Researching an Implementation of Network Analysis for Elite Rugby Team Coaching: A CBAR Case Study

by

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B.Ed. PDPP University of Victoria, 2013

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Supervisory Committee

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Abstract

This study sought to understand how the application of a network analysis of rugby gameplay could inform coaches of their teams’ patterns of play in an effort to aid their teams’ performance. A qualitative case study utilizing open-ended interviews and a process of evaluation and constant comparison served as a guiding framework for this the data collection and data analysis methods incorporated during this study.

Results of the study identified four key findings. First, incorporating elements of community based action research into the design of a case study provided the researcher with an opportunity to build effective working relationships with both participants. Second, providing coaches with effective feedback that informed them of their player’s performance was critical to the performance analysis (PA) process. Third, modifying the network analysis process to meet the participant’s needs was key in providing applicable analysis during the cases study. Fourth, performance analysts and coaches, like those in this case study, require video feedback, linked to the network analysis, if the network analysis process is to be considered informative. Finally, creating a PA process that is able to adapt to the coaches changing needs as well as the work cycles the organization proceeds through is a benefit of the NA process that we developed.

Keywords: Network analysis, coaching, performance analysis, qualitative research
Table of Contents

Supervisory Committee .................................................................................................................................. ii
Abstract ......................................................................................................................................................... iii
Table of Contents .......................................................................................................................................... iv
List of Tables .................................................................................................................................................. ix
List of Figures ................................................................................................................................................ x
Dedication ..................................................................................................................................................... xii
Chapter 1 Focus and Framing ...................................................................................................................... 1
  Background .................................................................................................................................................. 1
  Research Questions ................................................................................................................................... 2
  The Problems ............................................................................................................................................. 3
  Objectives .................................................................................................................................................. 7
  The Outline of the Thesis ........................................................................................................................... 7
Chapter 2 Review of Literature ................................................................................................................... 9
  Overview ................................................................................................................................................... 9
  The Coaching Process ............................................................................................................................... 9
  Performance Analysis ............................................................................................................................... 12
  Rugby is a Territory/Invasion Game ....................................................................................................... 15
  Performance Indicators ........................................................................................................................... 17
  Performance Indicators Used in Rugby ................................................................................................. 18
  Considerations for the Use of Performance Indicators ........................................................................ 22
  Dynamic Systems ................................................................................................................................... 24
Limitations ........................................................................................................... 57

Ethical Issues ...................................................................................................... 58

Chapter 4 ............................................................................................................ 59

Context and Findings ......................................................................................... 59

Setting the Scene ............................................................................................... 59

The Researcher ................................................................................................. 61

The Participants ............................................................................................... 62

Carl the elite level performance analysis coach: Initial Interview ................. 63

Initial Opinion on PA ..................................................................................... 64

Carl’s current use of PA .................................................................................. 66

Initial Opinion of NA ....................................................................................... 67

Planning for the Future .................................................................................... 67

Final Impression of NA: “Thinking about analysis in a new way.” .......... 69

David the elite varsity coach ........................................................................... 73

Diagnosing or Paralysis by analysis: David’s Initial Opinion PA ............. 75

Current Use of PA .......................................................................................... 78

Initial Opinion of Network Analysis (NA) ..................................................... 83

Interview two with David: Observing need to re/present NAs ............... 88

Action: Team Presentation ............................................................................. 90

Preparing Analysis for the Coaches as well as the Players: The Team PA Meeting ............................................................................................................ 97

Reflecting on event: End of an action research phase but what about “put boots on the field” .......................................................... 100
Plan: Develop a YouTube Channel to host a Team Playlist ....... 102

Revisions to the process ................................................................. 103

Evaluation of YouTube Playlist implementation ...................... 105

Reflection: Did we achieve our Goals? ........................................ 106

Final Evaluation of the process ...................................................... 108

Buy-in from players ................................................................. 109

Video quality ................................................................. 110

Time to work with players and time for players to work on PA ....... 110

Video and wanting to look at everything .................................... 112

Planning for next Year’s Campaign: Next cycle of Performance Analysis

Development ...................................................................................... 113

Final Impression ............................................................................. 114

Chapter 5 ...................................................................................... 116

The Gyro metre ............................................................................. 121

‘I Know this Already’ ..................................................................... 122

Pre-Conceived Notions ............................................................... 125

I Want to Look at That ............................................................... 128

A Change in Focus ....................................................................... 130

The Inverted Triangle of Analysis .................................................. 133

Proposed Interface ....................................................................... 135

Conclusion .................................................................................... 139

Recommendations ......................................................................... 142

Bibliography .................................................................................. 144
Appendix A: Participant Consent Form .......................................................... 155
Appendix B: A Time Table Summarizing the Events, Carl ............................. 159
Appendix C: A Time Table Summarizing the Events, David .......................... 161
Appendix D: Team PA Meeting: Feedback Mechanics ..................................... 165
Appendix E: Team PA Meeting 2: Feedback Mechanics ............................... 168
Appendix F: YouTube Channel: Feedback Mechanics .................................... 172
Appendix G: The Development of the Video and Network Analysis Methodology
Utilized during this Case Study. ...................................................................... 175
Choosing the Match Videos .......................................................................... 177
The Analysis Procedure .................................................................................. 178
The Network Analysis Procedure ................................................................... 179
Changes to the NA procedure ....................................................................... 184
After Meeting One ......................................................................................... 184
YouTube ........................................................................................................ 188
Appendix H: A Time Table of the Interactions, that occurred with David ...... 191
List of Tables

Table 1. Examples of Network Analyses of Sports. ............................................. 30
List of Figures

Figure 1. Diagram adapted from Franks et al. (1983) representing the coaching process.................................................................................................................................................. 10

Figure 2. Game classification (Adapted from Hughes and Bartlett, 2002 after Read and Edwards, 1992) ........................................................................................................................................ 16

Figure 3 Sub categorization of invasion games, with examples (Adopted from Hughes and Bartlett, 2008). .................................................................................................................. 17

Figure 4. A representation of the user interface I created within Longomatch to analyze rugby games. ......................................................................................................................... 96

Figure 5. The phases of research as they happened during this case study ....... 117

Figure 6. The categories related to the theme 'I Want to Look at That' ............ 130

Figure 7 the categories and codes related to the theme 'Change in Focus' ....... 132

Figure 8 a proposed model of analysis detailing the process of PA that occurred during this case study. .................................................................................................................. 133

Figure 9. A proposed interface representing combined findings of Carl and David during this case study. ......................................................................................................................... 136

Figure 10 A summary of NBA Passing Networks modified from Fewell et al., (2012) ........................................................................................................................................ 175

Figure 11. Passos et al. methodology for analyzing the passing networks that occurred during a game of water polo (2011) ................................................................. 176

Figure 12. An example of the notational analysis utilized during the analysis process ................................................................................................................................. 178
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Dedication

To my lovely wife, my caring family and supportive friends!
Chapter 1 Focus and Framing

Background

My interest in this project started from a passion for playing and watching rugby. This interest led me to a personal inquiry into the concept of network analysis and its application to rugby and blossomed into a part time career as a performance analyst. After I performed an extensive review of the body of knowledge regarding network analysis, it became apparent that an amalgamation of network analysis and performance analysis had the potential to provide novel performance information to both players and coaches in team sports. In fact, I thought it possible that the visual representation provided from network analysis might provide information that was more useful than the sports analysis already performed by coaches and analysts. With this in mind, I started a journey of applying network analysis to coaching rugby.

My background in coaching rugby and teaching in general influenced the next stage of this developing inquiry. I felt that most of the articles that I read contained information that seemed interesting but I questioned how useful they were to the average coach. I also wondered if a coach had the time to read the article in the first place. I wondered how the information in these articles could be anything other than for informational purposes and applied by the people it was to help.

Although the method of performance analysis that I was developing seemed very interesting, I had to determine if the concept I was proposing was practical and if it would be useful to other coaches in a practical settings. Furthermore, I wanted to present this method of performance analysis utilizing coaches involved in instructing a high-
performance level of rugby because this is where it would have the most effect and I would be able to gather the most feedback on its usefulness.

**Research Questions**

The initial research questions that I developed for this study were:

- How can I develop an understanding of the ways in which a network analysis can enhance coaches’ understanding of their team’s performance in rugby?
- How can I develop an understanding of the means in which the use of network analysis can be combined with currently utilized performance indicators to inform coaches’ decisions of their teams’ patterns of play in order to improve the team’s effectiveness?
- How as a researcher, can I work with my participants to develop the use of network analysis in a university elite rugby team?

I also formulated another list of personal questions that would need addressing before I could initiate this project in the first place. First, how would I be able to master the technical skills necessary to perform this inquiry? Second, was my tactical and technical understanding sufficient to create information that would be useful for a coach or player? Finally, how would I be able to create visual representations of the networks that were similar to those I had seen in the articles I had read? I knew that finding questions to these answers was important to the success of this project. Little did I know that the pursuit in answering these questions would lead to a part-time career as a video analyst! Although my work with the participants in this study (an elite coach and a national performance analyst) has officially ended, I have continued to provide
performance analysis to the coach on an ongoing basis. The following section addresses the problems that I identified that lead to the initiation of this project.

**The Problems**

The coaching process is an ongoing cycle of performance and practice. The role of the coach is to observe and analyse the performance and provide feedback, which can be incorporated into planned practice that should theoretically lead to the enhancement of player performance (Hughes & Bartlett, 2008; Maslovat & Franks, 2015; McGarry T., Anderson, Wallace, Hughes, & Franks, 2002). Successful coaching among other things depends upon the accuracy of observation and analysis. It is therefore extremely important that the information collected during athletic performance is objective, unbiased, accurate and as comprehensive as possible (Hughes & Franks, 2008; Hughes & Bartlett, 2008).

Traditional coaching practices often involve subjective observations and conclusions based on the coach’s perceptions, biases and own previous experiences. However, a number of studies have revealed that subjective observations are potentially both unreliable and inaccurate (O'Donoghue, 2010; Laird & Waters, 2008; Franks, Goodman, & Miller, 1983).

The collection of information that is objective, unbiased and as comprehensive as possible can be achieved by using performance analysis based on video (O'Donoghue, 2010; Hughes & Bartlett, 2008). Impartial methods like performance analysis (PA) provide coaches with an objective method of measuring sports performance (O'Donoghue, 2010). PA usually takes the form of video analysis (VA)
using either manual or computerized systems to perform biomechanical analysis, notational analysis or both (Hughes & Bartlett, 2008; Maslovat & Franks, 2015; Hughes & Franks, 2008). PA can occur during and post event, and can focus on technical, tactical or movement analysis details. The process of PA assists coaches in evaluating athletic performance by providing them with a method that can both quantifying or qualifying performance and strategies of teams or individuals (Hughes & Bartlett, What is performance analysis, 2008).

The sport of rugby is a form of territory invasion game where the central intent of a team is to invade their opponents' territory with the ball in order to score. The opposing team endeavours to stop this scoring by preventing the invasion and by getting possession of the ball (Johnson, 2001; Delacy & Fox, 2000). A PA of athletic performance during territory invasion games provides coaches with technical and tactical information from which they can base their feedback on these core intents of the game.

PA creates outcome measures termed performance indicators (PI). PIs are a selection of frequency or quality measures that explain the performance or behaviour of individuals or teams in athletics (Hughes & Bartlett, 2002; Correia, et al., 2012). PI can take the form of match indicators, technical indicators and biometric indicators (Hughes & Bartlett, 2002). Comparing the patterns of play of two opposing teams enables coaches to define the PI that differentiate between the two teams and highlight the tactical strategies that contribute to a team’s success. Being able to define quantitatively and objectively where technique fails or excels is of great practical use for a coach
especially one who is looking to analyze the performance of players at high level of performance.

Rugby coaches rely on PI such as ruck retention, possession, set play performance, turnovers, penalties and field position to evaluate their players’ athletic behaviors, and to the coaches abilities to analyze their team’s performance (Vaz, Rooyen, & Sampaio, 2010; Ortega, Villarejo, & Palao, 2009; Higham, Hopkins, Pyne, & Anson, 2014; Higham, Higham, Anson, & Eddy, 2012; Higham, Hopkins, Pyne, & Anson, 2014; Ross, Gill, & Cronin, 2014; James, Mellalieu, & Jones, 2005).

However, these types of PI have inherent problems when analyzing player(s) and team performance. For instance, performance indicators are widely used as a frequency measures to explain, understand, and predict future athletic performance. Unfortunately, this only provides coaches with outcome results that lack complexity and are prone to errors due to reliably, and stability issues. Factors such as time, location, environment, weather, game situation, playing position and game attributes can affect the reliability and stability of PI and the coach’s abilities to accurately and reliably summarise, describe and predict athletic behavior (McGarry T., 2009; James, Mellalieu, & Jones, 2005; Lames & McGarry, 2007; McGarry T., 2009; Hughes, et al., 2012). Furthermore, PI focus on individual performances and rarely gather data simultaneously from other performers. In relation to outcome measures, in certain situations, PI can provide an inaccurate and ineffective means of explaining the complex and dynamic behaviors and interactions that occur during sporting events and particularly in the sport of rugby (Correia, et al., 2012; Hughes, et al., 2012; Garganta, 2009).
The term social network describes the interrelation of relationships that form between groups of organisms, animals, individuals. Teams, which are a form of social network, are characterised as a group of individuals who work together towards a common goal. The interactions that occur between individuals or groups of individuals (teams) as they coordinate to solve a common goals form patterns of complex interactions among group members. A network analyse (NA) of a group’s interactions can make sense of those complex interactions (Murase, Doty, Wax, DeCHURCH, & Contractor, 2012).

A NA can provide informative summaries of group interactions through the creation of an informative graphic visualization (a weighted graph) and metrics (various summaries of group interactions). This information combined with various PI has the potential to aid the understanding of a team’s interactions, functioning, coordination and performance (Lusher, Robbins , & Kremer, 2010).

Territory/invasion games like basketball, soccer and rugby are described as a group of individuals (teammates) interacting in a coordinated manner in an effort to score on their opponents in a pre-defined amount of time (Hughes & Bartlett, 2002). The interactions that form between teammates as they attempt to score, while at the same time preventing their opponents from scoring, forms a dynamic web of interactions both within and between teams.

