1	2	3	4	5	6	7
points_scored	,859	-,037	,362	,041	,183	-,130	,081
points_suffered	-,669	,529	,256	-,012	,185	-,002	,081
points_diff	,920	-,342	,063	,030	-,001	-,078	,000
tries_scored	,734	,077	,452	,005	,204	,004	-,044
tries_suffered	-,535	,561	,345	-,046	,125	-,065	,092
successful_kicks	,709	-,204	,099	,089	,133	-,277	,233
lineouts_won_on_opp_th row	,330	,005	-,013	,133	,353	,518	,315
handling_errors	-,174	,370	,164	,596	-,053	,010	,108
min_in_possession	,472	,352	-,354	-,110	-,221	,155	-,278
min_in_opp_half	,558	,360	-,376	,024	-,045	-,028	-,245
penalties	-,163	-,303	,155	-,043	,501	,513	-,222
yellow_cards	-,181	,043	,015	,157	,625	-,014	-,383
tackles	-,301	-,446	,580	-,201	-,123	-,079	,110
tackles_missed	-,349	-,234	,610	-,063	-,290	,070	,000
tackles_completed	,108	,071	-,368	,104	,270	-,270	,481
turnovers	,126	-,069	,398	,340	-,351	,009	-,296
passes	,358	,590	-,105	-,305	-,230	,255	-,002
offloads	,354	,500	,278	-,058	-,180	,289	,341
possession_kicked	,033	-,384	-,273	,538	-,183	,160	-,063
percent_poss_kicked	-,077	-,478	-,221	-,175	-,195	,447	,269
kicking_errors	-,137	,107	-,003	,794	-,120	,115	,100
linebreaks	,641	,203	,517	,043	-,021	,117	-,137

Metodo estrazione: analisi componenti principali.

a. 7 componenti estratti

**Table 27.** *Component matrix*, (source: www.rbssixnations.com, personal elaboration using SPSS Factor analysis)

Looking at the principal component, as I said before, I took into consideration only the first two because the other are not meaningful. For each column I examined the highest and the lowest numbers. In the first, points scored, points difference, tries scored, successful kicks and line break count a lot while at the opposite, points suffered and tries suffered have a negative weight. This results are pretty expected.

In the second component, we have something more interesting. Passes, tries suffered and points suffered have a positive weight, that could mean that making many passes leads to a loss, while tackles and possession kicked

have a strong negative weight. This suggests that it would be better to kick more and pass less in order to concede less points.

From the analysis, it is clear that the factor analysis does not work well. The first principal component does not have a variance high enough, in fact, in order to reach an acceptable level (around 70%), I have to take into consideration at least 7 variables. So, it is clearly impossible to infer anything from it.

I could have expected this results because the correlation matrix did not show a strict relation among the variables.

In the next paragraph, I will try to find more significant results making a binary logistic regression.

### 3.5 Binary logistic regression

After I noticed that the factor analysis was inapplicable, I decided to carry on making a binary logistic regression. A binary logistic regression is a model generally used to predict response based on more predictable variables. It measures the relationship between the dependent variable and one or more independent variables, by estimating probabilities.

In our case, I set a new binary variable, “win,” that has the outcomes 1 for the win and 0 for the loss. This is our dependent variable. Then I checked the correlation between the new variable and the others.

The results in the table below are not significant because  $\alpha > .05$  but we see a positive trend with the variables related to points scoring system performance indicators, as for example tries scored and line-breaks, and a negative correlation with the variables related conceding points system as penalties and errors.

	win	points_	points_	points_	tries_sc	tries_suf	successful	lineouts	handling	min_in_p	min_in_c	
Corr	1	.138*	-.038	0,1071	.159*	-.0935	0,08238	-.0006	-.0136	0,04757	0,03683	
penalt	yellow	tackles	tackles_	tackles_	turnove	passes	offloads	possesic	percent_	kicking_e	linebreak	
	0.02	-0.03	0.005	0.0105	.142*	0.0149	-0.0995	-0.0545	0.0931	0.04661	-0.051	0.03863

**Table 28.** Correlation between the “win” variable and the other 22, (source: www.rbssixnations.com, personal elaboration using SPSS logistic regression)

The following classification’s table shows how good is the model in predicting the outcomes. The global percentage of nearly 50% cannot be considered satisfactory.

**Tabella Classificazione<sup>a,b,c</sup>**

Osservato		Previsto			
		win		Percentuale corretta	
		,00	1,00		
Passo 0	win	,00	0	122	,0
		1,00	0	118	100,0
Percentuale globale					49,2

a. Nessun termine nel modello

b. Funzione log verosimiglianza iniziale: -2 log verosimiglianza = 332,711

c. Il valore di riferimento è ,500

**Table 29.** *Classification table*, (source: www.rbssixnations.com, personal elaboration using SPSS logistic regression)

Unfortunately, in the table below, there are not variables in the equation because all the P value (Sig.) are over 0,1 and so they are not significant. They do not distinguish the team who win and the team who lose.

**Variabili non nell'equazione**

Passo 0	Variabili	Punteggio	df	Sig.
	points_scored	,538	1	,463
	points_suffered	,247	1	,619
	points_diff	2,749	1	,097
	tries_scored	2,143	1	,143
	tries_suffered	1,361	1	,243
	successful_kicks	,075	1	,784
	lineouts_won_on_opp_th row	,066	1	,798
	handling_errors	,097	1	,756
	min_in_possesion	,011	1	,918
	min_in_opp_half	,016	1	,900
	penalties	,018	1	,894
	yellow_cards	,283	1	,595
	tackles	,051	1	,822
	tackles_missed	,020	1	,887
	tackles_completed	,021	1	,886
	turnovers	,006	1	,937
	passes	,472	1	,492
	offloads	,417	1	,519
	possession_kicked	,023	1	,880
	percent_oss_kicked	,003	1	,955
	kicking_errors	,473	1	,492
	linebreaks	,023	1	,881
	Statistiche globali	23,106	22	,396

**Table 30.** *Variables not in the equation*, (source: www.rbssixnations.com, personal elaboration using SPSS logistic regression analysis)

### **3.6 Linear regression**

The last analysis I made is the linear regression. The linear regression is an approach for modeling the relationship between a scalar dependent variable and one or more explanatory independent variables.

I have used the SPSS forward method to perform the regression. The forward method enters at each step the variable with the smallest probability not yet in the equation.

I decided to choose the most significant three dependent variables, following the number of their correlations. The three variables are: points difference, points suffered and points scored.

Each of these variable is firstly analyzed considering all the data set and secondly split for team.

#### **General linear regression with points difference as dependent variable**

The regression for points difference is the most significant of the three: there are 9 variables that together explain nearly 50% of the total variance.

**Riepilogo del modello<sup>j</sup>**

Modello	R	R-quadrato	R-quadrato corretto	Deviazione standard Errore della stima
1	,522 <sup>a</sup>	,273	,270	14,33865
2	,579 <sup>b</sup>	,336	,330	13,73253
3	,621 <sup>c</sup>	,386	,378	13,23141
4	,640 <sup>d</sup>	,409	,399	13,00146
5	,655 <sup>e</sup>	,430	,417	12,80639
6	,671 <sup>f</sup>	,451	,436	12,59419
7	,684 <sup>g</sup>	,467	,451	12,42814
8	,693 <sup>h</sup>	,481	,463	12,29926
9	,702 <sup>i</sup>	,493	,473	12,17423

- a. Predittori: (Costante), linebreaks
- b. Predittori: (Costante), linebreaks, handling\_errors
- c. Predittori: (Costante), linebreaks, handling\_errors, min\_in\_opp\_half
- d. Predittori: (Costante), linebreaks, handling\_errors, min\_in\_opp\_half, lineouts\_won\_on\_opp\_throw
- e. Predittori: (Costante), linebreaks, handling\_errors, min\_in\_opp\_half, lineouts\_won\_on\_opp\_throw, passes
- f. Predittori: (Costante), linebreaks, handling\_errors, min\_in\_opp\_half, lineouts\_won\_on\_opp\_throw, passes, yellow\_cards
- g. Predittori: (Costante), linebreaks, handling\_errors, min\_in\_opp\_half, lineouts\_won\_on\_opp\_throw, passes, yellow\_cards, tackles\_missed
- h. Predittori: (Costante), linebreaks, handling\_errors, min\_in\_opp\_half, lineouts\_won\_on\_opp\_throw, passes, yellow\_cards, tackles\_missed, possession\_kicked
- i. Predittori: (Costante), linebreaks, handling\_errors, min\_in\_opp\_half, lineouts\_won\_on\_opp\_throw, passes, yellow\_cards, tackles\_missed, possession\_kicked, kicking\_errors
- j. Variabile dipendente: points\_diff

**Table 31.** *The explained variance for points difference*, (source: www.rbssixnations.com, personal elaboration using SPSS linear regression analysis)

From the table below I noticed that some variables account for point scored and other for points conceded. It is interesting to see that for each line-break it scores nearly three points while for each yellow card collected it suffers more than three points. Also, lineout won on opposite throw is quite significant, and the same, but at the contrary, the kicking errors. As expected, handling errors and tackles missed increase the points conceded, while minutes in opposite half account for scoring points. Surprisingly, passes are negatively related while kicking is positively related. So once again, a team that relies more on kicking rather than passing has better chance of winning.