There have been several attempts to apply network analysis to the field of athletics. Many of these studies focus on team coordination, strategic gameplay and the influence of an individual or a group of individual’s interactions on the performance of
an entire team (Cotta, Mora, & Merelo, 2013; Duch, Waitzman, & Amaral, 2010; Peña & Touchette, 2012; Lusher, Robbins, & Kremer, 2010; Fewell, Armbruster, Ingraham, Petersen, & Waters, 2012; Radicchi, 2011; Yamamoto & Yokoyama, 2011; McGarry T., Applied and theoretical perspectives of performance analysis in sport: Scientific issues and challenges, 2009; Passos, et al., 2011). It is possible that a systems approach to rugby analysis could offer insight into a player or team’s performance that otherwise might not be available to a coach. Unfortunately, the body of knowledge concerning the network analysis of rugby is lacking (Hughes, et al., 2012, p. 399).

**Objectives**

The objective of this study was to address the problems that I have outlined in the previous section. The first objective of this study is to develop an understanding of the ways in which a network analysis can enhance a coach’s understanding of their team’s performance. The second objective of this study was to determine how I could develop an understanding of the ways in which the use of network analysis can be combined with currently utilized performance indicators to inform a coach’s decisions of their team’s patterns of play in order to improve their team’s effectiveness. The final objective of this study relates to how I, as a researcher, could work with my participants to develop the use of network analysis in a university elite rugby team.

**The Outline of the Thesis**

This study contains five chapters and an appendix section. Chapter One provides the statement of the problem, frames the problem within the context of the research setting, describes the purpose of the research and explains the significance of the study.
Chapter Two presents a comprehensive review of the literature. Chapter Three describes the research methods, including the role of the researcher, the incorporation of a community-based action research, the types of data collected and the methods used for data collection. This chapter also alludes to the strategies that were incorporated to increase the rigour of the study, any potential limitations of the study, and any possible ethical issues the researcher faced. Chapter Four describes the results of the study and Chapter Five addresses my conclusions and recommendations.
Chapter 2 Review of Literature

Overview

This chapter contains six sections. The first section discusses the use of network analysis as a tool to summarize and explain the complex interactions and coordination process that occur between members of a team as they attempt to work towards a common goal. The next section establishes that field territory/invasion games, like rugby, are examples of dynamic systems. The following section highlights performance indicators and their use as a method to summarize, explain and predict athletic behavior. It concludes with a review of the literature related to PI and the various concerns expressed in regards to their reliability, stability, complexity, and suitability in explaining the complicated dynamics and interactions that occur in rugby. Finally, the last section of this chapter highlights the historical relevance of action research and its practical ability to incorporate inquiry and action in an attempt to aid a group of people towards implementing change.

The Coaching Process

In any sporting situation, it is difficult for a coach to notice and remember all of the key events that have occurred within a training session or during a game. Despite a coach having the knowledge, vision and powers of observation, there are limitations in their ability to recall all that has happened, and then rely upon their memory for the details. This implies the performance information that they have collected will likely be unreliable. The coaching process, as illustrated in Figure 1 below, represents the coaching process as an ongoing cycle of performance and practice. During this cycle,
the coach is required to evaluate, intervene, and provide feedback information to

**Figure 1. Diagram adapted from Franks et al. (1983) representing the coaching process.**

performers with the ultimate aim of enhancing their athletic performance (Hughes & Bartlett, 2008).

In coaching, feedback is a means of eliciting change. This implies that without feedback there will be no change in performance. Coaches traditionally use various forms of feedback to provide performance information to their athlete(s). In fact, some may argue that providing feedback on athletic performance is “one of the most important variables affecting learning and subsequent performance of a skill” (Maslovat & Franks, 2015, p. 11).

Research has shown that it is a tradition in athletics for coaches to provide feedback to their athletes based on subjective observations. For instance, Hughes and Bartlett (2008) stated, “Traditionally, coaches have provided feedback to their players based on subjective observations during practice in the belief that they can accurately recall the critical events that occurred without any observational aids” (p. 19).
Unfortunately, studies have highlighted the fact that subjective observations made by coaches have their limitations. For instance, a study performed with international level soccer coaches found that forty five percent of the coaches were able to recall the key incidents that occurred during a game correctly (O'Donoghue, 2010, p. 3). In another study, the researchers found that eight qualified football coaches were able to recall fifty eight percent of the key incidents that occurred in a game forty five minutes after its conclusion (O'Donoghue, 2010, p. 3). Finally, yet another study found that experienced coaches were “more likely to report there was a difference in player performance when no difference occurred and were not able to identify actual differences in the players performances any more successfully than the experienced coaches” (O'Donoghue, 2010, p. 3). The authors of these studies concluded that the errors made by these coaches were due to factors related to the environmental conditions including arousal levels, observer bias and errors in attention focus (O'Donoghue, 2010, p. 3). Regardless of the reasons, it is apparent that it is problematic for coaches to rely on subjective evaluations and their memory to base their feedback on.

In summary, providing feedback to players is an important aspect of the coaching process as players rely on the feedback from coaches to improve their performance. Coaches traditionally rely on first hand observations and their memory to form the feedback they provide their athletes. Unfortunately, this feedback could often be inaccurate or too subjective to be useful. Fortunately, there are options available to coaches to aid their ability to provide accurate and objective feedback to their athletes.
**Performance Analysis**

The process of performance analysis provides coaches with an objective method of evaluating athletic performance. Peter O’Donoghue, author of the book *Research Methods for Sports Performance Analysis* defines performance analysis (PA) as the “investigation of actual sport performance or performance in training rather than activity undertaken in laboratory settings or data gathered from self-reports or questionnaires…” (O'Donoghue, 2010, p. 2). The goal of PA is to optimize feedback for athlete and coaches in an effort to improve performance (Hughes & Bartlett, 2002, p. 740). PA is useful to coaches because it provides them an objective means of analyzing performance and providing feedback to their player(s) and team.

Hughes (2008) cited five purposes of performance analysis as being “…of paramount importance to the coaching process, the initial raison d’être of performance analysis…” (p.60). The purposes that he identified are: provide immediate feedback, to assemble materials for database development, to indicate areas that mandate improvement, to evaluate specific aspects of performance, and to operate as a selection mechanism in assisting coaches and athletes (Hughes, 2008, p.60).

PA has several practical benefits for coaches. Hughes and Bartlett (2008) claim that the process of PA can “highlight good and back technique or tactical performance” (p. 18). They also claim that PA provides coaches with a process that allows them to “identify good and bad performance of an individual or a team member and facilitate comparative analysis of individuals, teams and players” (Hughes & Bartlett, 2008, p. 18).
PA consists of several forms of analysis including biomechanical and notational types of evaluations. Of the two forms of analysis, Ian Franks and Mike Hughes (2004) state that notational analysis is the most commonly used form of PA used by coaches (p. 4). Notational analysis is an objective way of recording performance so that key events in that performance can be identified and quantified in a consistent and reliable manner (Hughes & Franks, 2008, p. 3). This enables qualitative and quantitative feedback, which aim at being accurate and objective. Advances in both computer and video technology can make this observation process more efficient and provide a coach with audio-visual feedback about their athletes’ performances (Hughes & Bartlett, 2008, p. 19).

Biomechanical analysis, on the other hand, is a form of analysis that is concerned with evaluating the fine details of individual sports like the take-off angle or take-off speed of an athlete performing the long jump. In general, biomechanical analysis provides coaches with a method to define a good or bad technique whereas, notational analysis is more concerned with the effect the athlete’s performance has on the entire team (Hughes & Bartlett, 2008, p. 26). This study will focus on the use of notational analysis techniques to evaluate athletics rather than biomechanical analysis.

Coaches and analysts can perform notational analysis manually or with computers or a combination of both although in 2008, Hughes and Bartlett stated that the” use of hand notation systems was equal to computerized notation systems” (p. 20). With the recent popularity of computer tablets and the reduction in the size and price of laptops and software, it is likely that the majority of notational analysis is performed
with some form of computer rather than by hand. Computers have also influenced the methods in the analysis and storage of data. These advancements in computer technology have necessitated the use of computerized databases that provide coaches and analysts with the ability to process larger and more detailed volumes of historical data.

Coaches traditionally utilize the process of notational analysis in the effort to evaluate general match indicators like the frequency of passes or tackles a player makes during a game. The collections of these match indicators provide coaches and analysts with several methods to quantify and qualify athletic performance including:

- Technical evaluation provides coaches and analysts with the ability to define quantitatively where an athlete’s technique fails or excels (Hughes & Bartlett, 2008, p. 20).

- Movement analysis provides coaches and analysts with information including the intensity and extent of activities during game play. With this data, coaches and analysts are able to establish measures such as “work rates of different playing positions, distances covered in a game and the percentage time of each position in each of the different ambulatory classifications” (Hughes & Bartlett, 2008, p. 22).

- Development of computerized databases and modelling techniques provides coaches and analysts with the opportunity to store and analyze large amounts of data (Hughes & Bartlett, 2008, p. 23). The aim of these databases and modelling techniques is to identify an individual or team’s pattern of play in the hope to establish a ‘normal level’ of performance. Once this normal profile is established, it
allows coaches and analysts to compare current performance profiles with the norms in an effort to compare or predict athletic performance.

**Rugby is a Territory/Invasion Game**

Rugby Union is a contact sport played by teams of fifteen. Each team contains groups of eight forwards and seven backs. The primary function of the eight forwards is to compete for possession of the ball, while the seven backs attempt to use the ball provided to advance down the field and score points. The main facets of the game where possession is contested occur during the set piece and the breakdown. The term set piece refers to the main restarts in play kick-offs, lineouts and scrums, which are relatively structured portions of play. The breakdown involves the ball carrier or tackled player and one or more players from each team contesting for the ball. A ruck occurs if the tackled player is on the ground. A maul occurs when the ball carrier is unable to reach the ground (Johnson, 2001).

There are seven backs on each team. The inside backs (players numbered nine and ten) are responsible for the majority of the team's tactical decision-making. Once one of the inside backs receive possession of the ball, the general options are either to kick the ball, or to keep it in hand and execute a probing attack either individually or in combination with the help the inside center, outside center and right wing (players numbered twelve, thirteen and fourteen) (Delacy & Fox, 2000). Aside from winning possession, developing, and implementing strategies to advance up the field, all of the players on the team must be adept at defending and tackling. The defensive ability of the
team is paramount in countering the attacking moves and strategies of the opposition while attempting to regain possession of the ball.

In 1992, Read and Edwards classified formal games into three categories, net and wall, invasion games and striking and fielding games (as cited in Hughes & Bartlett, 2002, p. 742). Figure 2 illustrates that the three formal games are classified based on their dependency on score, time and innings.

![Figure 2. Game classification (Adapted from Hughes and Bartlett, 2002 after Read and Edwards, 1992)]

Hughes and Bartlett (2002) have further refined this classification system to differentiate territory/invasion games into three subcategories including: goal-throwing games, try scoring games and goal striking games (p. 747). Figure 3 illustrates this classification system and provides examples of the sports that fall within it.
Within the confines of these two classification systems, it is possible to establish that rugby is a territory/invasion game. The goal of the participants, which is to score more tries than their opponents, in a precise amount of time, creates a specific set of concerns for the analysts and coaches responsible for evaluating territory invasion games. Performance indicators created through PA provide coaches and analysts with the ability to monitor athletic performance and provide feedback to their athletes.

**Performance Indicators**

Hughes and Bartlett are experts in the field of PA. They define performance indicators (PI) as a “selection or combination of action variable(s) that aim to define some aspect, or all, of a performance” (p. 739). They also indicate that a performance indicator is a “variable, or combination of variables, aimed at defining some aspect of performance, and to be useful, should relate to a successful performance or outcome” (Hughes & Bartlett, 2002, p. 740). PI can take the form of match indicators, technical indicators, tactical indicators and biomechanical indicators to provide coaches with information that can help them to evaluate individual players or the entire team (Hughes & Bartlett, p. 740). According to Hughes & Bartlett (2012), one of the most common
type of data analyses that generates performance indicators is a frequency measurement related to the amount of times an athlete performs a certain type of action (p. 399).

**Performance Indicators Used in Rugby**

Jones, Mellalieu and James (2004), generated an analysis of twenty-two team performance indicators over twenty matches played by a professional male rugby union team. The aim of their research was to examine the differences between winning and losing performances. They measured team performance as a proportion of successful events such as scrums, lineouts, rucks, mauls and tackles. Of the twenty-two team performance indicators they generated, only the indicator percent of tries scored as well as the indicator percent of lineouts stolen, exhibited statistically significant differences between winning and losing performances. Additionally, there was a practical difference between the percentages of total turnovers won. The higher frequency of tries for winning teams was not surprising; but the higher values for gaining possession through stolen lineouts and turnovers was interesting as turnovers and stolen lineouts are forms of possession where the opposition defence can be caught by surprise.

James, Mellalieu, and Jones (2005) developed position-specific performance indicators for ten different rugby positional groupings. They found intra-positional variability and concluded that there is a need for more than one profile per playing position. Their conclusion is not surprising for someone familiar with rugby as there are many different playing requirements within each position (DeLacy & Fox, 2000).

Luis Vaz et al. (2010) studied the game related statistics that distinguished between winning and losing teams in the International Rugby Board (IRB) and Super
Rugby close games. The authors analyzed 120 IRB games and twenty-four Super Rugby games played between 2003 and 2006. They found that winning teams consistently kicked away possession and were more effective at retaining the ball on their own lineout than losing teams. They suggested that a kicking-based game supported by an effective defensive structure is more likely to win matches than a possession-based one. Luis Vaz et al, (2010) also found that winning teams also made fewer passes and won fewer turnovers during their opposition’s possession, but this was at odds with the previous findings of the work of another group of sport scientists (Jones, Mellalieu, & James, 2004).

Enrique Ortega et al. (2009) studied the differences in game statistics between winning and losing teams. They analyzed data from fifty-eight games of round robin play from the Six Nations Championship from the 2003-2006 seasons. Enrique Ortega et al. (2009) found that winning teams had “average values that were significantly higher in points scored, conversions, successful drops, mauls won, line breaks, possessions kicked, tackles completed and turnovers won” (p.1). They also found that “losing teams had significantly higher averages for the variable scrums lost and line-outs lost” (Ortega et al., 2009, p.1). Enrique Ortega et al. (2009) made three conclusions:

- First, they suggested that in the phases of obtaining the ball, winning teams lose fewer balls than losing teams;
- Second, they suggest that winning teams tend to play more with their feet when they obtain the ball, to utilize the maul as a way of attacking and to break the defensive line more often than the losing team does;
- Finally, they claim that on defence, winning teams recovered more balls and competed more tackles (p. 1).

Dean G. Higham et al. (2014) performed a study in which they attempted to relate PI to points scored and games won in International Rugby Sevens. They choose four categories of PI related to match-development scoring, set-piece play and phase play. The PI that the authors selected within these categories were:

- Match development, which included possession time, penalties, free kicks conceded, and yellow cards;
- Scoring, which included points scored, points conceded, tries scored, tries conceded, tries scored per minute of possession and conversions;
- Set-piece play, which included lineouts, line-put possessions retained, scrums, scrum possessions retained restarts and restarts regained;
- Phase play, which included passes, passes per minute of possession, passes per try scored, ruck, rucks per try scored, rucks retained, mauls, rucks and mauls per minute of possession, rucks and maul retention, kicks, kicks per minute of possession, turnovers conceded, turnovers conceded per min of possession (Higham, Hopkins, Pyne, & Anson, 2014, p. 359)

The authors modeled the linear relationships between points scored and likelihood of winning for teams competing in 196 matches during the 2011/2012 International Rugby Board Sevens World Series. The authors found “13 of 17 PI had substantial clear within-team relationships with points scored and/or likelihood of victory” (Higham, Hopkins, Pyne, & Anson, 2014, p. 358). They concluded, "tactics that
increase points scoring and likelihood of winning should be based on greater ball possession, fewer rucks, mauls, turnovers, penalties and free kicks, and limited passing" (Higham, Hopkins, Pyne, & Anson, 2014, p. 358).

Higham et al., (2014) studied PI related to tournament outcomes during the 2011/2012 IRB Sevens World Series. They utilized novel analyses involving linear mixed-modeling to quantify the effects within and between teams for an increase in PI from typically low to high value on the logarithm of tournament ranking (p. 58). They found that three performance indicators had substantial within-team effects and twelve had substantial between-team effects on tournament ranking (Higham et al., 2014, p. 81). They also found "more entries into the opposition’s 22, zone per match, passes per match, rucks per match and a higher percentage of tackle completion were associated with a better mean ranking” (Higham et al., 2014, p. 81). Conversely, “more passes per try, rucks per try, kicks per try, errors per match, surrendered possession per-match, and missed tackles per match were related to a worse ranking” (Higham et al., 2014, p. 81). They concluded that "the most successful teams maintain ball possession by reducing errors and turnover, are efficient in converting possession into tries and have effective defensive structures resulting in a high rate of tackle completion" (Higham, Hopkins, Pyne, & Anson, 2014, p. 58).

Higham et al. (2012), also analyzed the movement patterns of players in rugby sevens in an attempt to understand the effects of tournament-level fatigue related to the substitution of players during a match. The authors studied the movement patterns of nineteen international level male rugby sevens players using a Global Positioning
System device during eleven international and sixteen matches. They found that substantially greater distances were covered at high velocity and more accelerations and decelerations were performed in international rather than domestic matches. They also found that the relative distance covered by players at velocity and the number of changes in velocity were reduced from first to second half. They concluded that international rugby sevens competition is more intense than domestic matches are (Higham et al., 2012). They also found that there is little indication of accumulated fatigue over multiple day tournaments, despite a reduction in work-rate within individual matches (Higham et al., 2012).

**Considerations for the Use of Performance Indicators**

Although a coach’s ability to utilize PI to focus on general match and technical indicators is advantageous, there are several factors to consider when relying upon performance indicators to quantify athletic performance. Factors such as playing position, rules, time of day, opponents, game attributes, location, environment, weather, and game situation can affect the reliability and stability of performance indicators and their ability to accurately and reliably summarise, describe and predict athletic behaviour. (James, Mellalieu, & Jones, 2005; Lames & McGarry, 2007; McGarry T., 2009; Hughes, et al., 2012). Martin Lames and Tim McGarry (2007) present a compelling argument that if game sports are unique events and the game structure itself results from the spontaneous and dynamic interactions that occur between two groups, then there should be no expectation that the observed behaviour should be stable (p. 64). They argue that specific measures need implementing in order to ensure the stability and
reliability of performance data if it is to be considered reliable and objective (Lames & McGarry, 2007).

Another detractor to the use of performance indicators is that there is currently a lack of accurate, position-specific information available for coaches. This factor makes it difficult for coaches to evaluate players in specific playing positions, like the scrum half or flanker who have significantly different responsibilities while on the field. Although research has shown that “while general positional performance profiles appear to exist, intra-positional differences may occur due to variations in an individual’s style of play, the decision-making demands of the position and the effects of potential confounding variables” (Jones, James, & Mellalieu, 2008, p.63). In fact, James et al. (2008) recommend that multiple performance profiles may be necessary for some player positions to account for variation in factors such as playing conditions and the strength of the opposition (p. 71). These factors combined with the specific rules, player speed, and strategies being performed in the rugby suggest that even if positional performance indicators were available to coaches, the information may be unreliable or possibly misleading (Ross, Gill, & Cronin, 2014, p. 357).

The difficulty of the procedures necessary to ensure their reliability is another disadvantage to the use of performance indicators. In the analyses of sports and science, there is a common notion that the reliability of a measure relates to its stability. Unfortunately, randomized factors as match location, quality of opponent and match status affect the stability of PI (Taylor et al., 2008, pp. 885-886).
Another disadvantage to the use of PI is the variability of data within matches and in-between matches (Lames & McGarry, 2007, p. 4). For example, performance indicators in rugby can be unreliable due to context-based issues such as differences in weather and variance in the strength of the competition (Hughes, et al., 2012). Hughes et al. (2012) termed these contextual issues “confounding errors”.

Although it is established in this section that there is a tendency in rugby to relate PI to winning and losing teams; Hughes et al has found that in complex interactive team sport like rugby, a simple analysis of frequency data cannot be expected to model such a complex game (Hughes, et al., 2012, p. 399). In fact, Hughes (2012) states that a more complex tool, such as network analysis, would be more suitable in explain the complex dynamic interactions that occur during the rugby (p. 399).

**Dynamic Systems**

Competitive sports are an example of a dynamic system in which a collective relationship forms between teams and individuals because of a controlling factor (McGarry & Anderson, 2002; P Passos et al., 2010; Duarte, Araújo, Freire, & Folgado, 2012). This controlling factor can take the form of a constraint such as the rules of a game, the weather, field size, or coach’s instruction to their players. McGarry et al. (2002) suggests that a sense of rhythmic kinship occurs between individual components in a dynamic system because of “spontaneous emergence of stability patterns that are actually due to a result of an instability that occurs within a dynamic system” (p. 773). Examples of this phenomenon include a flock of geese or a school of fish, which reflects
how multiple organisms can spontaneously interact and coordinate their movement with little or no communication.

In the field of athletics, these coordinated patterns of interaction are obvious when watching the ebb and flow of a soccer, tennis or rugby games. These spontaneous patterns of coordination are especially noticeable when they occur without any apparent communication occurring between the athletes. For example, no-look passes in basketball or a well-timed dummy pass to a third runner in rugby. In these cases, it seems like the athletes are almost guessing that their teammates will be there for the pass, but in actuality, there are a few simple rules, constraints, and processes that are occurring that allow athletes to interact and coordinate in an effective manner.

Within these dynamic systems, McGarry et al. (2002), suggests that patterns of stability and interaction can form between system agents (team members). These patterns of interaction can take the form of either linear, nonlinear, in-phase or anti-phase interactions (p. 772). The probing pass that occurs in a soccer game or a prolonged rally that occurs in a tennis match are good examples of this phenomenon. In all of these examples, the system agents’ (athletes) actions proceed through various phases of stability and instability as they interact with each other. Dynamic systems will generally transition between phases of linear and non-linear behaviour until a perturbation causes a rapid disturbance in the system.

A perturbation is a fluctuation that causes a disturbance in a dynamic system (McGarry, Anderson, Wallace, Hughes, & Franks, 2002). McGarry et al (2002) explain that a perturbation will sometimes create a transient period of instability before the
system returns to its pre-existing state (p. 773). At other times, a perturbation will lead through the same mechanism of instability to a non-linear transition from one stable state to another stable state (McGarry et al., 2002, p. 773). An imbalance that occurred in a sport system would be an example of a perturbation in sports (Tim McGarry et al., 2002, p.773). For instance, in rugby, perturbations can result from a well-timed pass that extends a defense or a high-step that misplaces a defender. Another example of a perturbation in competitive play might be a side step performed by a player at an unexpected moment, or a quick kick taken immediately after the whistle. In both cases, the perturbation is a sudden unexpected movement that utilized at a key moment, allows the athlete with a chance to score.

McGarry et al. (2002) claims that perturbations create a transitional period of instability in a dynamic system before it is able to return to its pre-existing state (p. 773). In both of the previous examples, the offensive and defensive teams have to absorb the effects of the pass or side step for the reoccurrence of the pre-existing pattern of play to emerge. If the players were successful, if the perturbation has a large enough effect on the pattern of play, this perturbation could ultimately affect the stability of the system enough that it leads to a successful try being scored by the attacking team. This pattern of linear and nonlinear behaviour in systems agents (team members) is an example of self-organization.

The ability of network agents to self-organize is a major underpinning of dynamic systems. The central assumption of self-organization is that repeated interactions between individuals can produce complex adaptive patterns at the group
level (Sumpter, 2006, p. 6). These interactions occur without a centralized controlling unit and are guided by task constraints, such as a common goals, rules or environmental factors that bind an individual’s action to another in what is termed as a dyadic relationship (Marsh, Richardson, Baron, & Schmidt, 2006, p. 18). In some cases, this relationship can take the form of physical contact, in other cases it can take form of expert knowledge gained from the experience of interacting with each other over a long period of time (Marsh et al., 2006, p. 14).

This notion of one's movement affecting another’s in a coordinated manner is founded on the principles of coupled oscillator theory. The coupled oscillation of two people creates dyadic relationships between network agents (players) (McGarry, Anderson, Wallace, Hughes, & Franks, 2002, p. 778). In the attempt to analyze the dyadic relationships that occur through coupled oscillation, researchers have analyzed the coordinated clapping of individuals (Néda, Ravasz, Brechet, Vicsek, & Barabási, 2000) and the coordination of limbs (Schmidt, Carello, & Turvey, 1990). One of the key findings of this type of research is that a coupling of actions can occur spontaneously between individuals. They also found that these couplings occur randomly and can be reformed or broken instantly (Tim McGarry et al., 2002).

Field invasion games, such as rugby, are examples of dynamic systems characterized by an environment of continuous interaction of players contesting ball possession and territorial gain (Correia, Araújo, Davids, Fernandes, & Fonseca, 2011, p. 662). Within this interactive environment, the team with possession of the ball is in a competition with their opponent to advance the ball forward so that they can score a try.
Alternately, their opponent’s goal is to hamper the offensive team’s advancement of the ball so that the opponent may acquire possession and mount their own attempt at scoring a try. Within this dynamic pattern of offensive and defensive interaction, “the balance of contestability, continuity, coordination and competition, coexist in a complementary way” (Correia et al., 2011, p. 662). Therefore, each player in this system ”adjusts its behaviour, not through a central command centre, but based on variables that emerge from the interactions with other system agents in the neighbourhood” (Passos, Araújo, & Davids, 2012, p. 1).

Network analysis is a method that can explain these dynamic patterns of interactions between groups and individuals (Fewell et al., 2012). NA permits “researchers to explore social relations between team members and their individual-level qualities simultaneously” (Lusher, Robins, & Kremer, 2010, p.211). In fact, NA “can be seen as a tool that is able to augment existing approaches for the examination of intra-group relations among teams and provide detail of team members’ informal connections to others within the team” (Lusher et al., 2010, p. 214).

**Network Analysis**

Network analysis (NA) is an effective means of analyzing individual and group interactions within a system of re-occurring and complicated dynamic interactions. A NA allows researchers to explore social relations between team members and their individual qualities simultaneously (Lusher et al., 2010, p.212). A network contains a series of “nodes” as well as the relationship that occurs between them, which are “ties”
(Lusher et al., 2010, p.1). The application of NA is proposed to have the following three main benefits (Katz, Lazer, Arrow, & Contractor, 2004, p.324):

- Network analyses provides a structured method of conceptualizing and measuring ties and their impacts;
- The network perspective can help researchers integrate the internal workings of the group and the group’s external environment;
- Network analyses offers techniques for exploring important features of small group interactions (Katz et al., 2004)

Although there are benefits to network analysis, Katz et al. (2004) suggest that there are challenges that face a researcher applying network analyses to small groups (p. 325). For example, network analyses typically involve a static picture of a network, usually created at the end of a project at a time when the participants of the group have produced their output (Katz et al., 2004, p.325). If the NA is performed at the end of a project, it is hard for the analyst to decide if it was the ties that formed between the members of the group that affected the success of the project, or if it was the success of the project that influenced the formation of the ties that formed between the group members. To solve this problem, Katz suggests that network measurements should take place before the formation of the group, during the formation, during work, and after work to form a true understanding of the casual relationships that occur between network members (Katz, Lazer, Arrow, & N, 2004, pp. 325-326).

There have been several studies in recent years that have applied a NA to understand the complicated interactions that form during athletic events. Within these
studies, the nodes of the network are assigned to players while the ties are assigned to a type of interaction related to the sport that the investigators are attempting to analyse.

Table 1 is a representation of some of the currently utilized methods that have been employed in the study of the interactions that occur in athletics. I have not been able to locate any network analysis on the game of rugby and to the best of my knowledge; this type of analysis has yet to be performed in this sport. Table 1 also illustrates that the network analysis of sports events is common and an accepted form of analyzing sporting events. It is apparent from the list that the measurement of group coordination and interaction has been applied to athletics in an effort to explain athletic behaviour.