Coefficients<sup>a</sup>

Modello		Coefficienti non standardizzati		Coefficienti standardizzati	t	Sig.
		B	Deviazione standard Errore	Beta		
1	(Costante)	-11,646	1,550		-7,512	,000
	linebreaks	3,094	,328	,522	9,444	,000
2	(Costante)	,911	3,037		,300	,764
	linebreaks	3,182	,314	,537	10,124	,000
	handling_errors	-1,005	,212	-,251	-4,741	,000
3	(Costante)	-15,540	4,753		-3,270	,001
	linebreaks	2,872	,311	,485	9,233	,000
	handling_errors	-,952	,205	-,238	-4,652	,000
	min_in_opp_half	,406	,092	,230	4,392	,000
4	(Costante)	-17,444	4,711		-3,703	,000
	linebreaks	2,737	,309	,462	8,864	,000
	handling_errors	-,942	,201	-,236	-4,687	,000
	min_in_opp_half	,385	,091	,218	4,219	,000
	lineouts_won_on_opp_th row	1,641	,535	,156	3,069	,002
5	(Costante)	-13,630	4,827		-2,824	,005
	linebreaks	2,917	,311	,492	9,393	,000
	handling_errors	-,943	,198	-,236	-4,760	,000
	min_in_opp_half	,491	,097	,278	5,052	,000
	lineouts_won_on_opp_th row	1,666	,527	,159	3,163	,002
	passes	-,066	,023	-,160	-2,866	,005
	yellow_cards	-3,390	1,133	-,147	-2,992	,003
6	(Costante)	-10,903	4,834		-2,255	,025
	linebreaks	2,940	,306	,496	9,624	,000
	handling_errors	-,899	,195	-,225	-4,600	,000
	min_in_opp_half	,493	,096	,280	5,167	,000
	lineouts_won_on_opp_th row	1,662	,518	,158	3,209	,002
	passes	-,076	,023	-,183	-3,309	,001
	yellow_cards	-3,390	1,133	-,147	-2,992	,003
	yellow_cards	-3,390	1,133	-,147	-2,992	,003
	yellow_cards	-3,390	1,133	-,147	-2,992	,003
7	(Costante)	-2,737	5,651		-,484	,629
	linebreaks	3,090	,307	,521	10,080	,000
	handling_errors	-,870	,193	-,218	-4,505	,000
	min_in_opp_half	,397	,101	,225	3,932	,000
	lineouts_won_on_opp_th row	1,486	,515	,142	2,883	,004
	passes	-,080	,023	-,192	-3,517	,001
	yellow_cards	-3,482	1,119	-,151	-3,113	,002
	tackles_missed	-,421	,156	-,143	-2,696	,008
	tackles_missed	-,421	,156	-,143	-2,696	,008
8	(Costante)	-9,312	6,214		-1,498	,135
	linebreaks	3,155	,305	,532	10,358	,000
	handling_errors	-,880	,191	-,220	-4,606	,000
	min_in_opp_half	,350	,102	,198	3,441	,001
	lineouts_won_on_opp_th row	1,382	,512	,132	2,700	,007
	passes	-,066	,023	-,159	-2,850	,005
	yellow_cards	-3,496	1,107	-,152	-3,158	,002
	tackles_missed	-,447	,155	-,152	-2,889	,004
	possession_kicked	,266	,110	,121	2,426	,016
	possession_kicked	,266	,110	,121	2,426	,016
9	(Costante)	-9,472	6,151		-1,540	,125
	linebreaks	3,173	,302	,535	10,523	,000
	handling_errors	-,694	,204	-,174	-3,397	,001
	min_in_opp_half	,334	,101	,189	3,312	,001
	lineouts_won_on_opp_th row	1,401	,507	,134	2,765	,006
	passes	-,071	,023	-,170	-3,066	,002
	yellow_cards	-3,592	1,096	-,156	-3,276	,001
	tackles_missed	-,488	,154	-,166	-3,164	,002
	possession_kicked	,349	,114	,158	3,064	,002
	kicking_errors	-1,106	,460	-,129	-2,402	,017
	kicking_errors	-1,106	,460	-,129	-2,402	,017
	kicking_errors	-1,106	,460	-,129	-2,402	,017

a. Variabile dipendente: points\_diff

**Table 32.** Points difference coefficients, (source: www.rbssixnations.com, personal elaboration using SPSS linear regression analysis)

## Teams linear regression with Points difference as dependent variable

Unfortunately, the teams regression do not explain as much as the overall regression does. Only few teams like England, France and Ireland reach an acceptable level of variance.

Riepilogo del modello<sup>e</sup>

team	Modello	R	R-quadrato	R-quadrato corretto	Deviazione standard Errore della stima
england	1	,655 <sup>a</sup>	,429	,414	11,51572
	2	,737 <sup>b</sup>	,543	,519	10,43740
	3	,787 <sup>c</sup>	,619	,587	9,67098
	4	,815 <sup>d</sup>	,665	,626	9,19805
france	1	,579 <sup>f</sup>	,335	,318	12,05852
	2	,683 <sup>g</sup>	,467	,438	10,94695
	3	,731 <sup>h</sup>	,535	,496	10,36552
ireland	1	,645 <sup>f</sup>	,416	,400	11,27580
	2	,728 <sup>i</sup>	,530	,505	10,24767
italy	1	,365 <sup>j</sup>	,133	,110	15,05585
scotland	1	,541 <sup>k</sup>	,293	,274	11,18430
wales	1	,491 <sup>f</sup>	,241	,221	13,43379

**Table 33.** The explained variance for points difference per team, (source: [www.rbssixnations.com](http://www.rbssixnations.com), personal elaboration using SPSS linear regression analysis)

England has the best performances with four independent variables: lineouts win on opposite throw, line-breaks and minutes in opposite half contribute to the win, while passes are negatively related. This means that England's game plan is based more on putting importance on the lineouts, which ensure possession, and on occupation of the opposite half, so it can prevent the other team to score. I have imagined that their goal is to play in the opposite field, stealing lineout, gaining possession and make line-breaks to score tries.

France has three independent variables: line-breaks are the most important with nearly 3,5 point scored for every time they beat the defense. Passes are

negatively related as it is for England, and this may be surprising because of France's reputation of a team that love to play the ball all around the field. Tackles completed mean that a 1% increase in the tackle effectiveness increases of 1 the points scored. So, France is more focused than England on the defense.

Ireland has the same value as France for line-breaks but, more than that, handling errors account a lot. For each ball they lose, they concede one points to the opponents.

Italy has only a negative correlation with missed tackles: for every tackle they missed, they suffer one points. This output is not very significant.

For Scotland is important to kick. The more they kick the more they score points.

Wales relies a lot on line-breaks. The more they are able to break the line the more they score points.

In the table below are reported all the teams' coefficients.

**Coefficienti<sup>a</sup>**

team	Modello		Coefficienti non standardizzati		Coefficienti standardizzati	t	Sig.
			B	Deviazione standard Errore	Beta		
england	1	(Costante)	-44,534	9,791		-4,548	,000
		min_in_opp_half	1,210	,226	,655	5,346	,000
	2	(Costante)	-37,630	9,160		-4,108	,000
		min_in_opp_half	,873	,233	,473	3,742	,001
		linebreaks	1,662	,546	,384	3,043	,004
	3	(Costante)	-37,426	8,488		-4,409	,000
		min_in_opp_half	1,286	,266	,696	4,835	,000
		linebreaks	2,319	,563	,536	4,119	,000
		passes	-,150	,056	-,425	-2,664	,011
	4	(Costante)	-38,697	8,093		-4,781	,000
		min_in_opp_half	1,264	,253	,685	4,993	,000
		linebreaks	1,858	,575	,430	3,229	,003
passes		-,151	,054	-,426	-2,804	,008	
lineouts_won_on_opp_th row		1,969	,899	,242	2,190	,035	
france	1	(Costante)	-7,880	3,467		-2,273	,029
		linebreaks	3,093	,706	,579	4,379	,000
	2	(Costante)	-102,423	31,483		-3,253	,002
		linebreaks	3,112	,641	,583	4,854	,000
		tackles_completed	1,041	,345	,362	3,018	,005
	3	(Costante)	-95,527	29,962		-3,188	,003
		linebreaks	3,455	,625	,647	5,526	,000
		passes	-,145	,063	-,272	-2,295	,028
		tackles_completed	1,165	,331	,406	3,519	,001
ireland	1	(Costante)	-9,656	3,487		-2,769	,009
		linebreaks	3,387	,651	,645	5,200	,000
	2	(Costante)	5,204	5,879		,885	,382
		linebreaks	3,255	,594	,620	5,483	,000
handling_errors		-1,245	,415	-,339	-3,001	,005	
italy	1	(Costante)	-2,545	5,456		-,466	,644
		tackles_missed	-1,022	,423	-,365	-2,415	,021
scotland	1	(Costante)	-35,857	7,258		-4,940	,000
		possession_kicked	1,163	,293	,541	3,968	,000
wales	1	(Costante)	-5,311	3,718		-1,429	,161
		linebreaks	2,319	,667	,491	3,478	,001

a. Variabile dipendente: points\_diff

**Table 34.** *Points difference coefficients per team*, (source: www.rbssixnations.com, personal elaboration using SPSS linear regression analysis)

## General linear regression points suffered as dependent variable

Among the three regression models, the dependent variable points suffered is the least significant. Even if there are seven variables included in the analysis, they only explain 25% of the total variance (R-square ,258).

**Riepilogo del modello**

Modello	R	R-quadrato	R-quadrato corretto	Deviazione standard Errore della stima
1	,257 <sup>a</sup>	,066	,062	9,82524
2	,337 <sup>b</sup>	,113	,106	9,59303
3	,397 <sup>c</sup>	,158	,147	9,37045
4	,444 <sup>d</sup>	,197	,183	9,16755
5	,470 <sup>e</sup>	,220	,204	9,05238
6	,488 <sup>f</sup>	,238	,219	8,96650
7	,508 <sup>g</sup>	,258	,236	8,87000

- a. Predittori: (Costante), min\_in\_opp\_half
- b. Predittori: (Costante), min\_in\_opp\_half, handling\_errors
- c. Predittori: (Costante), min\_in\_opp\_half, handling\_errors, possession\_kicked
- d. Predittori: (Costante), min\_in\_opp\_half, handling\_errors, possession\_kicked, linebreaks
- e. Predittori: (Costante), min\_in\_opp\_half, handling\_errors, possession\_kicked, linebreaks, yellow\_cards
- f. Predittori: (Costante), min\_in\_opp\_half, handling\_errors, possession\_kicked, linebreaks, yellow\_cards, tackles\_missed
- g. Predittori: (Costante), min\_in\_opp\_half, handling\_errors, possession\_kicked, linebreaks, yellow\_cards, tackles\_missed, kicking\_errors

**Table 35.** *The explained variance for points suffered*, (source: www.rbssixnations.com, personal elaboration using SPSS linear regression analysis)

Looking at the coefficients below, at step seven the most important are the yellow cards conceded: for each card collected in a match a team suffers 2,2 points. Minutes in opposite half and line-breaks are inversely correlated as we may have expected, and also kicking, so the more you kick the less points you make. Tackles missed, handling errors and kicking errors are obviously

positively related. It seems strange that only yellow cards count so badly, while the penalties are not even mentioned.