**Table 1. Examples of Network Analyses of Sports.**

<table>
<thead>
<tr>
<th>Title</th>
<th>Authors</th>
<th>Population</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common and Unique Network Dynamics in Football Games</td>
<td>Yamamoto, Yokoyama, (2011)</td>
<td>Teams competing in the 2006 FIFA World Cup Final</td>
<td>Utilizing recorded footage from the 2006 FIFA World Cup the developed a network which analyzed the passes that occurred between teammates as well as the changes of possession which occurred during the game. The authors developed a method in which they analyzed the probability distribution for the connectivity of the vertices or the players by performing a through a topological analysis of triads which formed every five minutes during the soccer game.</td>
</tr>
<tr>
<td>Quantifying the Performance of Individual Players in a Team Activity</td>
<td>Dutch, Waitzman, Amaral, (2010)</td>
<td>Teams competing in the 2008 European Cup</td>
<td>The authors developed a method in which they analyzed the probability distribution that emerged in the passing behavior in the 2006 FIFA World Cup finals and a match in Japan. They described players as vertices connected by links representing passes. The authors</td>
</tr>
<tr>
<td>Topic</td>
<td>Authors</td>
<td>Details</td>
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<td>------------------------------------------------------------</td>
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<tr>
<td>Basketball Teams as Strategic Networks</td>
<td>Fewell, Armbruster, Ingraham, Petersen and Waters, (2012)</td>
<td>To evaluate basketball teams as networks, the authors examined the offensive ball sequences by National Basketball Association (NBA) teams during the first round of the 2010 playoffs. They graphed player positions and inbound/outcomes as nodes, and ball movement among nodes as edges. The authors combined performance indicators and network metrics like betweenness centrality to determine a team’s offensive strategy and division of labour.</td>
<td></td>
</tr>
<tr>
<td>Networks as a Novel Tool for Studying Team Ball Sports as Complex Social Systems</td>
<td>Passos, Davids, Arujo, Minguens, Mendes, (2011)</td>
<td>The authors utilized network methodology to analyze the structure of successful and unsuccessful patterns of play in sub-phases of water polo. They analyze the intra-team interactions that occurred in competitive matches to perform a network analysis of the patterns of interactions that take place in the attacking areas of a water polo game.</td>
<td></td>
</tr>
<tr>
<td>Who Is the Best Player Ever? A Complex Network Analysis of the History of Professional Tennis</td>
<td>Radicchi, (2011)</td>
<td>Network analysis of matches won and lost between ATP tennis players. By considering the list of all tennis matches played by professional players during the last 43 years (1968–2010) the authors were able to create a network of the matches that occurred between professional tennis players. Using an algorithm similar to the network measure Page Rank, the authors were able to create a measure called 'prestige score', which allowed them to rank professional tennis players.</td>
<td></td>
</tr>
</tbody>
</table>
Table 1. A review of the findings from (Yamamoto & Yokoyama, 2011; Duch, Waitzman, & Amaral, 2010; Fewell, Armbruster, Ingraham, Petersen, & Waters, 2012; Radicchi, 2011; Passos, et al., 2011).

**Community Based Action Research**

Action research is one of a number of different forms of action enquiry (Tripp, 2005, p. 445). It is a generic term for any research process that follows a cycle in which one improves their practice by systematically oscillating between taking actions in the field of practice, and inquiring into the research process (Tripp, 2005, p. 445). Although there are numerous approaches to action research, Stringer (1999) states that the common themes that emerge from the diverse approaches to action research is that:

- they all acknowledge fundamental investment in processes that are rigorously empirical and reflective (or interpretative);
- they engage people who have traditionally been called 'subjects' as active participants in the research process; and
- they result in some practical outcome related to the lives or work of the participants (p. 5).

Action research is a process of inquiry that has the following features:

- It is democratic, enabling the participation of all people.
- It is equitable, acknowledging people’s equality of worth.
- It is liberating, providing freedom from oppressive, debilitating conditions.
- It is life enhancing, enabling the expression of people’s full human potential (p. 10).
Like most forms of research, action research begins with a problem that needs to be solved. Unlike other forms of research, however, its goal is to build collaboratively constructed descriptions and interpretations of events that enable groups of people to formulate mutually acceptable solutions to their problems (Stringer, 1999, p. 188). In fact, this is what makes action research distinctive. Stringer claims “by sharing their diverse knowledge, and experience-expert, professional, and lay-stakeholder can create solutions to their problems and, in the process, improve the quality of their community life “ (Stringer, 1999, p. 10).

Action research is a methodology that provides researchers with a practical set of methods that allow them to work collaboratively with a group of people in an effort to inquire on and solve their problems. In fact, Yoland Wadsworth states:

Action research is not merely research which it is holed will be followed by action! It is action, which is intentionally research and modified, leading to the next stage of action which is then again intentionally examined for further change and so on as part of the research itself (p. 6).

**Action Research a History**

Kurt Lewin conceived the methodology of action research at the conclusion of World War II as a reaction to the massive social changes that were occurring in the area of the social sciences (Baskerville & Harper, 1196, p. 236). Kurt Lewin was a social psychologist working to improve social, economic and industrial conditions (Melrose, 2001, p. 160). While employed as a researcher at the Research Centre for Group Dynamics, Kurt Lewin sought a general theory of how social change could be facilitated
Action Research gained in popularity and became very influential until the 1950's when the positivistic culture that dominated the American social sciences had all but rejected action research as a legitimate form of research (Carr, 2006, p. 423). Recently though, the popularity of action research has grown with the developments in academic thought that have occurred over the last few years (Stringer, 1999, p. 9).

**Community Based Action Research**

Action Research is a name given to a family of research methods that involve both action and research. It separates itself from other methodologies by the degree to which the practitioner/researcher is involved in their research as well as the balance that the researcher/practitioner maintains between action and research (McNiff & Whitehead, 2005, p. 11).

In terms of the balance between action and research, the family of action research falls into two main categories. One form of action research called interpretive action research is characterized by “people who believe that the proper way to do research is for an external researcher to watch and report on what other practitioners are doing” (McNiff & Whitehead, 2005, p. 11). This form of research occurs externally, with emphasis placed on the research and the formation of a knowledge base that both guides and develops by the research. The other form of action research is called first person action research. This form of action research is characterized as containing people who are enacting change and believe that a practitioner is able to offer their own explanations for what they are doing (McNiff & Whitehead, 2005, p. 11). In this form
of research, the emphasis is on the actions that the practitioner or researcher performs while trying to improve or change their situation.

Community based action research (CBAR) is a form of first person action research. Through its participatory processes, CBAR enables stakeholders to:

- Investigate systematically their problems and issues
- Formulate accounts of their situation, and
- Devise plans to address with problems they have identified
- Enact revisions that the stakeholder feel are necessary

CBAR has five defining characteristics that separate itself from other forms of research. First, a CBAR approach to inquiry and action favors consensual and participatory procedures that allow people to (a) systematically investigate their problems and (b) formulate accounts of their situations (Stringer, 1999, p. 17). Second, a CBAR approach to inquiry and action takes into account the context in which people live (Stringer, 1999, p. 17). Unlike other forms of scientific research, action research is presented in terms that make it accessible to professional practitioners and laypersons (Stringer, 1999, pp. 17-18). Third, CBAR is cyclic in nature. Researchers may perform recurring steps of look, think and act in sequential fashion. Fourth, CBAR tends to be qualitative in nature as it often deals with language rather than numbers (Dick, 2000). Finally, researchers and practitioners can incorporate the process of CBAR in order to enact the process of organizational evaluation, revision and change. Within such a methodology, the role of the researcher is not that of an expert who is solely responsible for the research, but that of a facilitator. In a sense, the researcher becomes a facilitator
who acts as a catalyst to assist stakeholder in defining their problems and to support them as they work together towards an effective solution to the issues that concern them.
Chapter 3 Methodology

Overview

The purpose of this chapter is to provide a rationale for my approach to research utilized in this study and to provide a detailed account of the way in which the research was conducted. This chapter describes the methods employed during this study and starts by reiterating the research questions that guided the design, analysis, and representation of the study. Then, there is an overview of the participants and researcher, including a description of the researcher’s position during the research process, as well as the relationships that formed during the study. The subsequent sections then addresses the data collection and data analysis procedures which included two stages: (1) categorizing the interviews into unique narratives using Qualizer software text analysis program and then (2) utilizing the method of concept mapping, incorporating the mind mapping software Xmind to add meaning and conceptual representation to each of the participants’ narratives (XMind, 2015; McGill, 2015). The final section in this chapter addresses the measures taken to ensure rigor as well as the ethical considerations that ensured the safety, well-being, and privacy of those involved in this study.

This purpose of this study is to form an impression of an analyst’s and a coach’s view of the data acquired from the NA of a rugby team’s gameplay. The researcher acted as the primary facilitator for this study. An inductive case study methodology allowed the researcher to bind this study to a coach and his practices. A qualitative methodology informed the techniques utilized to formulate interview questions, data
collection and data analysis methods. This chapter is immersed with the
epistemological and ontological conventions that underpin the study’s methodology.
Importantly, the study is conducted through a qualitative lens, viewing knowledge as co-
created between the researcher and participant, while truth being constructed through the
representation of the participant’s account; validated by the stories’ emotion, merit,
insightfulness, authenticity and its ability to engage the reader to assume the
participants’ narratives and draw insight out of this experience (Crabtree & Miller,

Research Questions

The research questions are listed below.

- How can I develop an understanding of the ways in which a network analysis
can enhance coaches’ understandings of their team’s performance?

- How can I develop an understanding of the ways in which the use of network
analysis can be combined with currently utilized performance indicators to
inform a coach’s decisions of their teams’ patterns of play in order to
improve their teams’ effectiveness?

- How as a researcher, can I work with my participants to develop the use of
network analysis in a university elite rugby team?

These research questions developed from the focus on the use of network analysis to
then the researching of how to support coaches’ use of this process to inform coaching
in an elite rugby team. Then to how the relationship developed between the participants
and myself as the researcher as the utility of NA was explored and taken up to a certain degree by the two participants.

**Overview of Participants**

This subsection describes the number and type of people who participated in this investigation (Stringer, 1999, p. 174).

After receiving ethical approval from the Human Research Ethics Board at the University of Victoria, two male experts in coaching and analyzing the rugby at a high-performance level were recruited. Both participants were purposely selected because of their proximity to the primary researcher, as well as their expert knowledge of PA and coaching rugby. While it was important to ensure each criterion above was met, diverse perspectives were selected in order to display different stories and experiences within the framework of high-performance rugby.

**Performance analyst participant**

Carl is a male performance analyst. He was purposely selected because of his professional credentials and his reputation in the local rugby community as an expert on the topic of analyzing high-performance rugby. Carl has played rugby at a high-performance level and currently performs performance analysis for a national level, male rugby program.

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1 Name changed to protect the anonymity of the research participants as indicated in the research ethics
Elite coach participant

David is a male high-performance rugby coach. He was purposely selected because of his professional credentials and his proximity to the primary researcher. David has a wealth of experience playing and coaching rugby.

Overview of the Researcher

This section describes the number and type of researcher’s roles I took up in this investigation. As the researcher in this study, I served as a facilitator for the study and acted as the primary performance analyst for Carl’s team during the majority of this study. Informing my role as researcher was my acquired depth of knowledge of playing, coaching and analyzing rugby. I had played rugby for a number of years of club level and collegiate level of play. As an adult, I had coached rugby at both an elementary and middle school development levels and have led a number of rugby clinics for young players. In order to improve my coaching effectiveness, I had also attended several coaching camps and clinics. As an educator, I make it a point to introduce students to the basics of rugby and other sports during their physical education time. While I do not have a background in PA, I do have a general understanding of the rules and tactics used in rugby. In addition, I have a wealth of experience working with computers and various software packages. I am also familiar with the process of utilizing social media for sharing information with others.
Position of the Researcher

The purpose of this subsection is to explain the role of the researcher as well as how the relationship between the researcher and the studies participants helped shape the processes and outcomes of the investigation (Stringer, 1999, p. 174).

As the study progressed, the researcher’s role changed to that of a practitioner/researcher with an insider/outsider relationship to the participants’ community (Zuber-Skerritt, 2001). Within this role, the researcher continued to function as a researcher/consultant but added the responsibility of functioning as the team’s primary PA coach. Within this new role, the researcher provided PA on a weekly basis to David, the members of his coaching staff and the team’s players. It is likely that this new role within the team would not have been possible if the researcher had not been able to develop a working relationship with the participants through open, supportive and friendly methods of communication.

Relationships

The researcher’s goal during the study was to follow Stringer’s (1999) advice and attempt to develop and maintain social and personal interactions with the participants that were non-exploitive and enhanced the social and emotional lives of all the people that were involved in the project (p. 28).

In particular, the researcher aimed to promote relationships with the participants that:

- Promoted feelings of equality for everyone by providing opportunities for all of the participants to engage in the study as equals.
• Maintained harmony and avoided conflicts by respecting the participants’ opinions and their position as professional analysts and as a head coach.

• Avoided conflicts, by listening to the participants’ responses first and asking my questions later in a respectful manner.

• Encouraged personal and cooperative relationships by engaging in respectful conversations with the participants before the interviews were initiated. I also went to great lengths to learn the “lingo” that was necessary to converse with the participants in this setting.

• Accounted for the participant’s feelings by being respectful of their positions of authority as well as the personal relationships they might have had with the players on their team (p. 29).

Recruitment: Researchers Background in the Sport of Rugby

Recruitment occurred utilizing my first-hand knowledge of rugby. To comprehend the method of recruiting, an understanding of my involvement within rugby, and the various roles I have assumed is essential (Sparkes A., 2002, p. 51).

To begin, I have had six years of experience playing rugby, including one year as a player at a Western Canadian University. Outside of my role as an athlete, I have served as a grade level coach for five years introducing young athletes to the sport of rugby. I have attended several coaching clinics and camps offered by Rugby Canada and BC Rugby in order to improve my coaching abilities. I have also volunteered at several tournaments where I have aided in the operation and administration of the event. Due to this exposure to the rugby community, I have developed many relationships with
administrators, coaches, athletes, spectators, players and volunteers, and have engaged in repeated dialogue with these people. Ultimately, these ongoing connections and experiences within the rugby community have provided me with a deeper understanding of the intricacies of the sport and those who function within it.

During the recruitment process, I was able to use this first-hand knowledge of rugby in order to select participants who fit the study’s criteria. It is only through my unique outlook and involvement in the rugby community that the participants were identified and selected. While this could be seen as a limitation to this study, a researcher who had no rugby-related knowledge or established relationship within the rugby community, might have failed to identify participants with such rich and authentic stories to share, and furthermore, might have been unsuccessful in connecting with participants on an interpersonal level.

**Method of Recruiting Participants**

The specific method for recruiting participants occurred in the following ways. The contact information for Carl was obtained prior to the commencement of the study due to my previously established connection within the rugby community. I pursued participants who demonstrated the qualities described in the selection criteria, as well as participants with whom I had a good rapport to ensure openness and trustworthiness in later stages of the research process. While there were other coaches who fit the study’s criteria, I specifically selected participants who were actively analyzing and coaching rugby at an elite level of performance.
To initiate contact with the participants, I used a scripted email that was approved by the Human Research Ethics Board. The message informed participants of the study’s purpose, research questions, design, and role of the researcher. In the case of Carl, prior approval was sought and received from Rugby Canada using a scripted email that was also approved by the Human Research Ethics Board, before his voluntary participation was obtained (See Appendix 1). Both participants were given a voluntary option to participate.

Methodology

One of the major principles of any qualitative method is that the researcher, using his own filtering system, is the instrument, rather than an external measuring device (Patton, 1990). Therefore, in the context of this study, I brought my own perspectives and worldviews to the research process. As a result, my personality, understanding, skills and training in rugby affected this research process. Although these subjective factors are sometimes a threat to objectivity, they can also be strengths since “the researcher’s personal experiences and insights are an important part of the inquiry and critical to understanding the phenomenon” (Patton, 1990, pp. 40-41)

It is important to realize that I shared the research context with the participants involved. Interviews are inevitably a social process. Therefore, the knowledge that was created throughout each interview was negotiated collaboratively through the interactions between the participant and I (Klenke, 2008, p. 131). Fundamentally, in order to understand the meaning around each narrative, the participant and I depended on each other for this process to be successful. Rather than the participant simply sharing a story,
and then me accepting this narrative at face value, I would create meaning alongside the participant to ensure the insightfulness of each story. For example, it was common throughout the interview process for the participant to share a particular narrative, and then as a meaning-making method, I would explain this experience comparing my own lived realities with the participant’s experiences. Often this process formulated a deeper and more significant understanding of our experiences, or at the least, created an opportunity to ensure that the means in which I interpreted the story was coherent, thereby upholding the integrity of each narrative.

In short, I meaningfully assumed an active role with the participant in co-creating what was known and valued within this researcher context. Since I was able to understand the intricacies within rugby and the type of experiences that arise through participation, the stories were told in a manner in which enhanced their uniqueness, impact, and authenticity (Sparkes A., 2002, p. 208). While other researchers could utilize the same interview questions, the knowledge obtained from the interviews in this study were borne through a relational process, where new knowledge was only able to flourish because of the interdependent relationship between the specific researcher and participant. Importantly, the knowledge created within the research context remained an interpersonal process whether the interview was conducted in person, over the phone or through email correspondence,

**Design**

This subsection describes of the type of information that was acquired during the study and how it was recorded (Stringer, 1999, p. 175). The researcher collected and
analyzed interviews, observations, documents, audio and field journals in order to collect data for this case study. The researcher incorporated a generic coding method to analyze the raw data and to develop it into the major themes utilized in this study. (Lichtman, 2013).

Data Collection

Stringer (1999) suggests that interviews enable participants to describe their situation (p. 68). They not only provide “a record of their views and perceptions, but also symbolically recognize the legitimacy of their views” (Stringer, 1999, p. 68). In this study, the researcher utilized interviews and meetings as the primary source of data collection. The interviews occurred at a time and setting that was both natural and convenient for the participants. The researcher’s goal during the interviews was to create an atmosphere that was both natural and ‘open’ to the participants while at the same time maintaining a sense of systematic professionalism. The steps the researcher took during the interviews to meet these goals are described below:

- Prior to the commencement of each interview, the researcher obtained participant consent (See Appendix A).
- Prior to the start of each subsequent interview, the participants were asked to sign a Letter of Free and Informed Consent (See Appendix A).
- The participants were notified that they could conclude the interview or study at any time.
During the initial interview, the researcher took the time to introduce himself, and describe his intended role. During each subsequent interview, the researcher identified himself to the participant and reiterated the purpose of the research.

Upon subsequent interviews, the researcher took the time to reintroduce the purpose of the research and for the purpose for the interview.

The researcher notified the participants at the start of each meeting that an iPhone was going to be used to create an audio record of the interview. The participants were asked if they had any questions or concerns over the researcher’s use of the iPhone. The participants were notified that if they had any issues with the use of an iPhone, it would be put aside and turned off.

The researcher asked the participant if they had thirty minutes of time available for the interview.

At the conclusion of each of the interviews, the participants were asked if they had any questions or concerns over the issues discussed during the interview, the major topics discussed during the interview were summarized for clarification; a date was set for the next interview. Then the interview was adjourned.

Stringer (1999, p, 68) notes that a common problem with the interview process is too often the questions can be flavoured by the researcher’s perceptions, interests, and agendas. In order to address these concerns, the researcher created a series of Grand Tour questions. Stringer (1999) claims that Grand Tour questions are “sufficiently global and enable participants to describe the situation in their own terms” (p. 69).

During this study, Grand Tour questions took the following form:
Tell me about…? These type of questions were utilized because they “provide focus to the question without giving direction or suggesting types or forms of answers”,

How does that usually…? These types of questions were utilized because they “enable respondents to talk of the ways events usually occur”,

Can you tell me…? These types of question focus on a “specific event or phenomena” (p. 69).

On several occasions during the interview process, the researcher found it necessary to prompt the participants for further information or for clarification of a topic. During these instances, a well-placed prompt was incorporated into the discussion with the participants in order to “enable the participants to reveal more details of the phenomena they are addressing” (Stringer, 1999, p. 70). The researcher incorporated a variety of prompts throughout the interview process depending on what was deemed necessary at the time. An example of the prompts that were utilized were:

- Extension questions – for example “Can you tell more about that?”
- Encouragement questions – for example “Go on, or Yes…” and,
- Example questions – for example “Can you tell me more about that?” (Stringer, 1999, p. 70).

Upon leaving the interview location, the researcher created an audio reflection of the interview on his iPhone. At the conclusion of the day’s events, the researcher transferred the audio files to a computer and stored them in a folder called Interviews (Participant Name). After this task was completed, the researcher transcribed the interviews and reflections using Microsoft Word. These Microsoft Word files were
labeled with the interview number and the name of participant the interview related to. Backups were made of all of these files and they were stored on a password protected external hard drive. (For a complete list of the interviews that occurred with Carl and David, See Appendix I).

In addition to interviews, documents were also utilized to inform this research process. Stringer (1999) explains that documents can reveal a great deal of the significant information (p. 73). During this study, the researcher utilized the following documents to inform the research process:

- Team documents containing player evaluation procedures and policies
- Team documents containing post-game summaries and player and opponent evaluations.
- A series of webinars were analyzed. The focus of these webinars was the role of an analyst as well as the relationship they had formed with their coaches and players. They also discussed their day-to-day workload as well as the major issues they faced while trying to provide PA to their coaches and teams.
- Information from several PA blogs were utilized to inform the researcher of current tactics and techniques being incorporated in rugby as well as the cultural lingo used to explain those tactics and techniques.
- National and international level coaching documents were scrutinized to gain an increased understanding of current tactics and coaching lingo used in the sport of rugby.
The researcher stored these files in a folder labeled Thesis Documents on his computer for ease of reference. Backups were made of this folder and stored on a password protected external hard drive.

Participant observations were also utilized to inform this research process because they provide a “clearer picture of the research context by observing the setting in which participants live and work” (Stringer, 1999, p. 71). During this study, participant observations took place during practices, team meetings, and games. During these events, the researcher took audio recordings and notes. The notes and reflections that were created were based on Stringer’s (1999) “Six Question Method” in which the researcher asks the following questions:

- Why am I here?
- What are the problems?
- How does this affect us?
- Who is being affected?
- Where is this happening?
- When are these things happening? (Stringer, 1999, p. 75)

At the conclusion of these events, the researcher created a reflective journal, which was copied to a Microsoft Word document. The document was stored in a folder located on a password protected external hard drive.

At the end of that day, the researcher transferred the audio recordings to external hard drive on a local computer. The audio recordings were transcribed to a Microsoft Word document and stored in a folder created for files related to participant observation.
The field notes and reflective journal were transcribed using Microsoft Word and stored in a folder labeled Participant Observation (Reflective Journal). This particular sorting method was chosen in order to keep the two types of data separate from each other. A password protected external hard drive was utilized to store copies of these files.

The recorded audio files and the entirety of the data collected from the interviews are scheduled to be discarded five years after the completion of my graduate program. Furthermore, the participants were provided with pseudonyms throughout all stages of the research process in order to ensure confidentiality.

**Data Analysis**

The next step in this study was to analyze information. The purpose of this section was to provide readers with an understanding of the manner in which the information was analyzed or interpreted (Stringer, 1999, p. 175). During this phase of the study, the researcher’s goal was to analyze the transcribed information and develop it into key elements by formulating key categories into themes (Stringer, 1999, p. 88). Data analysis, which was conducted during and at the conclusion of the study, involved the identification of dominant themes and the clustering of themes into categories. As expected, the researcher had to alter the codes, themes and categories throughout the course of the study.

The researcher used Stringer’s concept of “Problem Analysis” to formulate the codes utilized for this study. During this process the researcher and participants identified the:

- core problem(s),
• major antecedents to the problem(s),
• significant factors related to those antecedents,
• major negative consequences and
• Other significant consequences (Stringer, 1999, p. 100).

To accomplish the goal of qualitative data analysis the researcher incorporated a
generic/inductive method for data analysis (Thomas, 2006). David Thomas (2006)
states that a generic/inductive approach to data analysis can aid the researcher in
“understanding the meaning in complex data through the development of summary
themes or categories from the raw data” (p. 239). The researcher’s primary purpose for
implementing a generic/inductive approach to analyzing data was to “allow the research
findings to emerge from frequent, dominant or significant themes inherent in raw data,
without the restraints imposed by structured methodologies” (Thomas, 2006, p. 239). A
generic/inductive approach was also incorporated because it allowed the researcher:
• to condense extensive and varied raw text data into a brief summary format;
• to establish clear links between the research objectives and the summary findings
derived from the raw data and to ensure these links are both transparent and
defensible; and
• to develop a model or theory about the underlying structure or experience or
processes which are evident in the transcribed data (Thomas, 2006, p. 239).

The researcher followed Lichtman’s (2013) ‘Three C’s of Data Analysis’
technique while coding the data. This is a six-step process and the details of the process
are explained below:
1. Initial Coding – During this step, the researcher read and re-read the transcribed text. The researcher’s goal during this step was to provide an initial code to the text in an effort to create summary ideas of the participant’s responses. The researcher used words, phrases and in some cases, the respondent’s own words, to create labels for the codes.

2. Revisiting Initial Codes. The researcher’s next step was to collapse and rename these codes. This occurred on several occasions during the study; when the researcher found that codes became redundant or when some of the codes needed to be modified based on an examination of new data or a re-examination of old data.

3. Developing an Initial List of Categories – The next step in this process is to start developing codes into categories. The researcher found that certain codes could become major topic while others were grouped under a major topic and became subgroups of that topic.

4. Modifying the Initial List Based on Additional Reading – The researcher’s goal during this process was to move from coding the initial data to the “recognition of important concepts or themes” (Lichtman, 2013, p. 254). During this phase, the researcher re-read the transcripts to re-evaluate the codes and categories. The researcher decided that some of the categories were of less importance than others. In some cases, two or three categories were combined when they seemed to relate to each other.
5. Revising Categories and Subcategories – The researcher’s aim during this phase was to revisit and re-evaluate the categories and subcategories that were developed. During this phase, the researcher further refined the codes, categories and themes by removing redundancies and identifying critical ideas to expand upon.

6. Moving from Categories to Concepts – The researcher’s goal during this step was to “identify key concepts that reflected the meaning attached to the data” (Lichtman, 2013, p. 254). In an effort to add depth to the analysis, the researcher implemented the use of metaphors taken from the participants’ comments. These metaphors were selected in order to add depth to the concepts whenever possible (pp. 253-255).

The researcher utilized the CAQDAS program, Qualizer version 1.2.1 to aid in data analysis process (McGill, 2015). The contents of the Microsoft Word documents that were created from the transcribed interviews, meetings, and participant observations were uploaded into the CAQDAS software for evaluation. The researcher created a label for each of the participants within the CAQDAS software and then linked their respective files to those labels.

The researcher utilized the CAQDAS program to code the data, and amalgamate the coded data into major categories. Once this was accomplished, the researcher created a flow chart to visually represent the links that formed between the codes and categories. The flow chart was created with the mind mapping software called X-Mind 6 (XMind, 2015). Hyperlinks were created within the mind mapping software to link the
major concepts developed in the flow chart with the coded data it referred to in the transcribed Microsoft Word documents.

**Rigor**

The purpose of this section is to provide the reader with evidence that the research was carried out rigorously, that the procedures and processes of inquiry have minimized the possibility that the investigation was superficial, biased, or insubstantial (Stringer, 1999, p. 176).

Traditional forms of inquiry generally focus on a researcher’s ability to show objectivity, reliability, validity, and generalizability as criteria for evaluating the rigor of experimental and survey research (Stringer, 1999, p. 176). Focussing on this type of criteria is inappropriate in naturalistic inquiry and researchers should report instead on the following: credibility, transferability and the dependability and confirmability of their study (Stringer, 1999, pp. 176-177).

**Credibility**

Stringer states that credibility is “parallel to the concept of validity”. During this study the researcher established credibility through:

- A prolonged engagement of seven months in which the researcher and participants worked together in informing the objectives of this case study.
- Progressive subjectivity aided by the cyclic nature of the research design in which the researcher and participants were able to formulate, evaluate and revise developing constructions.
Several phases of member checks in which the researcher and participants met to ensure clarification of arising themes and categories.

**Transferability**

Transferability relates to the extent to which we can see similarities in the findings that may relate to other settings (Zhang & Wildemuth, 2005, p. 6). Ultimately, the transferability of this study relies upon the reader’s ability to assess whether the participants in this study as well as the events that occurred could be just as applicable elsewhere. By providing, the reader with a thick and rich description of the participants as well as a well-documented description of the events that unfolded over a seven-month engagement, I hoped to aid the transferability of this study (Guba & Lincoln, 1994).

**Dependability and Confirmability**

Dependability is parallel to the concept of reliability in other forms of research. Dependability was established in this study with a dependability audit performed by the researcher and his supervisor. During the seven-month duration of this study, the researcher met with various members of the research committee to evaluate and revise the use of methods, key themes and categories that were utilized in the final report of this study.

Confirmability is roughly parallel to objectivity in other forms of research. In this study, confirmability was established through a detailed audit trail that clearly describes the processes of collecting and analyzing data (Stringer, 1999, p. 177). In addition, research insights were shared with participants who offered similar or parallel interpretations of events.
Limitations

The intent of this subsection is to inform the reader of any limitations that arose from the pragmatic realities of investigation (Stringer, 1999, p. 177).