**Coefficienti<sup>a</sup>**

Modello		Coefficienti non standardizzati		Coefficienti standardizzati	t	Sig.
		B	Deviazione standard Errore	Beta		
1	(Costante)	31,212	2,859		10,918	,000
	min_in_opp_half	-,274	,067	-,257	-4,101	,000
2	(Costante)	24,029	3,445		6,975	,000
	min_in_opp_half	-,264	,065	-,247	-4,039	,000
	handling_errors	,526	,148	,218	3,558	,000
3	(Costante)	30,748	3,869		7,948	,000
	min_in_opp_half	-,249	,064	-,234	-3,903	,000
	handling_errors	,535	,145	,221	3,700	,000
	possession_kicked	-,281	,080	-,211	-3,520	,001
4	(Costante)	31,776	3,797		8,369	,000
	min_in_opp_half	-,198	,064	-,186	-3,077	,002
	handling_errors	,570	,142	,236	4,021	,000
	possession_kicked	-,313	,079	-,234	-3,972	,000
	linebreaks	-,738	,217	-,206	-3,400	,001
5	(Costante)	30,603	3,775		8,107	,000
	min_in_opp_half	-,189	,064	-,177	-2,976	,003
	handling_errors	,543	,140	,225	3,865	,000
	possession_kicked	-,320	,078	-,240	-4,120	,000
	linebreaks	-,738	,214	-,206	-3,444	,001
	yellow_cards	2,137	,807	,154	2,649	,009
6	(Costante)	26,113	4,201		6,216	,000
	min_in_opp_half	-,123	,069	-,115	-1,775	,077
	handling_errors	,525	,139	,217	3,768	,000
	possession_kicked	-,334	,077	-,250	-4,323	,000
	linebreaks	-,820	,215	-,229	-3,812	,000
	yellow_cards	2,182	,799	,157	2,730	,007
	tackles_missed	,262	,112	,148	2,346	,020
7	(Costante)	26,533	4,159		6,380	,000
	min_in_opp_half	-,106	,069	-,099	-1,537	,126
	handling_errors	,387	,149	,160	2,599	,010
	possession_kicked	-,400	,081	-,300	-4,940	,000
	linebreaks	-,827	,213	-,231	-3,887	,000
	yellow_cards	2,232	,791	,160	2,822	,005
	tackles_missed	,292	,111	,165	2,626	,009
	kicking_errors	,825	,334	,159	2,469	,014

a. Variabile dipendente: points\_suffered

**Table 36.** *Points suffered coefficients*, (source: www.rbssixnations.com, personal elaboration using SPSS linear regression analysis)

### Teams linear regression with points suffered as dependent variable

Now I will analyze the teams' regression. From the table below we see that only France, Ireland and Scotland show significant results while England and

Italy show very poor contribution regarding the variance and Wales doesn't even appear in the analysis.

**Riepilogo del modello**

team	Modello	R	R-quadrato	R-quadrato corretto	Deviazione standard Errore della stima
england	1	,383 <sup>a</sup>	,147	,124	7,14681
france	1	,378 <sup>b</sup>	,143	,120	6,48201
	2	,524 <sup>c</sup>	,275	,235	6,04285
	3	,613 <sup>d</sup>	,376	,324	5,68225
ireland	1	,450 <sup>a</sup>	,203	,182	6,44503
	2	,560 <sup>e</sup>	,313	,276	6,06113
	3	,636 <sup>f</sup>	,404	,354	5,72466
italy	1	,393 <sup>d</sup>	,155	,132	12,00136
scotland	1	,508 <sup>h</sup>	,258	,239	9,16833
	2	,578 <sup>i</sup>	,334	,298	8,80047
	3	,639 <sup>j</sup>	,408	,359	8,41271
	4	,698 <sup>k</sup>	,487	,429	7,94294

- a. Predittori: (Costante), min\_in\_opp\_half
- b. Predittori: (Costante), passes
- c. Predittori: (Costante), passes, kicking\_errors
- d. Predittori: (Costante), passes, kicking\_errors, tackles\_completed
- e. Predittori: (Costante), min\_in\_opp\_half, handling\_errors
- f. Predittori: (Costante), min\_in\_opp\_half, handling\_errors, turnovers
- g. Predittori: (Costante), tackles\_missed
- h. Predittori: (Costante), possession\_kicked
- i. Predittori: (Costante), possession\_kicked, percent\_poss\_kicked
- j. Predittori: (Costante), possession\_kicked, percent\_poss\_kicked, tackles\_missed
- k. Predittori: (Costante), possession\_kicked, percent\_poss\_kicked, tackles\_missed, turnovers

**Table 37.** *The explained variance for points suffered per team, (source: www.rbssixnations.com, personal elaboration using SPSS linear regression analysis)*

Looking at the coefficients below, France demonstrates that their kicking errors count a lot: for each wrong kick, it concedes 1,5 point. This means that when France does not kick well, it is more likely that undergoes points. Then they are related positively with passes, so they should not do many passes to win matches and they are negatively related with tackles completed; the more they tackle well, the less able they are to conceding points.

Ireland shows pretty obvious correlations with minutes in opposite half, negatively related, and handling errors, positively related. What is interesting in Ireland's result is the presence of turnovers, which never appeared before. This variable is negatively related, that means the more they are able to steal the ball to opposition, the more they prevent them to score.

Scotland gives even more importance to turnovers: for them, each time they win a turnover, they prevent the opposition to score 1,2 point. Then they are positively related to tackles missed and negatively with possession kicked: if they kick a lot they have lesser chance to lose. It means that, generally, when they lose they make many passes.

England is slightly related to minutes in opposite half and nothing more, while Italy is related with tackles missed as we could expect. Unfortunately, Italy does not show evident results. It would have been interesting to understand from which performance indicator derive the points they conceded, taken that they are nearly every time the worst defense in the championships.

**Coefficienti<sup>a</sup>**

team	Modello		Coefficients non standardizzati		Coefficienti standardizzati	t	Sig.
			B	Deviazione standard Errore	Beta		
england	1	(Costante)	31,056	6,077		5,111	,000
		min_in_opp_half	-,359	,140	-,383	-2,555	,015
france	1	(Costante)	5,061	5,213		,971	,338
		passes	,095	,038	,378	2,517	,016
	2	(Costante)	1,089	5,095		,214	,832
		passes	,098	,035	,388	2,771	,009
	3	(Costante)	1,649	,636	,363	2,593	,014
		passes	39,596	16,632		2,381	,023
ireland	1	(Costante)	,110	,034	,438	3,285	,002
		kicking_errors	1,521	,600	,335	2,534	,016
	2	tackles_completed	-,440	,182	-,324	-2,418	,021
		(Costante)	34,139	5,799		5,888	,000
	3	min_in_opp_half	-,406	,131	-,450	-3,108	,004
		(Costante)	26,472	6,292		4,207	,000
italy	1	min_in_opp_half	-,387	,123	-,430	-3,147	,003
		handling_errors	,599	,245	,333	2,443	,019
	2	(Costante)	27,425	5,957		4,604	,000
		min_in_opp_half	-,337	,118	-,374	-2,853	,007
	3	handling_errors	,631	,232	,352	2,722	,010
		turnovers	-,736	,315	-,307	-2,340	,025
4	(Costante)	17,960	4,349		4,130	,000	
	tackles_missed	,889	,337	,393	2,636	,012	
scotland	1	(Costante)	44,356	5,950		7,455	,000
		possession_kicked	-,873	,240	-,508	-3,636	,001
	2	(Costante)	47,115	5,866		8,032	,000
		possession_kicked	-,747	,239	-,434	-3,129	,003
	3	percent_oss_kicked	-,198	,096	-,286	-2,060	,046
		(Costante)	43,201	5,904		7,317	,000
	4	tackles_missed	,493	,233	,281	2,119	,041
		possession_kicked	-,741	,228	-,431	-3,249	,003
	5	percent_oss_kicked	-,246	,095	-,357	-2,607	,013
		(Costante)	49,406	6,182		7,991	,000
	6	turnovers	-1,265	,545	-,289	-2,320	,026
		tackles_missed	,545	,221	,310	2,465	,019
7	possession_kicked	-,797	,217	-,463	-3,676	,001	
	percent_oss_kicked	-,281	,090	-,407	-3,105	,004	

a. Variabile dipendente: points\_suffered

**Table 38.** *Points suffered coefficients per team*, (source: www.rbssixnations.com, personal elaboration using SPSS linear regression analysis)

## General linear regression with points scored as dependent variable

Here we have the best R-squared overall, reaching the 55% of total variance with seven variables. The variables are pretty much the ones we would have expected: line-breaks, minutes in opposite half, lineout won on opposite throw and passes.

Riepilogo del modello

Modello	R	R-quadrato	R-quadrato corretto	Deviazione standard Errore della stima
1	,659 <sup>a</sup>	,434	,432	7,59525
2	,684 <sup>b</sup>	,468	,464	7,37929
3	,704 <sup>c</sup>	,495	,489	7,20363
4	,719 <sup>d</sup>	,517	,509	7,06212
5	,730 <sup>e</sup>	,533	,523	6,95564
6	,737 <sup>f</sup>	,543	,532	6,89559
7	,742 <sup>g</sup>	,551	,538	6,85081

- a. Predittori: (Costante), linebreaks
- b. Predittori: (Costante), linebreaks, min\_in\_opp\_half
- c. Predittori: (Costante), linebreaks, min\_in\_opp\_half, handling\_errors
- d. Predittori: (Costante), linebreaks, min\_in\_opp\_half, handling\_errors, lineouts\_won\_on\_opp\_throw
- e. Predittori: (Costante), linebreaks, min\_in\_opp\_half, handling\_errors, lineouts\_won\_on\_opp\_throw, passes
- f. Predittori: (Costante), linebreaks, min\_in\_opp\_half, handling\_errors, lineouts\_won\_on\_opp\_throw, passes, tackles\_completed
- g. Predittori: (Costante), linebreaks, min\_in\_opp\_half, handling\_errors, lineouts\_won\_on\_opp\_throw, passes, tackles\_completed, yellow\_cards

**Table 39.** *Points scored coefficients*, (source: [www.rbssixnations.com](http://www.rbssixnations.com), personal elaboration using SPSS linear regression analysis)

The coefficients below tell us that line-breaks is the most important predictor to score points. Each line-break account for 2,3 points. Also the stolen lineouts have some importance, they account for almost one point, while yellow cards are very penalizing because playing in 14 players makes it harder to score. Minutes in opposite half and tackles completed account for a small points increase, while surprisingly passes account for a decrease.

Coefficients<sup>a</sup>

Modello		Coefficienti non standardizzati		Coefficienti standardizzati	t	Sig.
		B	Deviazione standard Errore	Beta		
1	(Costante)	10,951	,821		13,334	,000
	linebreaks	2,346	,174	,659	13,514	,000
2	(Costante)	3,166	2,154		1,470	,143
	linebreaks	2,195	,173	,617	12,684	,000
	min_in_opp_half	,200	,051	,189	3,890	,000
3	(Costante)	8,539	2,588		3,300	,001
	linebreaks	2,237	,169	,629	13,213	,000
	min_in_opp_half	,190	,050	,179	3,768	,000
	handling_errors	-,397	,111	-,165	-,3,564	,000
4	(Costante)	7,444	2,559		2,909	,004
	linebreaks	2,160	,168	,607	12,878	,000
	min_in_opp_half	,177	,050	,167	3,580	,000
	handling_errors	-,392	,109	-,163	-,3,585	,000
	lineouts_won_on_opp_th row	,943	,290	,150	3,248	,001
5	(Costante)	9,519	2,622		3,631	,000
	linebreaks	2,258	,169	,634	13,386	,000
	min_in_opp_half	,235	,053	,222	4,455	,000
	handling_errors	-,392	,108	-,163	-,3,641	,000
	lineouts_won_on_opp_th row	,957	,286	,152	3,345	,001
	passes	-,036	,013	-,145	-,2,872	,004
6	(Costante)	-,9,659	8,886		-,1,087	,278
	linebreaks	2,336	,171	,656	13,681	,000
	min_in_opp_half	,218	,053	,205	4,118	,000
	handling_errors	-,406	,107	-,169	-,3,805	,000
	lineouts_won_on_opp_th row	,883	,285	,140	3,093	,002
	passes	-,037	,012	-,148	-,2,963	,003
	tackles_completed	,222	,099	,103	2,257	,025
7	(Costante)	-,9,804	8,829		-,1,110	,268
	linebreaks	2,349	,170	,660	13,837	,000
	min_in_opp_half	,218	,053	,205	4,145	,000
	handling_errors	-,391	,106	-,163	-,3,676	,000
	lineouts_won_on_opp_th row	,877	,284	,139	3,093	,002
	passes	-,041	,013	-,162	-,3,241	,001
	tackles_completed	,236	,098	,110	2,402	,017
	yellow_cards	-,1,244	,618	-,090	-,2,014	,045

a. Variabile dipendente: points\_scored

**Table 40.** Points scored coefficients, (source: www.rbssixnations.com, personal elaboration using SPSS linear regression analysis)

## Teams linear regression with points scored as dependent variable

In the table below we will look in detail at the teams' subdivision.