A limitation of this study is that it addresses a topic that is contextual. For instance:

- One of the participants is an elite male rugby coach; the other is an elite male performance analyst.
- Both participants are involved in coaching and analyzing the sport of rugby.
- The participants belong to rugby teams containing male athletes performing at an international and premier level of performance.
- The events that occurred during this study happened over a specific period of time and during a specific competitive season for both participants. Although each the day-to-day operation of a team is very similar from season to season, it is likely that some of the events that occur during each competitive season are unique to that season. Although the researcher’s length and depth of engagement with the participants and his experience in coaching limited the possibility of this effect, it is possible that the events that occurred and the manner in which they unfolded might be unique to this particular competitive season.
- At the onset of this study, the researcher accepted the fact that responsiveness would have to be traded for replicability (Dick, Paper 50 Action Research Thesis, 1993, p. 45). In the case of this study, the researcher sacrificed the ability to generalize the
findings of this case study to others in the need to be responsive to the situations affecting this study as they became apparent.

It is my belief that the rich and thick detail contained within the study created a narrative that allows the reader to understand how the researcher’s relationships with the participants developed in a genuine way allowing a persuasive account of what happened, and what meaning was made from this experience. The researcher’s goal, therefore, was to ensure the transferability of his insights by using sources of information to verify his interpretations and thereby allowing the reader to imagine themselves in this situation.

**Ethical Issues**

The purpose of this subsection is to describe the steps taken by the researcher to maintain the rights and privacy of the research participants (Stringer, 1999, p. 177).

The Human Research Ethics Board at the University of Victoria approved the study protocol (Appendix B). Both participants received an informed consent form with a clear explanation of what the study entailed. If the participant would have decline to agree to the final question of whether they agree to participate in a voluntary manner then their participation would have been terminated immediately.
Chapter 4

Context and Findings

The purpose of this chapter is to “provide richly detailed, thickly described accounts, or stories, that enable readers to understand the lived reality of research participants” (Stringer, 1999, p.178). These accounts are constructed from information collected and analyzed during the study and include the perspective of both of the participants (See Chapter 3 for more details).

Setting the Scene

This section presents the reader with a detailed account of participants involved in this case study and a description of the location where the case study occurred. These accounts will be expressed in a form of narrative. The researcher focused on items that were important to the participants and presented them from the participants’ perspectives (Stringer, 1999, p.178). Stringer suggests that presenting these stories in this manner “enables the readers to see the context through the eyes of the participants and to understand their perspective” (p. 179).

This chapter details two unique narratives. In the first narrative, Carl and I attempt to refine the NA methodology of analyzing rugby. In the second narrative, David and I attempt a practical implementation of the NA methodology that Carl and I developed earlier in the research process.

In each narrative, I provide an account using quotations from the interview to add detail and emotion, as well as to enhance the connectedness and identification with the narratives. I also highlight the key events that occur during the research process
along with the problem solving activities that coincided with them. These narratives will reveal both positive and negative experiences in relationship to the participant’s involvement in the process of developing a NA based methodology of analyzing rugby. Each narrative serves to address the primary research questions:

- How can I develop an understanding of the ways in which a network analysis can enhance coaches’ understanding of their team’s performance?
- How can a network analysis of rugby gameplay be combined with currently utilized performance indicators to inform coaches’ decisions of their teams’ patterns of play in order to improve their teams’ effectiveness?
- How I, as a researcher, can work with my participants to develop the use of network analysis in a university elite rugby team?

It is likely that my background, my interest in this topic as well as my personal association with Carl and David that developed over the duration of this project, shaped the meaning I have attached to this data. It is also just as likely that Carl and David’s backgrounds, interests, and personal association with me the researcher, have shaped their participation in this study. The researcher is the sole collector of data in this study, the events that guided the study and the meaning that the researcher attached to it are a direct result of the co-operation that occurred between the researcher and participants as this study progressed.

The total engagement with the participants was seven months. Because of the amount of data that was collected and the period of time that is addressed in this study, the researcher felt that some form of logical order was needed to organize the findings
so that they could “make sense” to the reader (Baxter & Jack, 2008, p. 555). It was determined that organizing the results into a sequential order provided the researcher with an opportunity to present the results in a coherent manner and also provided the reader with an understanding of the key events that shaped this case study as they occurred.

In some instances, it was necessary to alter the participants’ accounts in order to protect their identity or that of their organization and the players they represent but otherwise the text reflects their accounts as accurately as possible. The following sections contain a description of the researcher and participants that were involved in this study as well as the unique narratives in order to provide some context to the following narratives.

**The Researcher**

The researcher served as a facilitator for this study and eventually served as a performance analyst for David’s team. While the researcher does not have a background in PA, he does have a general understanding of the rules and tactics used in rugby. The researcher has a wealth of experience working with computers and various software packages. He is also familiar with the process of utilizing social media for sharing information with others. The researcher’s interest in this project began as an inquiry into a coach’s impression of the effectiveness of a network analysis of rugby gameplay. The opportunity to work in conjunction with the participants during this practical implementation of a NA based PA methodology reflected the principles of action research. Although the implementation and revision of a new PA methodology
was challenging, the process of working together with the participants on this project made it much more meaningful, and ultimately more rewarding.

The Participants

This case study evolved over a two-month period with the researcher working in a collaborative relationship with the two participants. One participant, Carl, is a performance analysis specialist for Rugby Canada. The other participant, David, is a head coach for a Western Canadian university, which is known for its reputation for developing top-class rugby teams in the Canadian West University Athletic System.

Carl is an ex-rugby player who is in his early thirties. Most of Carl’s expertise as a performance analyst has come through on-the-job training, as Carl has not officially trained as a performance analyst. In my discussion with Carl, I have found him to be very smart and very responsive to new concepts. Carl is a progressive thinker who is very good at networking with other performance analysts in the sporting community. He is constantly on the lookout for innovative methods of analysis that can improve his team’s performance. Administrators and coaches in the community consider him an authority on the topic of PA in rugby in Canada. His job as a performance analysis with Rugby Canada takes him around the world so is busy and is seldom at home.

The other participant, David, is a fit, ex-rugby player who is in his 50’s. In his younger years, David played for local and provincial level rugby teams in the province of British Columbia. He has also had the privilege of playing for Team Canada at an international level. After David retired from actively playing rugby, he turned to a career in coaching which was very successful. At a national level, David served successfully
for five years as a coach for Canada’s Rugby Seven program. In his current role as a head coach for a Western Canadian University Rugby program, David is responsible for managing four other coaches who assist him in providing coaching duties to five teams, including up to ninety student athletes, on a weekly basis.

Others have called David a “progressive” and forward-thinking coach. He is up-to-date on many of the current coaching and player management techniques utilized by coaches today. He works well with his assistant coaches and values their input, and is willing to ‘let go of the reigns’ when he needs to. For example, he is more than willing to bring in a guest coach or outside advisors to help the team, when he feels that his skill set in a certain area is lacking. David is very appreciative of his assistant coaches and has mentioned on several occasions that “they are students of the game” and that they are a “great value to the team”.

Carl the elite level performance analysis coach: Initial Interview

The next stage in the research process was to gain an understanding of Carl’s initial impression of PA as well as his general impression of the NA method that I had developed.

The portion of the study that occurs with Carl transpired over a period of seven months. Carl’s spoken words are utilized whenever possible but in some situations, it was necessary to alter them in order to protect the identity of the players and the organization, which he represents.

The initial meeting with Carl occurred after approval was sought and received from the board of ethics (see Appendix A for details). Once approval was obtained,
Carl’s employer was contacted via email with a script that was pre-approved by the board of ethics (see Appendix A for details). After their approval Carl was contacted via email with a script that was also pre-approved by the board of ethics (see Appendix B for details). After accepting entry into the study, a date and location was set for our first meeting at time and location that was convenient for Carl. The interview began after the participant signed the informed consent form and agreed to the use of an iPhone to record the events (see Appendix A for details). We followed the same protocol during all of our meetings in order to comply with ethical standards established for this study.

Although my initial intent was to let our conversation flow naturally, I realized that I needed to accomplish several objectives for the meeting to be successful. My first objective was to establish Carl’s current impression of performance analysis. I also needed to determine his initial impression of the NA methodology. Finally, I needed to determine the nature of the changes that needed to be made to the NA methodology so that I could utilize it more effectively to analyze rugby. The following section provides a narrative of the interview that took place and the objectives that we developed to enhance the NA methodology.

**Initial Opinion on PA**

Through our conversation, I immediately discovered that Carl’s initial opinion of performance analysis is very positive. He believes that performance indicators provide coaches and players with a wealth of information but also feels that PI do have their limitations. As he stated,
So performance indicators are very important in the role of the execution of individual skills on the field. They can lead us to a better understanding how a player as an individual is influencing the game. Key performance indicators (KPI), can give us better idea of whether there is a certain area where the team is being let down. In terms of the team role KPI are interesting they give an impression but do not tell the whole story. They are not the be all and end all because in a game of sevens not one KPI can tell the story of a whole game. Because it is such that is affected by many random occurrences. For instance, we win games sometimes with 25 percent possession and loose it with 75 percent possession.

Carl believes that video analyst plays a key role in his professional ability to evaluate performance at both an individual and group level of play. He believes that performance analysis benefits the coaches as well and the players because it provides them with an opportunity to watch their opponent’s performance at their own convenience.

Video analysis is hugely important at both the team and individual level. It allows individuals to understand the consequence of their actions even if they occur on the other side of the field.

Carl also believed that his organization is responsible for the development of their athletes’ physical skill level as well the development of the athletes’ cognitive abilities. Their gameplay groups are an example of how this principle manifests itself. Carl believes that involving players in the PA process has the added benefit of
increasing the team’s individual and group performance levels as it puts the onus on the player to set and meet their own performance goals. As he stated,

It empowers the players to self-coach and gives players a chance to watch their own and opponents’ plays repeatedly before we play them. The gameplay groups are an effective way of enabling the players so that they take ownership of their own and their team’s performance levels.

**Carl’s current use of PA**

Carl spends a significant amount of time analyzing his team’s performance. Most of his time is spent analyzing video and providing performance data to his head coach but some of his time is also spent providing information directly to the players. As he indicated, “A week after a competition I will spend 20 hours. After that, I will spend at least an average of 10 hours a week.”

After prompting, Carl informed me that the game-play group consists of three of the team’s veteran players. These players are responsible for analyzing the video and presenting analysis to the team on a weekly basis. Their analysis consists of the coded video and data that Carl creates at the end of each competition. They generally meet with the head coach and the analyst prior to the meeting to ensure they are meeting all of the performance issues that they are working on that week. He continued,

I also spend time with the gameplay group providing the three key veteran players from our team with analysis to formulate their presentation. This gameplay group depends on selection but if a veteran player is injured, they can still add their input to the group.
Initial Opinion of NA

At this point in our interview, our discussion changed to the evaluation of the network analysis that I had developed for this meeting. He was initially hesitant but generally optimistic about providing any firm conclusions about the method. Carl responded to the question about NA as follows,

Keep in mind that this is the first meeting. Not knowing much about it because I do not know much about it. So far, I cannot give an absolute value about my perception of network analysis but what I will say is that it may show a relationship that I may not have understood about scoring pathways. I am hopeful that it may be able to do this.

Although Carl saw promise in the NA methodology, he felt that several changes were necessary before he could determine its usefulness but if it correlated with other data but added new insights then it would have value. As he said,

I am looking for data that already agrees. Data sources that already agree with what we perceive on the field. The other thing would be outlier data. Either a high point or a low point of the interactions that we are considering. We could look at them because these are the things that we could look at and confirm or deny. It is a lot easier if you see something that is very low or very high rather than in the middle range.

Planning for the Future

At the conclusion of this interview, we agreed to make a few revisions to the NA methodology that I was utilizing. First, we decided that I would work from Carl’s coded
gameplay data. He felt that having two people creating the same set of data was “redundant and could possibly lead to errors”. Second, we decided that my current methods for analyzing gameplay lacked focus and that the results from my analysis “needed to be able to tell a story”. To accomplish this task, Carl felt that we should limit our focus to the team’s pathways to success. This would entail an analysis of their scoring opportunities as well as their ability to prevent their opponents from scoring. In effect, this change meant that I would only analyze the gameplay that occurred between the try line and the 22-metre line. We felt that these changes would also reduce the time it would take to analyze the games and make it easier to understand the visual representation of the NA data. Finally, Carl needed to be able to “look at it” (the gameplay video that matched the analysis) so that he could determine the nature of the performance issue that we were addressing and determine if he needed to pass this information on to his head coach. The current method I was utilizing to analyze the games was cumbersome and time consuming. We determined that I should try to acquire some form of performance analysis software that would allow me to match the events I was analyzing to the code I was developing.

The following section contains a record of the interactions that occurred during our second interview. To prepare for this interview I took the code that Carl provided me at the end of our previous interview and prepared a NA of two of the team’s competitions. I initiated the interview by recapping what we had accomplished in the previous interviews, and what our objectives were for the current interview. We then
initiated a discussion of the NA that I had created based on the priorities we had established in the previous interview.

Two issues immediately became apparent at the onset of this discussion. The initial issue was that Carl’s recollection of the game had become clouded over time. The games that we analyzed had occurred a few months prior to our meeting and he had forgotten some of the details of each game. The second issue was that the games we scrutinized contained lopsided results, which favored their opponents. Initially, I felt that this was a problem because the results would be useless, but Carl reminded me “we were looking for outlier’s, and these types of blowouts definitely created outliers”.

**Final Impression of NA: “Thinking about analysis in a new way.”**

When I asked Carl about being able to track the interactions of the players with the use of the NA methodology, he stated that he found that the results resembled his general impressions of the match.

It is an affirmation about what I saw in the match. I saw that they scored and I saw who their danger men were. The facts that the rucks were lower in the interaction were a confirmation about the nature of the game. It makes sense.

Most of our efforts during this meeting focused on examining the results of the NA. I directed Carl’s attention to several anomalies that I had identified in the analysis. We also examined some of the anomalies in the data that he was able to identify on his own. As I mentioned previously, Carl’s team had many tries scored against them. This allowed us to analyze their ability to retain kick restarts. By evaluating the NA and
video clips, we were able to determine that their opponents purposeful targeted one of his players on kick restarts.

Carl: They seemed to set that up. This is interesting; I will take a look at that because he isn’t known for that. He isn’t known for his ability to receive kicks. It is interesting that they picked on him as it identifies that they have discovered one of our kick return strategies. He is kicking at our player but also in the direction of their key defensive turnover specialist because he is one of the best at it. It is a two-way street because they identified that our player is weak and their player is strong.