All the teams, apart from Scotland and Italy, show great variance of results. England's three variables account for nearly 70% of the total variance. France

has the same results but with 2 on 3 variables different from England. Ireland and Wales are both pretty much consistent even if they have only two variables.

Scotland has line-breaks that account for only the 10% while Italy does not show anything. So, these two teams have not a precise attacking strategy.

**Riepilogo del modello**

team	Modello	R	R-quadrato	R-quadrato corretto	Deviazione standard Errore della stima
england	1	,748 <sup>a</sup>	,560	,548	7,79631
	2	,797 <sup>b</sup>	,636	,616	7,18991
	3	,824 <sup>c</sup>	,679	,652	6,83888
france	1	,682 <sup>a</sup>	,466	,452	7,82617
	2	,751 <sup>d</sup>	,563	,540	7,16915
	3	,782 <sup>e</sup>	,611	,579	6,85677
ireland	1	,695 <sup>a</sup>	,483	,470	7,96305
	2	,734 <sup>f</sup>	,539	,514	7,62096
scotland	1	,316 <sup>a</sup>	,100	,076	6,25565
wales	1	,578 <sup>a</sup>	,334	,317	7,54729
	2	,694 <sup>d</sup>	,482	,454	6,75094

a. Predittori: (Costante), linebreaks

b. Predittori: (Costante), linebreaks, min\_in\_opp\_half

c. Predittori: (Costante), linebreaks, min\_in\_opp\_half, passes

d. Predittori: (Costante), linebreaks, tackles\_completed

e. Predittori: (Costante), linebreaks, tackles\_completed, yellow\_cards

f. Predittori: (Costante), linebreaks, handling\_errors

**Table 41.** *The explained variance for points scored per team*, (source: www.rbssixnations.com, personal elaboration using SPSS linear regression analysis)

Differently from the general analysis, England's line-break nearly double the points scored with 2,4 points. This is very significant because, together with minutes in opposite half, it explains well how they score points. Staying in the opponents half allows the team to have more possibilities to score and to have more possibilities to make penalty goals.

For France, line-breaks are even more important than they are for England, accounting for 3 points each. It means that together with a great defense (tackles completed), France's way of scoring points is very related to line-breaks and consequently with tries rather than penalty kicks. Moreover, yellow cards have a really bad impact on France performance accounting for 5 points

loss, probably because they are not used to concede many yellow cards and they are not able to put in place their playing style without a man.

Ireland's line-breaks account as much as England's but differently the points scored depend inversely from handling errors. Also for Wales lineouts have some importance but not as much as the others and strangely there is a dependence from tackles completed. It means that the more they have good tackles performance, the more they are able to score points. It is difficult to give an explanation of this relation. Probably the Welsh, thanks to the high tackle completed rate, are able to steal the ball (turnover) to an exhausted attack and score.

**Coefficienti<sup>a</sup>**

team	Modello		Coefficienti non standardizzati		Coefficienti standardizzati	t	Sig.
			B	Deviazione standard Errore	Beta		
england	1	(Costante)	11,534	2,024		5,697	,000
		linebreaks	2,495	,359	,748	6,953	,000
	2	(Costante)	-5,170	6,310		-,819	,418
		linebreaks	2,000	,376	,600	5,315	,000
		min_in_opp_half	,445	,161	,313	2,771	,009
	3	(Costante)	-5,050	6,002		-,841	,406
		linebreaks	2,386	,398	,715	5,992	,000
		min_in_opp_half	,688	,188	,483	3,657	,001
		passes	-,088	,040	-,324	-2,213	,033
france	1	(Costante)	11,911	2,250		5,294	,000
		linebreaks	2,638	,458	,682	5,755	,000
	2	(Costante)	-47,136	20,618		-2,286	,028
		linebreaks	2,649	,420	,686	6,310	,000
		tackles_completed	,650	,226	,313	2,878	,007
	3	(Costante)	-33,248	20,790		-1,599	,119
		linebreaks	2,993	,433	,774	6,907	,000
		tackles_completed	,496	,228	,239	2,176	,036
		yellow_cards	-5,310	2,518	-,248	-2,109	,042
ireland	1	(Costante)	9,557	2,462		3,881	,000
		linebreaks	2,743	,460	,695	5,962	,000
	2	(Costante)	17,358	4,372		3,970	,000
		linebreaks	2,674	,442	,678	6,056	,000
	handling_errors	-,653	,308	-,237	-2,118	,041	
scotland	1	(Costante)	12,808	1,624		7,889	,000
		linebreaks	1,016	,495	,316	2,052	,047
wales	1	(Costante)	14,709	2,089		7,043	,000
		linebreaks	1,637	,375	,578	4,370	,000
	2	(Costante)	-54,759	21,526		-2,544	,015
		linebreaks	1,896	,344	,670	5,503	,000
	tackles_completed	,769	,237	,394	3,239	,003	

a. Variabile dipendente: points\_scored

**Table 42.** *Points scored coefficients per team*, (source: www.rbssixnations.com, personal elaboration using SPSS linear regression analysis)

## **Chapter 4. The metaphor**

Starting from the results obtained in previous analysis, I tried to find a link between the characteristics of the different rugby teams and the different organizational styles.

First of all I analyzed the most meaningful performance indicators in terms of what they could represent in organizational terms. Secondly I considered each team as a different business organization, while in the third and last step I had focus on the similarities between rugby and business that cannot be evaluated through analysis and are not numerical values.

### **4.1 The performance indicator metaphor**

In this paragraph I will illustrate how some rugby performance indicators can represent the metaphor of a company organization. Obviously not all the P.I. fit in the metaphor but however there are some interesting examples:

- **Points difference:** This indicator can represent the overall result of a company, which namely is the net profit.
- **Successful kicks:** It could have two different meanings. A try conversion can be seen as a capital gain because the kick after the try adds two more points to the score. Instead, a penalty kick might represent the ability to put pressure and push the other teams (competitors) to concede penalties.
- **Lineouts won on opposite throw:** this variable is one of the most interesting. Lineouts require a high level of organization; all the players involved in this set-up must be coordinated. There is a lineout leader that calls the move and everyone knows what to do and at the right time.

To “steal” a lineouts from the opposition is a pretty hard task, because all the players involved have to understand earlier the opponent’s idea. This explains the concept of anticipating the opponents’ moves.

This P.I. can also represent a manager that in order to take an opportunity sends ahead a particular division/product.

- Handling errors: Handling errors could be easily translated into business world. Indeed, it could be seen as a lack of skills, competences or communication through the employee. The latter indicator is generally influenced by the number of passes. The higher the number of passes you make, the higher is the risk to make handling errors. Considering the number of passes as a metaphor of how much is the team involved in a situation, when a team makes too much passes, it results in a mess because the job description is not clearly identified and decisions might take longer. Having too many people involved in a single project without specific tasks or plans on what to do, will eventually just slow down the pace and waste time.
- Minutes in possession: in rugby, holding the ball for long time requires a great level of team commitment because it is usually related to a multiphase strategy, a way of playing that need a big effort. This strategy is based on having a great number of play phases, trying to advance towards the try-line. In a managerial view this could be seen as a team that works well. Everyone in a team makes an effort in order to achieve a goal (a try). It could be considered as the “conditio sine qua non” in order to have a successful organization.
- Penalties conceded: they are related to a lack of respect towards the role and the competence of a colleague or a personal lack in something that penalizes all the team. In the worst cases the referee (the manager) can give a yellow card (downgrade), or even a red card (layoff).

- Tackles: generally the number of tackles made in a match is related to the time spent in defense. So the team who rely more on the defense could be seen as a company focused more on the costs structure than on developing new markets or new products with a particular added value. Once again the defense in rugby is an important element but it is not enough.
- Turnover won: staying in defense, being able to contend and stealing the ball, could be seen as a breaking innovation that gives an advantage in the situation. The organizational process is very dynamic, ready to change if necessary and always seeking for new opportunities.
- Passes: passes is the variable who fit better the rugby metaphor. It represent the ability of a team of “passing” the tasks in a project. There is specific pass that will clarify the concept. The so-called “hospital pass”<sup>7</sup>, happens when you pass the ball on to your team-mate not in the proper way, so in the case that he catches it, it’s almost sure he’ll be tackled and will get injured. This means he will end up in the hospital, and here comes the name. The classic injury example is when receiving a long and high pass, you are busy looking to catch the ball and you cannot see the incoming defenders, so you are not ready to receive the pass. Unfortunately this is something that happens very often in business projects. When team members need to hand over a task to each other, they generally under deliver. At a first sight, the team member that receives the task, doesn’t notice it. But as soon as he starts working on the input he received, he notices that it is not up to standards. He needs to rework a lot of it, or sometimes has to start over

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<sup>7</sup> Vermiljen B., *The hospital pass*, [www.bartwermiljen.com/hospital-pass/](http://www.bartwermiljen.com/hospital-pass/), 2014

again. In the worst case, he has to give the task back, which delays everything and puts even more pressure on the process.

This does not only happen among team members, but also between different teams, or between the company and the clients and suppliers. And it is one of the most counterproductive things around.

So it would be better to always evaluate and make sure, before handing things over, that your work (your pass) is in a state you would be happy to receive it yourself, while always checking that your colleague (team-mate) has the time and ability to receive it.

- Offloads: The offload is a quite hard technique to put in place. It requires a great amount of power to break to tackle and soft hands to pass the ball to a team-mate. It represents a form of action continuity without passing the ball while on the ground. For this reason, it needs a great self-confidence and trust in the support of the team-mates. It could be seen as internal growth of the employees within the company.
- Line-breaks: This P.I. can be associated to the famous Metaphor of the blue ocean strategy<sup>8</sup>. Finding the “hole” in a defense means avoiding the crowded competitors environment (the red ocean) in order to find a more profitable spot where the price battle has not yet started (the blue ocean).

Furthermore it might represent a breakthrough innovation.

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<sup>8</sup> Chan Kim W., Mauborgne R., *Blue ocean strategy*, Harvard Business School Press, 2005

## 4.2 Teams metaphor

In this paragraph I have at first resumed the team profiles, and then I have tried to make some associations between teams and companies structures.

In the below table, at left I put the characteristics I would have expected to find in each team, using my experience. On the right I summarized the performance analysis results.

### Expected

#### England:

- Very scrum-based team
- Few passes
- Few offloads
- Organized set-pieces
- High kicking team
- Strong defense
- Skilled players

### Effective

#### England:

- **Positives:**
    - Top performer as linebreaks made
    - Strong lineout
    - Best tackling rate
    - Strong defense
    - Few kicking errors
    - Many passes
    - High ball possession (but not easy to convert into points)
  - **Negatives:**
    - Worst turnover maker
    - Handling errors (related to high number of passes)
    - Many penalties
- Tries scores are well correlated to: linebreaks, minutes in opposite half, offloads, passes and minutes in possession.
- **Linear regression analysis**

**France:**

- Many passes
- Many offloads
- “French flair” style of play: a way of playing associated to a free running spirit, keeping the ball always alive, making many offloads and concluding making a try.
- Few kicks
- Smaller but fast players
- Unpredictable players

- Points difference: lineouts won on opposite throw, linebreaks, minutes in opp.half, passes (neg.) (67% var.)
- Points suffered: minutes in opp. Half (neg.) (15%)
- Points scored: linebreaks, minutes in opp. Half, passes (neg.) (68%var.)

**France:**

- Positives:
  - Turnovers
  - Disciplined team
  - High kicking rate
- Negatives:
  - Few passes
  - Low percentage of lineouts stolen

Tries scored are related to linebreaks and turnovers, and they generally score more tries with backs players.

- Linear regression analysis
  - Points difference: linebreaks, passes (neg.), tackles completed (54% var.)
  - Points suffered: kicking errors, passes, tackles completed (37%

**Ireland:**

- Very strong defense
- Multi-phases way of playing, very patient team
- Good lineouts and scrum

var.)

-Points scored: linebreaks, yellow cards (neg.), tackles completed (61% var.)

**Ireland:**

- **Positives:**

- High scoring tries
- Most effective team in turning possession into points
- Many offloads and linebreaks

- **Negatives:**

- Few passes
- Indiscipline
- Handling errors

In 2007 and 2008 editions Ireland made an high number of passes and low number of kicks. This strategy did not lead to noticeable results.

In 2009 and 2010 it played nearly in an opposite way and it was the best for time in opposite half. The result was a grand slam victory in 2009.

- **Linear regression analysis**

-Points difference: linebreaks, handling errors (neg.) (53%var.)

-Points suffered: turnovers (neg.),

min in opp half (neg.) (40% var.)

-Points scored: linebraks, handling errors (neg.), tackles completed (54%var.)

**Italy:**

- Many errors
- Good scrum
- Poor backs
- Many rolling maul
- Few passes
- It has great individuality but it is not able to play together.

**Italy:**

- **Positives:**

- High kicking team
- Tries scored come from opposition errors, turnover, interception and driving maul, but not from linebreaks.
- Effective lineout
- Good possession

- **Negatives:**

- Highest number of tries conceded
- Low number of passes
- Least successful for kicking percentage
- Highest penalized team
- Lowest number of linebreaks and offloads
- Lowest tackles effectiveness

In 2012 arrived a new French coach. It changed Italy's way of playing

from an high kicking team to a more passes style. With the new strategy in 2013 Italy arrived fourth and it was the best year so far.

- Linear regression analysis

-Points difference: tackles missed (neg.) (13%var.)

-points suffered: tackles missed (15%var.)

-points scored: no relation

**Scotland:**

- Many passes
- Scarce players availability
- Great commitment

**Scotland:**

- Positives:

- Many passes

- Good lineouts

- Negatives:

- Worst tries scorer ( in 2012 it scored only 3 tries in whole tournament)

- Least effective for turning possession and occupation into points

- Many yellow cards

- Handling errors

- Lowest kicking rate in the game

- Defence nearly as bad as Italy

- Number of linebreaks nearly as bad as Italy

- Worst turnover rate

## **- Penalties**

**It makes many passes but just few linebreaks.**

**It usually wins if it kicks more and if it is more disciplined.**

- **Linear regression analysis**

**-Points difference: possession kicked (30% var.)**

**-Points suffered: turnovers, possession kicked (neg.), tackles missed, % possession kicked (neg.) (48% var.)**

**-Points scored: linebreaks (10% var.)**

## **Wales**

- **Very strong and physical players**
- **It often changes style of playing**
- **Generally it is an high kicking team**

## **Wales**

- **Positives:**

**- Strongest defense (94% tackles success rate, in 2012 edition they conceded only three tries)**

**- It scores most of its tries from turnover**

**- Highest kicking rate success**

- **Negatives:**

**- Least for minutes in opposite half**

**- Least for lineouts effectiveness**

**- Many penalties**

**Wales is a controversial team; it does not have a clearly defined and**

**stable style of play. It has been able to arrive fourth and fifth for many years and to win three times the championship.**

- **Linear regression analysis**

**-Points difference: linebreaks (25% var.)**

**-Points suffered: no relation**

**-Points scored: linebreaks, tackles completed (50% var.)**

I made this recap in order to underline the most significant characteristics of each team. I now try to associate each team style of play to an organizational structure.

- **England**

England is the best team overall. In the period of time that I considered England never went below the third place, collecting five second positions and one tournament win. It has a well-structured organization and the data confirm this statement. The P.I. are well bounded with each other, and they conceive a defined style of play. With its excellent lineouts and scrum, England is a very organized team. Indeed, it is a team with a high grade of ball-possession and makes a lot of passes.

Nevertheless, when the number of passes is too high, few problems may arise. Indeed, the number of handling errors grows with the increasing on the number of passes. This means that when too many people are involved in a decision, the decision might be delayed. However, England could represents a well-organized company, with a degree of control in goods' costs (good defense), renowned and successful in many market (ball

possession and time in opposite half) and always ready to take up on new opportunities (linebreaks).

For this reasons, England's structure could represent a flat organization. The employees involved in this organization are very collaborative, elastic, and versatile. This model is more responsive to changes and innovations compared to a strict hierarchical organization.

- **France**

France's historical way of playing is called "rugby champagne," an apparently not structured game, based on free running spirit and on personal creativity. This peculiar style of play led to many achievements, as they won the championship in 2007 and in 2010. But since 2011, French ideas about game's strategy have changed. They put more focus on discipline and defense, while striving to win more turnovers. They tried to shape a more "anglo-saxon" type of organization, which unfortunately did not pay off at the beginning, and France touched the bottom finishing last in the 2013 edition.

Changes in the strategy might come from ideas of a new coach or maybe from different players' characteristics.

However, France original idea is the first expressed. It has the unique way of playing of "organized confusion," that is only possible when the team is made of players with specific skills, characteristics and with a certain vision of the game, called culture. Unlike England, France is more similar to a less organized team (indeed his lineout and scrum are not performing), but it benefits from outstanding individualities, which lead the team.

- **Ireland**

Ireland has the highest number of tries scored and the best correlation between points scored and minutes of possession. This means that Ireland is a very effective team. Ireland is a team with scarce resources, but able to get the best out of that. They are the best for turnovers, line-breaks and offloads. These indicators are the best predictors for tries scored. This means that even with a small team (low ball possession), they are able to catch sudden opportunities (turnovers), to be innovative (line-breaks) and to make the team member growing inside the organization (offloads). Sometimes they suffer from a lack of continuity and discipline.

- **Italy**

Italy requires a specific consideration. It gained the right to enter the competition only 15 years ago, so it is still considered the “rookie” of the tournament. In spite of this, Italy proved with some important wins to have the right to remain part of the tournament. In the first six years, it only won few times against Scotland, while since 2007 they started to defeat all the other teams apart from England. This tough beginning can be compared to a market really difficult to access, with high entry barriers, and even once in, it requires many years to be seriously competitive with the other companies, (teams). France, i.e., admitted after the WWI, needed nearly 50 years before winning the championship.

Despite its young age, Italy has some strength. Its scrum and lineouts are nearly the best of the tournament and many points come from these set-pieces. So we assert that Italy is a well-structured and well-organized team. Unfortunately, this is not enough for the Italian national team, which suffers from a lack of good players or, in other words, human capital. Indeed, many Italian players are not good enough to play against the other teams; they have weak skills and eventually make a lot of errors. This lack of skills led

the former trainer to adopt a high-kicking strategy instead of a passes one, through which he tries to develop the game inside the opponent half. But also this strategy had not succeeded because of the high rate of kicking-errors and of the low tackle rate. These errors cause big defense problems, and this make it hard to win matches. In defense, a missed tackle represents someone in a team who avoids or fails an important task, due to a lack of skills or commitment, and this forces a team member to repair the damage.

- **Scotland**

Scotland shares some similarities with Italy; they always finish toward the last positions.

In spite of this, their way of playing is characterized by many passes and a great number of lineouts stolen, indicators that predict a high-level organization, but they are the worst in converting this opportunity into points. It seems that they are missing a leader that develop new ideas, new strategy. The data illustrate that when they are able to change their strategy of playing, kicking more and passing less, the kicking goal rate increases and they usually win.

Scotland seems a well-structured team, but not capable to come up with new ideas, probably because it misses a leader and suffer from a lack of skills of some or the team-members.

- **Wales**

Wales is the most inconsistent team. It won the championship three times but it arrived also four times fourth.

Wales is very focused on the defense, in fact it has the highest tackles rate, and it uses frequent long-kicks that allow the team to play in the opposite

half. Alongside their great defense, they are the best for turnover won and most of its tries come from this indicator. This means that thanks to their defense they are able to tire out the opposition, steal the ball and score. This kind of strategy has been particularly successful when they won two championships in a row (2012 and 2013), and also because they introduced in the team new and more suitable players.

From an organizational point of view, Wales seems a high-skilled team, always ready to get new opportunities and very dynamic.

### **Further consideration:**

Along with the metaphor that I proposed in the previous analysis, I will also report some personal considerations about the teams' performance.

First of all, England's continuity of results over the years probably comes from the great availability of top-level players who play in the English national championship, with the addition of great number of foreign players that increases the overall level of the league. In England all the players have close interactions with the federation, and this implies a more effective control and management of them. Another pool of very good players is their national under-20 team, which is one of the best in the world. Every year it offers new, young players ready to be part of the senior team.

Moreover, England has the greatest budget among all the teams of the competition.

France, like England, has the best national club championship in the world, but it suffered from a significant increase in foreign players in the championship, especially after 2010. Along with an exponential growth of team-budget and with a lack of foreign players' policies, the number of player from the Southern Hemisphere grew a lot, taking minutes of play away from the French players. While the foreign players were taking more and more spots on French clubs,

French players had fewer opportunities to play and this reflected in a poorer performance of the French national team. This occurred mainly because of a deregulation in the salary cap of the league, allowing teams to offer salaries to players, which could not be matched by any other league.