I took time to revisit some of the basic principles of network analysis with Carl. We discussed the principles of ties and nodes and that larger red ties meant more connectivity between the nodes. Immediately after this discussion, Carl noticed that the player numbered nine and eight were connected more than the other players were. I mentioned to him that this meant that nine passes to eight more than any other player does on the team. I asked Carl if this information was useful as it might show a tendency that could be exploited by their team. He responded, “It is interesting but. It is too hard to base something off one single match. Guys are hot or cold. You might need more than one tournament or a third of a tournament. That would give you a span.”

We were also able to identify that one of Carl’s impact players was hurt during the game. Carl noticed this anomaly because the scrumhalf node was not as prevalent as it normally was in the other networks we had analyzed. After quickly reviewing the
video from the game, he recalled that the scrumhalf was injured prior to this game and was not supposed to play.

As far as the analysis is concerned for our team, it is interesting that the scrumhalves involvement being lower than another player. It is interesting but it affirms his injury. We would imagine that the scrum half would have a heavier involvement in this match. We knew that he had an injury and shouldn’t have played; this affirms that.

I also was able to apply my understanding of perturbations (see Chapter 2 for more on perturbations) to our discussion, which lead to an interesting conversation with Carl about attacking, defending, and exploiting mismatches. I pointed out the fact that their opponents seemed to be much more effective at creating mismatches at the conclusion of set pieces than our Canadian team. We decided that it would be interesting to incorporate the evaluation of perturbation attempts and defense to our analysis as it was not something he was currently analyzing.

If you look at how our opponent scored the try this is very interesting. To see how a team scored the try and how it was given up. The perturbations. It is something I have never tracked before. It is interesting to find out how the tackles were given up. They were identified as side steps, change of directions and straight arms. It would be very interesting to follow up on how certain tackles happened how it was missed and follow this up and identify that.

At the conclusion of the interview, we formed a summary of our findings. We decided that the revisions that we had made to the NA methodology were effective.
Unfortunately, we decided that the visual representation of the network findings was too convoluted and difficult to analyze.

There are a lot of things going on and it is hard to pick things up and also hard to draw conclusions. It is hard to make conclusions or perhaps to ignore something you noticed after the fact. Alternatively, it is hard to make new conclusions about something you already knew or try to form new conclusions based on what you saw after the fact. This focus on *interactions* versus *events* has me thinking about analysis in a new way. I already have some things on my mind that I want to try out.

It was at this point in our conversation that we decided to conclude the meeting. Carl agreed that the NA was correctly able to identify many of the key performance issues that occurred during the game and that the findings “made sense” as it matched Carl’s general impression of the games. Overall Carl felt that “the findings from the NA were interesting, and provided an affirmation of what he “already knew” but that it “added nothing ground breaking to what I already know about my team.” I concluded the meeting by asking him if he would discuss any of these findings with his head coach.

How would I present this to a coach or would I. Would I keep the interest to peak my interest in one area…then I could go to the video and present that information. Generally, the Performance staff or coaches won’t be that well versed …for me to take it to the meeting they would likely leave the meeting shaking their head and not confident in it. Don’t be disheartened by this, most of
my ideas aren’t accepted by the coaches. Sometimes I feel a bit like a used car salesman when it comes to presenting new ideas to the coaches. They don’t have a lot of time spare time to try new things. Most of the things we are talking about here are off-season projects for me.

Based on my interviews with Carl, I was able to modify my current NA methods to match his needs. I still had to work on improving the NA presentation (visual feedback) but I felt that the method that I had developed to analyze rugby would be able to provide informative feedback to a coach.

**David the elite varsity coach**

The portion of the study that occurs with David transpired over a period of seven months. I have structured this portion of the results to coincide with the three key turning points that occurred during this portion of the case study. These turning points will be presented in the form of action research (Stringer, 1999) that cycled through the seven month period (Stringer, 1999). David’s spoken words are utilized whenever possible but in some situations, it was necessary to alter them in order to protect the identity of the players and the organization, which he represents.

The initial meeting with David occurred after approval was sought and received from the board of ethics (see Appendix A for details). Once approval was obtained, David was contacted via email with a script that was pre-approved by the board of ethics (see Appendix A for details). After accepting entry into the study, a date and location was set for our first meeting at time and location that was convenient for David. The interview began after the participant signed the informed consent form and agreed to the
use of an iPhone to record the events (see Appendix 1 for details). We followed the same protocol during all of our meetings in order to comply with ethical standards established for this study.

Although my main intent during the meeting was to let our conversation flow naturally, I realized that I needed to accomplish several objectives for the meeting to be successful. My first objective was to establish David’s current impression of performance analysis. I also needed to form an understanding of his current use of PA and an understanding of the PA policies and procedures that the team was currently utilizing. Finally, I wanted to form an understanding of the participant’s initial impression of NA, as it would help me inform my research objectives.

To accomplish these objectives, I produced a NA based presentation for David to review (see Appendix H for more details). I utilized the same set of four open-ended questions that Carl and I had addressed earlier in the study. Keeping the questions consistent throughout the study provided me with an opportunity to compare the responses from the participants. The four open-ended questions were:

- What is your opinion on the value of performance indicators and video analysis?
- What are your initial opinions regarding the value of network analysis?
- What is the critical factor that you are searching for to determine the usefulness of network analysis?
- How can we visualize this data to make it represent the gameplay of a rugby team and how can we make it useful as an analytical system that can be used by athletes
and coaches to provide them with information to assist their decision-making processes?

Before my initial meeting with David, I can remember feeling overwhelmed with his success both as a player and as a coach. His office contains numerous trophies, medals, and pictures of his successes both as a player and as a coach. In our first meeting, I remember thinking to myself, “I just want to leave. He is not going to get anything out of this. He’s just going to ask me to leave, and possibly laugh at me. What am I ever going to show him that he doesn’t already know?” Fortunately, I did not leave, and he did not laugh at me or throw me out of his office. Actually, he was very receptive to the PA I presented to him and to the suggestions I had for him, as well as my observations of his team’s performance (see Appendix H for more details on the process that we utilized to select the gameplay videos at this point in the study). Although I am not sure, I feel that my background and association with Carl, aided my acceptance as being part of the rugby coaching team and played a key factor in the working relationship that David and I attained during this project.

**Diagnosing or Paralysis by analysis: David’s Initial Opinion PA**

I found David’s response to PA was generally positive but with some concerns. David believes that the results from video analysis provide an accurate and non-subjective means of representing events that happen during a game. In fact, David has found that the results from VA are more accurate than his own recollection of the same event.
I think that you’re getting direct information. If you pick a series of things that you are looking for. There is good research out there saying that using the naked eye and subjectively watching the game isn’t that accurate. I have seen over the years and made comments and then seen through video analysis that I was wrong.

David also believes that the results of PA can provide feedback to the team and players. He also believes PA can provide direct and immediate feedback to either correct or reinforce player performance.

The video is a good feedback tool. It has a value to sit down with the players to provide them direct immediate feedback.

David also trusts that the PA process facilitates the creation and evaluation of focused team goals throughout the season.

I think that it also has certain things that you might want to focus on and try to focus on with your team or get towards during the season.

Although David values the use of PA, he is quick to express that it is not a perfect method. On several occasions, David took the time to express his concern that the amount of time to perform, facilitate and present PA to the players is restrictive.

It is time consuming. Doing it, keeping track of it, storing the files, and presenting it to the players all takes time. Its fine if you have allot of people on your staff like the pros but I am the only one here doing it. I just do not have the time!
David has identified several constraints that affect his ability to utilize PA. First, David was concerned that PA could have a negative effect on his athletes’ performance levels. He stated that PA needed to maintain a focus or it “could be done too much”. He was especially worried about overloading his athletes with information, as it could reduce the players’ ability to react automatically to changing situations on the field. David termed this effect “paralysis by analysis” and referred to it often throughout the duration of this study. David found that limits on his time prevented him from providing VA for the team. David also felt that time constrained his ability to involve the players in the PA process. His primary concern was that he did not want to occupy the players’ practice time with time for PA. He referred to this as “keeping their (the players) boots on the field”.

It is important to keep a focus. I only have these guys two days a week. I only have so much field time and I don’t want to lose it. There are only so many things you can work on throughout the year and so many things you can work on in practice.

Finally, like Carl, David felt that it took a certain mindset to value the results of PA over his previously held beliefs. For instance, he stated that he had some doubt about his ability to accept the findings from PA when they were differed from his pre-conceived notions. As he stated, “Sometimes you think of things a certain way and it is hard to change that.”
Current Use of PA

The next part of our discussion focused on David’s current use of PA. I discovered that video recordings of previous games are stored online for the players to access at their convenience. David stores an edited/condensed copy of each week’s game in a Dropbox folder. The players could watch these games on their own time. For example, David may notify them that their tackling is ineffective. If they disagree with his feedback, they can go back to the video and examine their tackles.

It depends on what you are looking for. It has a value for what you are looking for. It has a value to sit down with the players to provide them direct immediate feedback. They have access to go online and it (performance analysis) has become more accessible over the last five years. Our players have access to the games online. To validate it with the players. They might say oh I am doing that but then they see the video and say no I am not. You weren't actually doing that because this is what the video is saying. It gives direct immediate feedback to the players. It gives tackle count or whatever key performance indicators (KPI) you are looking at. So they can go back on line and look at.

David receives match video once a week. Normally, the match video is segmented into small parts in order to keep the video files small and manageable. He generally edits the match video to reduce its length and the amount of dead time in the video and therefore, the total time required for the players watch the video. David has a limited amount of Dropbox space and he does not want to spend more money to get more space. He also feels that the players will be more likely to watch the match video
if this video is condensed. There have been problems with this method in the past because some of the players have inadvertently deleted the files from the Dropbox folder by mistake. Although there are some complications with their current method of sharing match video, David feels that keeping the videos on the Dropbox is useful because they can use this video to refer to feedback the players received during the week.

At the beginning of the season, the league was using a service called Huddle to create and store digitalized video recordings of their games. This service provided each team in the league with access to all of their own and their opponent’s games. Although David felt that it was a benefit to have access to such a large library of videos, he was not entirely happy with the Huddle video service. He felt that the quality of videos was low and their videography was not suitable for effective game analysis. Another issue he had with the videography was that the wide-angle view provided through the Huddle coverage was effective in examining certain elements of the game but not others like breakdowns or scrums. Because of issues such as these, David hired a person to record his team’s home games as he stated, “The league…facilitating the ability to put up videos on Huddle….issues over the quality of the videos.”

David also believes that PA was useful for evaluating and correcting the technical issues that affect his teams’ performance on the field. Because of David’s experience and in-depth understanding of the game, he is able to analyze the performance errors his team are making, what needs correcting, and provide feedback to the players to facilitate the change. David’s feedback was generally useful and well
received because of the skill and experience level of the players on his teams. As he stated, “VA allows me to focus on pathways to success. These include set pieces, clean outs, break down.”

In an ideal world, David would like to perform video analysis once a week in order to analyze and evaluate the strengths and weaknesses of his opponents as well as any patterns in their style of play. His use of video analysis generally includes:

- An evaluation of his opponent’s ability to perform their offensive and defensive schemes. This may include their patterns of passing during phase play or how many people they commit to the counter attack during the breakdown.
- An evaluation of his opponent’s ability to perform set pieces. This could include lineouts, scrums, kick returns or restarts.
- An evaluation of his opponents for their strengths and weaknesses, tendencies and preferences in patterns of play as well as to scout an opponent’s player roster to identify their impact players. He uses the information he gains from scouting opponents to prepare his team for upcoming events.

Player unavailability, injuries, and other commitments are the constant realities of a coach planning a week-to-week roster in the David’s league. Throughout the season, teams in David’s league change their player rosters because of these personnel issues. It is important for David to understand how each team’s style of play will vary under various personnel constraints. For instance, will the loss of a team’s star kicker due to injury mean that an opponent will have to kick less than they normally would during a game? Alternatively, does the return of a team’s star winger mean that they
will be passing wider more often than they have been without that player? As he commented,

I use video to correct things they are doing on the field. We look at the strengths and weakness of opposition. In our league, the personal changes quite a bit from team to team and from week to week. That is something you have to factor in. It allows you to target key areas of the game based on the opposition. It allows you to target their weaknesses and do something against them. That is an area where analysis really helps. If you are targeting key parts of the game against opponents, you can pick that up. Who we can attack weaknesses in the offensive schemes. We can pick up certain styles of play. We can find weaknesses in their offensive schemes. Later in the game, we can attack teams. You can really break a team’s back.

David valued PI’s such as tackle count because they allow him to monitor his team’s effectiveness in performing certain skills, like tackling. Currently, the assistant coaches or in some cases, injured players, monitor PI from the sideline.

The last few weeks we have been having our captain do it. He is injured so he stands on the sideline and keeps track of the tackle count. The problem is that he is busy and there are many distractions on the sidelines (including fans and other players talking to him while he is trying to keep track of the tackle count). He hasn’t been trained to do it. It’s a pretty subjective measure.

David is concerned that the PI data he is receives from these team members is inaccurate. He believes that cheering fans and other distractions during the game affect
the ability of these individuals to accurately track these PI from the sideline. David believed that VA could improve his ability to provide his team with accurate PIs such as tackle counts. Unfortunately, David did not have time review the videos in order to verify the accuracy of these PI.

I would actually like to check the tackle count and see if it is right. I'm pretty sure that people are getting credit for and not getting credit for tackles that they are making. In the perfect world we could watch the video if it was a good quality and see if it was right.

David and the teams meet at the beginning and throughout the season to set and monitor individual and team goals. These goals might include improving tackling efficiency, reducing turnovers or improving the team’s ability to perform scrums or lineouts. Due to performance issues and personal changes, they often find it necessary to establish new or modify existing team goals as the season progressed. PA provides the teams with data that allows each team to monitor and maintain their performance levels. David felt that this ongoing process of goal setting and feedback provided focus to the PA process.

I think that it also adds focus to the things are trying to focus on or are trying to get towards during the season.

Although David normally performs his own VA, he has had the opportunity to work with VA in the past. He normally gives them a list of things he is looking for and then meets with them to reviews what they have found. When I asked David “Have you worked with a PA analyst in the past?” He responded,
Yes a little bit yes. What I normally do is just give them the things I want. Well normally in the past, I have just done it myself. What I normally do is just give them the things I want like the things we talked about like set pieces, phase play, breakdowns.