Ireland and Wales together won five times in eight years the championship. A possible explanation of this result may come from the fact that all the players of both the national teams play in the two major national clubs and the results of the national team is related to the performance of these clubs. This close relation between the clubs and the national teams allows the teams to be more cohesive because they know each other very well.

Furthermore, in both countries, rugby is considered as football in Italy. Indeed, rugby really plays an important role in their culture, much more than in other countries, and a strong cultural background always support and anticipate any success.

As I said before, Italy only joined the competition fifteen years ago. It tried to handle the initial difficulties by investing a lot in foreign trainers and by making big investments in order to develop the Italian rugby movement. Moreover, with in mind the goal of increasing the team level, the federation invested a lot of resources for the recruitment of players with some Italian origin but formed in a more advanced rugby countries. This policy implied a lower level of players' commitment and a frequent turnover of players. More on, a great number of players currently play in foreign countries clubs because the level of the Italian championship is too low.

In a business point of view, this problem typically happens to a company that does not form the employees (or don't form them properly), and ends up seeking people (players) with specific tasks who are left on the "market" because they are not good enough to play for their home country (better company). The result is a significant waste of money to "hire" them.

In conclusion, I noticed that Italy's performance is closely related to the nationality of the players and also of the trainers. Indeed, in the period of time

that I considered, Italy changed four trainers: two of them from the Southern hemisphere (New Zealand and South Africa) and two of them from France. When there were the French coaches, Italy had its best results, finishing even fourth.

This illustrates how influential the nationality of the coach is, in term of the team's success. The cultural background and the of the two French coaches was more similar to the Italian environment, so also the rugby strategy that they pursued fit better the Italian players, leading to success. Italy and France, indeed, have much more to share on the cultural and historical level than Italy has with New Zealand/South Africa, and this emerges also on a rugby field.

### **4.3 Non-numerical similarities between field and business**

If we consider the complexity of the game and of the organizations, it would be too simplistic to reduce the analysis in a purely numerical analysis. For this reason I have also made a qualitative analysis of some other objects that cannot be measured analytically.

- **The strategy role**

The game of rugby is a situational sport that asks the players to be ready and responsive to every environmental change. It includes open-skill situations (with many variables and choice possibility) and closed-skill situations (with no choice possibility, for example the penalty kick). On top of it, rugby is a very quick game, and so it is the promptness to adapt to changing-situation that makes the difference. The essential requirements are flexibility, ductility and readiness. However, it is also a game where strategy has a tremendous impact: it is important to recognize the momentum, but also to be able to organize a series of moves to reach the goal.

In fact, it is impossible to play well just in the last ten minutes to win a match as it often happens in soccer. You need to play well for 80 minutes and have a pre-set game plan for the whole match. Similar situations occur in business too, where it is not enough to organize themselves near a deadline to be successful, you also need a coherent and consistent programming.

The systematical complexity requires the manager to be capable of taking advantage from the environmental transformations and hopefully to anticipate them. But at the same time he must set a program, without which it would be impossible to develop and achieve new objectives.

- **The responsibility concept and the errors management**

In a team the responsibility assumption is a prerequisite for the growth and contributes to the empowerment development. This responsibility assumption comes from the awareness that everyone in the team will do what he is capable of and at his best, in order to reach the mastery and control of what the environment offers. A rugby player knows that taking a responsibility means also recognizing his errors. In rugby, errors not only are tolerated, but are also seen as collective learning: once they have been discussed and analyzed, the errors become the starting point for a future growth both for the individual and team perspective, according to the logic of continuous improvement.

The error evaluation offers an impression of the team-mates (or colleagues) work-rate. It is very important to only discuss only his behavior, why he made the error and not to judge the individual as a person. So the task is to evaluate and judge the errors, not the person who made it. You could be strict with him, and maybe set a specific training, but it is important that the player/employee does not feel in any way questioned as a person. All in all, the error represents a learning opportunity from which one should take a valuable lesson for the future.

- **Organizational effectiveness and the support concept**

The functional relationship between individual and group (a constituent element of each organization) is composed by a constant interaction of two dimension: the strategic one, and the emotional/motivational one. The first, already discussed in the previous paragraph, mobilizes the technical/skill competences and is more task oriented, while the emotional/motivational dimension, relies on interpersonal and communication skills, and helps to maintain a positive atmosphere within the group. Together these two

components determine the degree of effectiveness of an organization. The effectiveness is a valuable measure of a team's success.

On one hand, it is true that, in the context of individual performance, the confidence of being able to handle tough situations leads to a significant advantage in term of enhance the individual's performance. On the other hand, when the individual operates together with others, the individual's belief of self-efficacy can determine the performance only partially. Indeed, in such contexts, the collective belief of efficacy is crucial to the success of the organization - as demonstrated by Stajkovic and Luthans in their famous research<sup>9</sup> - and necessary to achieve the objectives, to handle circumstances and to cope with the arising difficulties.

The collective efficacy beliefs are based, essentially, on the perception that the individual has towards the relationships and the performance of his teammates. The collective efficacy beliefs are determined by both the commitment of each one toward the mission and the belonging to the group; People feel much more tied to the group when they believe to be adequate and worth it for the team, and when they have trust in the organization. In rugby, this set of considerations is summarized in the concept of support.

The concept of support in rugby is fundamental. First of all, the ball can only be passed backwards, so when someone runs into the defense, there should be some other players behind him supporting the action, either for receiving the pass or for helping him to keep the ball. This means that the whole team is involved in the action. Shifting to the business view, this concept represents the fact that each of your co-workers takes his responsibility, and supports the activities of the others. Obviously we have also to take into consideration the individual qualities, the willingness to sacrifice and the quality of the company's strategy. That being said, if all the members of an organization are willing to

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<sup>9</sup> Stajkovic, Luthans, *Behavioral management and task performance in organizations conceptual background meta analysis and test of alternative models*, Personnel Psychology, 2003 56

sacrifice themselves for a common goal, which in rugby is holding the ball and in business the budget realization, the company will surely gain a plus, no matter what the strategic thinking the company undertakes.

- **The cohesiveness**

The concept of support leads to another important one, the cohesiveness. There are no sports like rugby that are played by fifteen players so different from each other both from a physical and from a technical point of view. Every role is different from the other and requires a set of well-defined skills. The different tasks are clearly recognizable from the static phases: for example the prop pushes in the scrum, the lock jumps in the lineouts, the fly-half kicks the ball. However, in the free play, this difference does not come out because all the player are involved in an action, they are all cooperating in order to take the ball over the try line. This general movement is then coordinated by the coach, who has to decide how the team is going to play depending on the weather, on the opposition and on the players available. This means that the individual competencies are necessary but not sufficient.

This concept can be shifted into a business organization, where all the employees have different tasks and competences but they all cooperate with each other in order to reach the goal set by the manager. In a more macro-vision, the same concept of cohesiveness is required among the different business units.

This concept highlights the importance of versatility and adaptation. The overall performance of both a rugby team and business organization has a greater potential compared to the sum of the single different sub-organizations.

- The trust

The concept of cohesiveness requires a fundamental pillar: the trust among each team member.

Trust among players is the number one requirement for the success of the team. However, this is not the case of a blind-trust, on the contrary it is built on the awareness that each team-member is competent and good at his task and that he is doing his best to win the game. Once again there is a need of competences and values. Trust is the root of any organization that wants to succeed, it is fundamental between co-workers, providers, customers. An organization based only on contracts, standards and procedures is not enough. There is a need of a social identity. Moreover trust helps to make the brand stronger. Trust allows you to respond quicker to external and internal challenges. Being in a trusting environment makes it easier to deal with the relationships in terms of confirmations and commitments that you must sign in. Finally, alongside with trust comes also a more effective contribution of all talents of the team.

Few examples will clarify what trust in rugby is.

The first example is concerned with the defense line. A successful defense line is a "line" where everyone communicates and knows which player of the opposition has to be defended. Communication is crucial when playing rugby. Players have to talk to each in order to hold on the line and everyone has to go towards the attack line at the same speed, to avoid "holes" in the defense. Once again, the game requires not only a physical strength to make the tackles but especially a great coordination and trust among players, so that everyone is doing his job.

Another meaningful example is the lineout. When the lineout leader calls the movement, all the other players need to be coordinated with each other and with the hooker to raise the right jumper so he can catch the ball. Also in this situation, there is a need of trust in your team-mates that they will do the right job at the right time. The lineout could be compared to a company that decide which segment or division to put in the front line and catch a new opportunity.

The scrum summarizes best the concept of trust.

Japanese professors Takeuchi and Nonaka,<sup>10</sup> (Takeuchi, 1986) published “The New New Product Development Game”, in the Harvard Business Review 1986, where they presented a “rugby-style” approach, in which a cross-functional team with self-managed roles work together to create a product. They believed that the flexibility and creativity of this kind of team, can be more effective in creating new successful products.

Rugby scrum promotes a set of values too, which are commitment, focus, openness, respect and courage. These values shape the behavior of Scrum team members. They are encouraged to make team-commitments, to work together and fulfill common goals, to overcome obstacles in an efficient way, and approach the work with a “gritty, not glorious” courage.

A scrum team is very cohesive. This means that are the team members themselves who make decisions on how to divide and approach the work. Scrum teams do not need a scrum master or anyone else to give them strict directions. The team itself, rather than a manager or lead engineer, is in the best position to decide how to approach the work to which the members are committed.

So even the organizations work dynamically to achieve a common goal.

Another example is the organization among the different business unit. So, just as in the game of rugby, the forwards could be seen as the marketing department, that does the initial work to create the platform and to create the opportunities, and then pass the ball out to the backs, the sales department, who try to score. The forwards and the backs, just like marketing and sales, are both good at the specific task they do. The tied collaboration between these two areas determines the win or loss of the team.

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<sup>10</sup> Takeuchi, Nonaka, *The new new product development game*, Harvard business review, 1986

- The mental preparation

In the previous paragraph we saw some examples of how few rugby set-plays can be shifted into a business view. Although the concept of organization and coordination are crucial, there is a third concept as important, and it is the mental preparation. There are three main points to keep in mind when playing:

1. The rules: you always have to remember the 118 “laws” of the game to avoid problems to your team. This requires a constant clarity about the rules from all the players.
2. The physical impacts: when on the field, players have to be highly concentrated because if they are not they will face a high risk of injury. In a team-environment, the individual injury affects both the single player and the whole team, that loses an asset.
3. The team reputation: in rugby every player feels to be part of a club and is proud to defend and fight for his colors, and this keeps him motivated.

- The ethic

The three concepts seen above reflect another characteristic of the rugby world: the ethic.

Ethic is considered the rugby framework. Respecting the rules, the opposition and the referee, accepting the trainer’s decisions, are fundamental for winning matches and championships, all with a no-excuse culture. If you are not in good health, you are not accepted by your teammates, or if you are not self-confident, you will not be able to give your 100% on the field. The same in business. If you feel accepted and considered by colleagues, if you are recognized and respected for the role you play, then you will give your 120%. If a company decides to not consider the ethic, it has to turn the market, recurring into a continuous turnover, which results in a loss of know-

how and in an increase in the salary expenses. The same happens with a rugby team. Teams with fewer economic opportunities can count on ethics, the value of the jersey and on attachment that the team members have to the team and to the other team-mates, that prevents them to leave the team for a much more economically rewarding one.

- Metaphor limitations

The rugby metaphor presents also some limitations. Since it is a very fast sport, it can lead to take decisions in very tight deadlines or on the wave of emotions, even if in today's world you have to improve the ability to react to the changes.

Another threat may come from the fact that a group, in order to preserve unity and conformance above change, moves to the lowest common denominator instead of the best solution.

We also to be aware that too much reliance on socialization can lead to inefficiencies as the project team grows in size.

Finally, it might be hard to set performance targets, as the process changes so much.

## Conclusion

When I was a child I was blessed to dive into a sport like rugby that helped me growing as a player and as a person, and at this point of life I would add also as a young man ready to face the jungle of real work-world. I have always had a tremendous passion for rugby and if at first it was mainly the love for the athletic movement, the fun time with the team and the tries scored, when I got a little older I started to appreciate the philosophy that lies beneath rugby, which is one of reasons that kept me in the field until now. I noticed how the small world of rugby was a perfect model of the real world, and in particular a pure and simplified edition of the more complex business world. But it only was during my first real working experience at Benetton that realized how business organizations present the same genuine pillars that rugby does. Starting from my own experience, the research aimed to find thoughtful insights on business organizations starting from a rugby analysis, a new perspective to talk about management.

In the early stages of this thesis I have explained what is the game of rugby, his history and his values.

In the second chapter I have outlined the applicability of statistics instruments to the Rugby. In order to create a suitable numerical summary of match events, the right data needed to be collected. I found the raw data per team on the RBS Six Nation website starting from 2007 until 2014. In the abovementioned period I have analyzed all the matches of the six teams involved in the competition. I have established 22 performance indicators (P.I.) that resume at best the team performances through which I have tried to explain the teams results in the period considered.

I have collected data from a total of 120 matches and I have analyzed the performances from both the team involved in the matches, so 40 matches per team. The analysis has been made with a statistical program, SPSS 20.0.

Thanks to this program, I have made several analysis, starting from a simple descriptive of the raw data to a more difficult factor analysis. Unfortunately the statistical analysis results' has not been much satisfying. The more complex but more meaningful studies, which are the factor analysis and the log-linear regression, did not give the expected results because of the low correlation among variables.

Nevertheless I have obtained some interesting results. The correlation and the regression functions have been pretty helpful in order to verify the connection among the P.I. and to create a "profile" especially for England, France, Ireland and Wales. These four teams together won all the eight editions of the championship analyzed. On the other hand Scotland and Italy did not show, from the statistical analysis, a really clear game plan. This could partly explain why they are always at the bottom of the competition.

I think that in the future, when there will be more data available about matches, performances etc, the analysis could be more precise and structured and it could generate more detailed profiles, necessary to provide a deeper and more exhaustive explanation of the performances and their correlations.

After the performance analysis, I have resumed the results obtained. Once I gathered together all the characteristics of the teams, I tried to give a possible explanation of the playing style of each one of them. Consequently I have tried to associate some organizational and managerial tips at first to the single performance indicators, and then to the six teams involved in the analysis.

Since the previous metaphor analysis did not include all the possible reflections about the metaphor between rugby and business organization, I have also made a qualitative analysis of the concepts that are not reproducible in numbers, but that are at the same level of importance.

The concepts of trust, support, cohesion, respect, team working, the importance of the human factor and so on are very important on a rugby field but they are also fundamental elements of a successful company organization.

The same values that, as the actual global crisis shows, have been jeopardized by unscrupulous and not respectful conducts.

Overall, Rugby shows with clear images a blurry concept that organizations try to explain by word. A principle that I respect a lot is that of correcting the other after a mistake only by referring to the error and not to the person as an individual. During a match, indeed, it is crucial that the players keep calm when a teammate makes a mistake. If the other team-members get upset and insult the player, he is going to feel hurt and he will fail again. But if the teammates just give him some advices on how to do it better on the next action, focusing only on the mistake, the team will stay cohesive and everybody will be better off. This happens all the time in a business environment, and I believe that the rugby image of the dynamic is a very powerful mean to convey this concept, as many others.

This study could be very helpful to specific companies, that might introduce some rugby concepts in their day to day working practices in order to enhance the level of team working, trust and support. This could eventually benefit the overall organizational framework, and, perhaps, allow the companies to increase their profitability and sustainability.

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## Appendix A. Teams descriptive statistics

team		N	Minimo	Massimo	Media	Deviazion e std.	Varianza
england	points_diff	40	-30,00	46,00	6,9000	15,04659	226,400
	points_sc ored	40	3,00	59,00	22,7000	11,60062	134,574
	points_suf fered	40	0,00	43,00	15,8000	7,63662	58,318
	tries_scor ed	40	0,00	8,00	2,0000	1,81164	3,282
	tries_suffe red	40	0,00	4,00	1,0750	,97106	,943
	succesful _kicks	40	1,00	9,00	4,7500	1,83624	3,372
	lineouts_ won_on_o pp_throw	40	0,00	9,00	2,1750	1,85206	3,430
	handling_ errors	40	4,00	25,00	11,8750	4,17678	17,446
	min_in_po ssesion	40	18,00	40,00	27,9000	5,42454	29,426
	min_in_op p_half	40	24,00	65,00	42,5000	8,14610	66,359
	penalties	40	5,00	18,00	10,2500	2,88008	8,295
	yellow_car ds	40	0,00	2,00	,6500	,73554	,541
	tackles	40	30,00	165,00	94,8750	29,33029	860,266
	tackles_m issed	40	0,00	24,00	9,1750	5,92642	35,122
	tackles_co mpleted	40	76,67	100,00	90,4805	4,70834	22,168
	turnovers	40	0,00	13,00	3,9250	3,08335	9,507
	passes	40	61,00	238,00	137,7250	42,53022	1808,820
	offloads	40	1,00	19,00	7,9250	4,55388	20,738
	possession _kicked	40	15,00	42,00	27,4250	7,47607	55,892
	percent_p oss_kicke d	40	10,00	57,00	30,3250	12,17687	148,276
	kicking_er rors	40	0,00	8,00	2,0250	1,70200	2,897
	linebreaks	40	0,00	15,00	4,4750	3,47878	12,102

team		N	Minimo	Massimo	Media	Deviazion e std.	Varianza
france	points_diff	40	-24,00	42,00	4,8000	14,60102	213,190
	points_sc ored	40	6,00	50,00	22,7250	10,56843	111,692
	points_suf fered	40	3,00	34,00	17,9250	6,91111	47,763
	tries_scor ed	40	0,00	7,00	2,1500	1,74753	3,054
	tries_suffe red	40	0,00	5,00	1,6250	1,07864	1,163
	succesful _kicks	40	0,00	8,00	4,4500	1,61642	2,613
	lineouts_ won_on_o pp_throw	40	0,00	7,00	1,9000	1,51573	2,297
	handling_ errors	40	6,00	20,00	13,5250	3,44173	11,846
	min_in_po ssesion	40	20,00	44,00	28,1500	5,85093	34,233
	min_in_op p_half	40	22,00	62,00	43,2500	9,51045	90,449
	penalties	40	4,00	16,00	8,3500	2,79698	7,823
	yellow_car ds	40	0,00	2,00	,2500	,49355	,244
	tackles	40	59,00	151,00	97,0750	23,70588	561,969
	tackles_m issed	40	1,00	27,00	9,7750	5,75788	33,153
	tackles_co mpleted	40	80,34	98,99	90,7828	5,08452	25,852
	turnovers	40	0,00	12,00	4,0750	2,92108	8,533
	passes	40	80,00	191,00	135,0500	27,42538	752,151
	offloads	40	3,00	20,00	9,9000	4,45950	19,887
	possession _kicked	40	14,00	40,00	25,4500	7,17885	51,536
	percent_p oss_kicke d	40	8,00	53,00	28,9250	12,12200	146,943
	kicking_er rors	40	0,00	6,00	2,2000	1,52248	2,318
	linebreaks	40	0,00	11,00	4,1000	2,73440	7,477

team		N	Minimo	Massimo	Media	Deviazion e std.	Varianza
italy	points_diff	40	-46,00	20,00	-14,4000	15,96117	254,759
	points_sco red	40	3,00	37,00	13,8750	6,79059	46,112
	points_suf fered	40	6,00	59,00	28,2750	12,88407	165,999
	tries_sco red	40	0,00	4,00	1,1250	,82236	,676
	tries_suffe red	40	0,00	8,00	2,9500	2,26399	5,126
	successful _kicks	40	1,00	7,00	2,8250	1,58337	2,507
	lineouts_ won_on_o pp_throw	40	0,00	6,00	1,6250	1,31437	1,728
	handling_ errors	40	5,00	24,00	13,1750	3,99286	15,943
	min_in_po ssesion	40	14,00	38,00	26,2250	6,00635	36,076
	min_in_op p_half	40	19,00	56,00	39,0500	9,32037	86,869
	penalties	40	3,00	19,00	10,0750	3,56901	12,738
	yellow_car ds	40	0,00	3,00	,7750	,76753	,589
	tackles	40	53,00	245,00	104,9500	34,22846	1171,587
	tackles_m issed	40	3,00	29,00	11,6000	5,69660	32,451
	tackles_co mpleted	40	77,68	98,91	90,1603	4,54996	20,702
	turnovers	40	0,00	14,00	4,0250	2,94816	8,692
	passes	40	64,00	191,00	125,0000	33,41580	1116,615
	offloads	40	0,00	20,00	6,8000	4,66410	21,754
	possession _kicked	40	13,00	53,00	26,6250	9,58548	91,881
	percent_p oss_kicke d	40	12,00	62,00	30,5500	12,57378	158,100
	kicking_er rors	40	0,00	9,00	3,1250	1,82837	3,343
	linebreaks	40	0,00	8,00	2,4250	1,44803	2,097

team		N	Minimo	Massimo	Media	Deviazion e std.	Varianza
ireland	points_diff	40	-23,00	39,00	5,9250	14,56090	212,020
	points_scor ed	40	6,00	51,00	22,1750	10,93545	119,584
	points_suf fered	40	3,00	33,00	16,4000	7,12453	50,759
	tries_scor ed	40	0,00	8,00	2,3250	1,81712	3,302
	tries_suffe red	40	0,00	4,00	1,1250	1,01748	1,035
	successful _kicks	40	1,00	9,00	4,0750	1,70049	2,892
	lineouts_ won_on_o pp_throw	40	0,00	7,00	2,2750	1,72445	2,974
	handling_ errors	40	4,00	19,00	11,4500	3,96750	15,741
	min_in_po ssesion	40	19,00	39,00	28,8750	5,35502	28,676
	min_in_op p_half	40	26,00	62,00	43,7000	7,90067	62,421
	penalties	40	1,00	16,00	9,5000	3,45669	11,949
	yellow_car ds	40	0,00	3,00	,9000	,87119	,759
	tackles	40	42,00	200,00	92,5250	30,85532	952,051
	tackles_m issed	40	1,00	23,00	8,4750	5,47248	29,948
	tackles_co mpleted	40	79,03	98,39	90,5658	4,67429	21,849
	turnovers	40	0,00	13,00	4,7750	2,96551	8,794
	passes	40	58,00	258,00	133,4000	40,64846	1652,297
	offloads	40	0,00	26,00	6,7500	4,93938	24,397
	possession _kicked	40	10,00	42,00	27,8750	8,32108	69,240
	percent_p oss_kicke d	40	8,00	82,00	32,2500	16,67141	277,936
	kicking_er rors	40	0,00	9,00	2,2500	2,14536	4,603
	linebreaks	40	0,00	12,00	4,6000	2,77165	7,682

team		N	Minimo	Massimo	Media	Deviazion e std.	Varianza
wales	points_diff	40	-23,00	48,00	5,3000	15,22515	231,805
	points_scor ed	40	3,00	51,00	22,2000	9,13208	83,395
	points_suf fered	40	3,00	32,00	16,9000	8,38130	70,246
	tries_scor ed	40	0,00	7,00	1,8250	1,44803	2,097
	tries_suffe red	40	0,00	3,00	1,2500	1,10361	1,218
	succesful _kicks	40	1,00	9,00	4,7750	1,68686	2,846
	lineouts_ won_on_o pp_throw	40	0,00	4,00	1,4750	1,30064	1,692
	handling_ errors	40	7,00	24,00	12,9000	4,24143	17,990
	min_in_po ssesion	40	17,00	40,00	27,6750	5,83705	34,071
	min_in_op p_half	40	25,00	60,00	43,0000	10,05115	101,026
	penalties	40	5,00	16,00	10,0000	2,57204	6,615
	yellow_car ds	40	0,00	2,00	,7000	,60764	,369
	tackles	40	56,00	178,00	99,4500	26,93482	725,485
	tackles_m issed	40	1,00	26,00	9,3750	5,26083	27,676
	tackles_co mpleted	40	75,41	95,29	88,7868	4,68005	21,903
	turnovers	40	0,00	10,00	3,9750	2,69365	7,256
	passes	40	66,00	227,00	140,7750	41,13922	1692,435
	offloads	40	0,00	22,00	8,6750	4,78988	22,943
	possession _kicked	40	15,00	43,00	26,9500	6,15171	37,844
	percent_p oss_kicke d	40	10,00	49,00	30,8000	12,02391	144,574
	kicking_er rors	40	0,00	11,00	2,9250	2,42199	5,866
	linebreaks	40	1,00	16,00	4,5750	3,22560	10,404

team		N	Minimo	Massimo	Media	Deviazion e std.	Varianza
scotland	points_diff	40	-48,00	24,00	-7,9250	13,12931	172,379
	points_scor ed	40	0,00	34,00	15,4500	6,50818	42,356
	points_suf fered	40	6,00	51,00	23,3750	10,50687	110,394
	tries_scor ed	40	0,00	4,00	,9500	1,08486	1,177
	tries_suffe red	40	0,00	7,00	2,2750	1,64843	2,717
	successful _kicks	40	0,00	7,00	3,7000	1,62038	2,626
	lineouts_ won_on_o pp_throw	40	0,00	8,00	2,2500	1,72091	2,962
	handling_ errors	40	5,00	28,00	14,0500	4,89872	23,997
	min_in_po ssesion	40	15,00	39,00	25,9500	5,42525	29,433
	min_in_op p_half	40	18,00	58,00	38,8250	11,07755	122,712
	penalties	40	4,00	16,00	10,0500	3,00384	9,023
	yellow_car ds	40	0,00	2,00	,5750	,71208	,507
	tackles	40	45,00	177,00	103,4500	27,57177	760,203
	tackles_m issed	40	2,00	27,00	10,5750	5,97382	35,687
	tackles_co mpleted	40	78,74	98,06	90,0938	4,40135	19,372
	turnovers	40	0,00	10,00	3,4750	2,39645	5,743
	passes	40	35,00	254,00	139,3500	52,84450	2792,541
	offloads	40	2,00	19,00	9,3250	4,50861	20,328
	possession _kicked	40	12,00	39,00	24,0250	6,11215	37,358
	percent_p oss_kicke d	40	7,00	82,00	29,3750	15,20743	231,266
	kicking_er rors	40	0,00	9,00	2,6250	1,86310	3,471
	linebreaks	40	0,00	7,00	2,6000	2,02295	4,092

## Appendix B. Rules and players position

### Pitch dimension

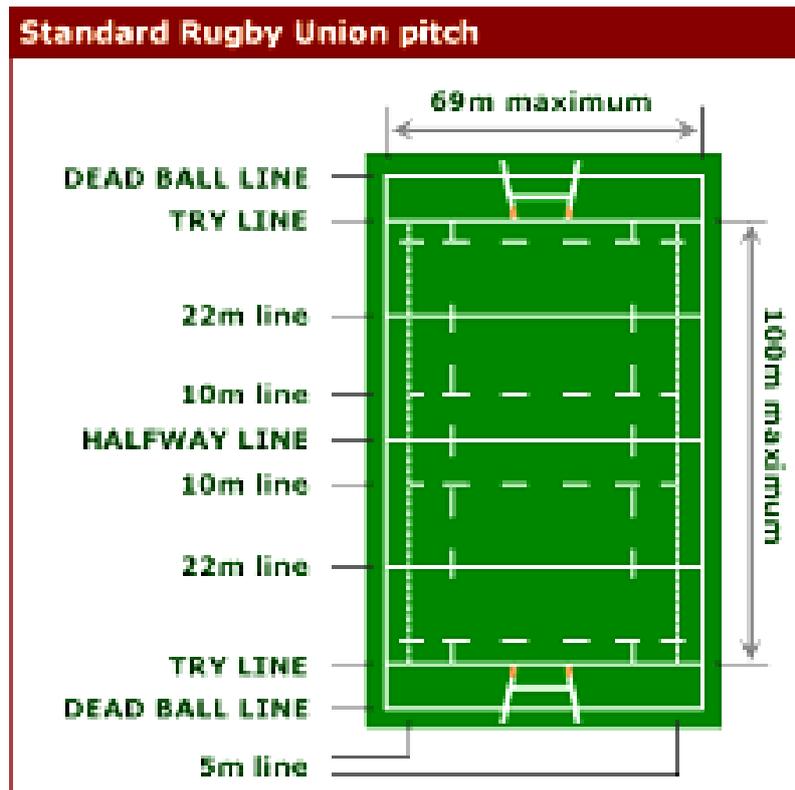


Table 1: Standard rugby union pitch

### Rugby ball dimensions and rules



Materials: Leather or suitable synthetic material. It may be treated to make it water resistant and easier to grip.

Weight: 410 – 460 grams.

Air pressure at game start: 0.67-0.70 kilograms per square centimeter.

### **Principal game situations**

- **Ruck**

A ruck is formed when the ball is on the ground and one or more players of the two teams, standing on their legs, contend the ball pushing against each other. The ball can be contended only head on and no-one can enter from the side.



**Table 2:** Typical ruck situation

- **Maul**

Differently from the ruck, the ball is not contended on the ground but from the hands of a player standing up on his legs. It happens when the player is grabbed by one or more defenders whom try to stop his progress and he is helped and pushed by his teammates. The purpose of the maul is to advance towards the try line using the push supplied by your teammates.



Table 3: Maul example

- **Scrum**

The scrum is a method of restarting play in [rugby](#) that involves players packing closely together with their heads down and attempting to gain possession of the ball. It happens when the ball is passed forward on purpose or not, or if it falls out of the hands (especially when receiving a pass). It is regulated by many rules and it is more related to a mental discipline than to the physical force.



**Table 4:** A scrum exemple

- **Lineout (Touch)**

The lineout is a way of restarting the game after the ball, or a player carrying the ball, goes off the touchline. The opponents of the team who last held or touched the ball, prior to it going out of play, throw the ball into the lineout. To win possession, any player in the lineout can jump for the ball, supported in the jump by two team-mates. The team throwing in the ball has the advantage since they can call a code that alerts their team mates to the destination of the throw. After the ball is caught, the ball can be passed to the scrum half for further distribution or a maul can develop. The option chosen may depend on field position.



**Table 5:** A lineout example

- **Penalty kick**

The referee can award a penalty kick for offside, ball held on the ground, high tackle, etc. The team who benefit from it can decide to kick for posts and gain three points or to kick into the lineout approaching the opponents' try line.



**Table 6:** A fly-half kicking at posts a penalty

## The positions of rugby



**Table 7:** Rugby positions starting from a scrum

- **The forwards**

- Numbers 1 and 3: the **loosehead prop** and **tighthead prop**. They form the “first row” together with the hooker. They have to hold up the “pack” and for this reason they are generally the strongest of the team.
- Number 2: the **hooker**. He stays between the two props and “hooks” the ball in the scrum and send it in his side. He throws the ball in the lineout in the middle of the two lines. He is generally the smartest of the first row players.
- Numbers 4 and 5: **the second rows (locks)**. They are the tallest players because their task is the ensure the ball reception in the lineout. In the scrum they push behind the first row players.
- Numbers 6,7 and 8: the **third row (Blind side and open side flanker, N. 8)**. they are the most powerful players, they need speed, dynamism and resistance. They are the firsts to support a playing when he goes to the ground, the best tacklers of the team and they also have a “runner in” function in order to break to defense.

- **The half backs**

- Number 9: the **scrum-half**. He is the smallest player and together with the fly half is the playmaker of the team. He is the leader of the forwards. He is the one who touches more times the ball per match. He has to decide the player who recycles the ball when a team mate is tackled and the ball is ready to play. He has to decide whether to pass, to kick or to hold the ball and run.
- Number 10: the **fly half**. He is the other playmaker of the team. He decides the moves of the backs, using his insight into the game. His position requires great kicking and passing skills, and also a good tackling technique.

- **The backs**

- Number 12 and 13: the **inside and outside center**. They are the most physical players of the backs' line. They have also a great passing and tackling technique.
- Number 11 and 14: the **right and left wing**. They usually play near the touch line. They are the fastest players of the team. Their principal task is to receive the last pass and score the try.
- Number 15: the **fullback**. He plays at the back of the line. During the attack phases he joins the backs line to hinder the defense line. In the defense phases he covers the defensive holes and receive the long kicks.