David performs VA on pre-recorded game supplied to him by various sources. He keeps a selection of past games on Dropbox, various external hard drives, CD’s and on his computer. David does not utilize professional PA software to perform VA. He generally watches the games and then uses Apple Movie Maker to edit the video into smaller clips. He plays these clips during team meetings to provide feedback to his players. The organization he works for has professional PA software (dartfish) but he felt that he can do it faster on his own because he believed that the benefits from the software outweigh the time it takes to learn how to use it. As he described,

We are doing it ourselves. It is a bit of an issue because the department bought licenses for it and did not train us. As well, most of us have MACs and Dartfish usually runs on PC. We have Dartfish but no one is trained on it. It is a bit of an issue with the department. They bought licensees but we don’t use it. Game breaker would be more appropriate. International teams are using game breaker. Its use seems to be more popular in the sport of rugby

Initial Opinion of Network Analysis (NA)

After we had a chance to discuss David’s initial opinion regarding PA as well as the procedures his teams currently utilizes to perform PA, we moved on to the next topic of discussion which concerned his initial opinions regarding the value of NA.
David’s initial view of NA was similar in many ways to Carl. David believed that it is beneficial to be able to see how the individual decisions made by the players created patterns of interaction that ultimately affected their performance at the team level. Like Carl, he believed the NA lacked focus in analysis and in presentation. Finally, like Carl, David’s general impression of the NA is that it validates many facts he already knew about the game and his team.

Yes, there is a lot there. Sometimes you have to say what you are trying to achieve. It validates a lot of the stuff. There is a game plan and you are giving them a lot of latitude to the decisions the players are making. You are starting to see some of the connections between who touches the ball the most and who is getting to the breakdown the most. Some of the coaches want to see who is making the mistakes and who is making the mistakes the most. Most coaches want to see who is making turnovers and what those turnovers are.

Cross-referencing the NA findings with video was as important for David as it had been with Carl. Although David found value in looking at the results from the NA he seemed to get more out of the analysis when I was able to cross reference it to the video. In fact, in my notes, I refer to the fact that it seems like Carl was able to get more from watching the video again than he did from the analysis that I prepared! It was also important to note that after viewing the NA that I had prepared, David wanted to look at the video to see how and where his team’s turnovers were occurring based on the patterns indicated by the network analysis. For example, in response to a network showing when breakdowns happened he commented when looking at the video,
Can I look at that on the video? Yes, we are bad at these problems. We were playing a wide style. We were playing wide. They are all back and we moved it wide. When you go wide, you got a lot of turnovers because your players get taken into touch.

David was also interested in tackle counts that occurred during the game. In particular, he was interested in “taking a look at” a certain player’s ability to tackle. He felt that that player had a poor game and he wanted to look at his tackle count and the tackles he made. The statistics demonstrated that the player only missed two tackles (this was average for this game). Unfortunately, the two tackles were significant as they resulted in two of the tires scored against them during the game. After looking at the tackle information contained in the NA, David indicated that a tackle count was meaningless on its own and that the tackle information needs to be qualified with more contextual information. As he commented,

It takes a much different skill set to make an open field tackle compared to the skill set necessary to make a tackle closer to the goal line. How about 12. I think 12 had a poor game on Friday against a quality player. You have to make sure that you can tackle a guy that has moves. Sometimes it depends on the type of tackles that he made and where they occurred.

We also discovered that teams had various pre-set tactics that will have an impact on the NA. For instance, David revealed that they have certain policies in place to guide a player’s actions after recovering turnovers.
We have some policies on what we do when we turn the ball over. Try to run the
opposition around. The players are expected to move the ball away from the
turnover with a sequence of passes before they advance the ball down the field.

This discovery was both promising and problematic. We both found it
promising that the network was able to identify these strategies because it verified that
the methodology was effective in analyzing rugby gameplay. However, it was
problematic because I realized I would have to become more educated in team policies,
procedures and strategies if I was going to be able to provide effective and useful
performance feedback to the team based on this policy.

Like Carl, David also felt that the NA analysis lacked focus. Our engagement
started mid-season. By this point in the team’s schedule, they had already identified and
were working on several key areas of the game that were affecting their team’s
performance. The focus David wanted to bring to the network analysis would help him
assess the issues that he felt he could address during practice.

I want to know how we scored our tries. Our pathways for success. Set pieces.
Clean outs. Breakdowns. We have the stats and an impression of how they did
so we can base the video on this. I want to take a look at the scrum and the
consequences of set pieces.

Overall, David felt that the results from the NA reflected his general impression
of the game although he found the visual feedback overwhelming. Presenting this
analysis to the players was important for David but he felt that the NA visualization was
“too much in its current form”. Similar to Carl’s comments he stated,
If I am going to present it to the players at some point there should be something there that is visual (video clips). This is the consequence of this. We can put it into groups and get them to look at it. Showing them the network might be a little too much. Showing them the gyro metre might be a little too much. You cannot take that to a player. A big problem that occurs with all of this analysis is being paralyzed by analysis. Now a day what is happening is there is so much analysis that it takes up so much time.

At the summary of our conversation, David provided a list of the things that he would like look at in future meetings. Many of the things David wanted to look at related to set pieces. He wanted to know where they originated, who was involved in them, how they concluded and how play continued after their completion. He wanted to see information that contained a larger amount of data from wider set of opponents and over a longer period. He noted that the team they competed against in the game we evaluated contained players that played at an international level. He felt that the information from this game, although interesting, did not truly reflect the current ability of his team. Like Carl, he felt that a longer engagement with his team was necessary to see data that truly reflected the ability of his team. He concluded,

For me the big thing is once the ball goes from one phase of play what is happening to the opposition. Is it happening at midfield or is it happening wide. I would also like to know where we are getting broken down. We have a smaller team so I would like to know. We need to look at this over a longer period of time and with stiffer team. Where are we breaking down and the opposition is
being broken down. Lineouts are good and execution is not too bad. Where are we ultimately breaking down are we hanging in there at scrum time? What are the consequences? Are we able to build a platform to attack from? I am dealing with younger players here, we have different concerns, and we are still working on the basics like lineouts and scrums here!

The interview lasted 30 minutes. It ended with David mentioning, “Thanks for taking the time to help me identify the consequences of the team’s actions”.

**Interview two with David: Observing need to re/present NAs**

The purpose of this meeting was to determine the type of analysis that would be of most use to David and his players. To accomplish this objective, I presented him with two NA of David’s matches against an opponent they had faced earlier in the year. I adopted all of the changes that David had asked for including:

- A refined analysis of the team’s tackles.
- Patterns of play during and after set pieces.
- Passing tendencies during phase play.
- A start to finish analysis of phase play tendencies.
- An analysis of breakdowns.
- The team’s tendencies while counterattacking.
- Opponents set piece efficiency.
- Opponents phase play tendencies.

I also modified the method I was utilizing to match the analysis to the video.

From my discussions with Carl and my previous meeting with David, I realized that I
needed to develop a more efficient method of linking the NA to the video. To accomplish the task I modified the method I utilized to analyze the games to include time stamps to refer to points that I thought would be interesting.

This interview, like the previous one, took place in David’s office. Looking at my journal entry for this meeting, I noticed that I made another comment about how nervous I was to be presenting this analysis to him. I also remember making the comment that “I don’t know how this is supposed to go” to him at the beginning of the interview. This was in reference to the fact that, up to this point, I did not have much experience in presenting performance analysis to coaches.

During the meeting, we addressed each of the points of analysis that David had requested. During the evaluation of set pieces, breakdowns, tackles and phase play tendencies he commented, “This is good; this is great to be able to see this”. When we discussed some of the technical problems the team was having during scrums and during phase play he made the comment, “that is something we are working on already, it is a big problem for us right now but we are getting better at it”. David indicated that the team was having trouble preventing their opponents from ‘wheeling’ their scrum. They had also had problems defending against their opponents ‘rolling mauls’ and David was happy that he could see that their team was performing in these areas.

Later in the meeting, I asked David about his initial impression of the NA now that I had addressed his concerns. In particular, I asked him to focus on what he was able to get out of the NA after I made the changes he had requested. His initial comment, “This is good, yes this is great to be able to look at the video like this”. When
I asked him to focus his impression on the NA, David, as Carl commented, “It’s not a revelation, but it does affirm what I already know about my team”. He added, “I know all my players and I also know all the teams in the league, there aren’t going to be any surprises for me”. He concluded, “I am thankful that you can help me identify the strengths and weaknesses of my current team”.

At the end of the meeting, David asked if I would be interested in presenting the analysis to the players and other coaches. He felt that it was important for the players as well as the coaches to be able to look at what we were working on. We also discussed the fact that it would be beneficial for the team if they could receive some form of PA on a regular basis. We decide at this point that it would be mutually beneficial if I could join the team as a performance analyst for the rest of the season. It would be my responsibility to provide the coaches and players with PA for the rest of the season.

**Action: Team Presentation**

At the end of the last phase, I decided that to make a conscious effort to improve the methods I was utilizing to analyze the games. I tried several other solutions but they all seemed to be very expensive or in my opinion “finicky”. David and I discussed the possibility of buying professional VA software but they all seemed to be very expensive for our purpose. Fortunately, through a bit of searching, and a little bit of luck, I was able to obtain a video analysis program called Longomatch (Fluendo, 2015). Longomatch is open source video analysis software that is very effective at analyzing sports like rugby. Longomatch provides the user with an ability to attach codes to video and refer to them with a click of a button. It also provides the user with an ability to
attach players to events, which improved the efficiency and accuracy of the NA process, as I had to spend less time “handling the data”. Although it might not be as good as some of the professional VA software that is currently available, it was “good enough for what I was doing” and “it was free”.

The next phase of this case study was to create a PA presentation for David, the assistant coaches and the players. During this meeting, we discussed the format for the presentation, the analysis that David wanted to discuss during the meeting, and the video clips that we would utilize to provide visual support for the analysis.

While planning the presentation, David was particularly attentive to the methods we incorporated to deliver feedback to the players. His main concern was that it be positive, and “short and to the point”.

You don’t always want to pick out the negative things. We want this to be a positive learning experience for them. This is the first time with this for some of them so we don’t want them to focus on the negative. Let’s provide the positive points first then the negatives. Maybe 3 positives for every negative point. I don’t want it to last too long though, maybe 9 minutes. After that, they lose focus. It becomes too much for them.

David also wanted to create an opportunity for the coaches and players to engage in constructive dialogue. He continued,

If we picked four things to focus on. I could have a sheet a one pager. I could do that and then ask them a couple of question. Things that we coded. Say 4-5 that you coded on the video. What I might do at the bottom of a page is have
one, two or three questions that they answer in groups. I would say, “You guys talk about it…how you guys would fix this now that you see it”.

David wanted the meeting to focus on “our team’s pathways to success”. These included set pieces, in particular how effective the team was contesting scrums, clean outs and breakdowns. David felt that these were “good areas of instruction” which would serve to create constructive dialogue during the presentation.

During the remainder of the meeting, David and I went over the analysis that I had performed and selected video clips to include in the presentation. The rest of this narrative contains a brief example of the dialogue that occurred during this process.

In our conversation over the team’s effectiveness during set pieces, David focused on the scrums. He identified some of the issues that they were currently working on already. He notified me that they that the team meeting would provide them with an opportunity to discuss the problem and formulate a solution to solve it. He is an example of our exchange.

Researcher: Scrums were under pressure.

David: Yes Big-Time. Here is an example of it. 9 is very good at it. I mean we still win the ball but we can’t win the attack. We are wheeling already and he should put the ball in we should ask for right shoulders and ask to reset the scrum.

Understanding his team’s tackle efficiency was also important to David.

Researcher: Looking at the 15 making a tackle.
David: He’s left his feet before he goes into the tackle. Normally he is a good tackler.

The team’s ability to defend in phase play after the occurrence of set pieces like scrums was a concern of David.

Researcher: Play off scrums. This happened twice: whose responsibility and whose responsibility is it?

David: He needs to be watching the man not the ball. He needs to be on the inside of him not the outside. The B spot rather than the A spot. He just isn’t looking.

David also identified a problem with mauls that they were working on already. This problem has been plaguing the team since the start of the season but it is something that David felt they were improving at as the season progressed.

Researcher: Being mauled off ball was apparent in the network and then in the video?

David: You see we aren’t ready [pointing to the video]. We aren’t ready there...it is key you have to hit it. Inside the red-zone we are hitting it. When in the red zone you have to hit it or you are in trouble. We are working at this already. Yes we went over this in the team meetings.

David also found it important to understand his team’s ability to contest the ball at the breakdown.

Researcher: What about the breakdown?
David: We aren’t committing anyone to ruck. We need to do more to win the ball. It is a problem playing against them because of their size.

Finally, David was also concerned with his team’s ability to cover kicks while they are on offense and defense.

Researcher: Kick coverage?

David: It is a problem…because we are all offside, we can’t advance. They need to have someone put us on side. A winger or someone next to him should put on onside. Someone should be running. He is just doing his own thing. He should have just kicked it out.

While David and I were selecting the videos for this presentation, I realized that my current understanding of rugby tactics needed improving if I was going to provide David with feedback that matched his expectations. For example, I found that my understanding of what determines an effective kick out of hand was incorrect, as I had assumed that a player was ineffective if they lost possession of the ball after a kick. David notified me that I should rethink my evaluation, as “possession of the ball at this level of play isn’t everything”. As he explained,

He made 80 metres and he stretched the ball out. That is a good kick he got it back on the breakout. You know time, space, and organization are also just as important. You also have to change things up every now and then. Sometimes when you face a flat shaped defense, you have to kick over them to keep them honest in defending the deep challenges.
David was actively involved in selecting the video clips that were going to address in the team meeting. He based his selection on the quality of the image in the video and the ability of the video to demonstrate a player performing a skill effectively. As he stated, “Show that one first and then show that one second. That way it will make more sense and we can keep it positive”

David based the videos he selected on the team’s ability to address the issue during practice. Time is a concern for David and he did not want to worry about things that they could not address in practice. Scrums, breakdowns, lineouts and kick coverage were all important to him, as were all things that they were working on in practice.

At the conclusion of the meeting I asked him if he had any comments about the changes that I had made to my PA methods. He mentioned that he really liked the addition of the Longomatch VA software (see Figure 4 below). He was amazed that it was “free and so easy to use”. He also commented on several occasions “You are getting good at that hey?” He also mentioned, “Looking at this again allows me to see things that I didn’t see during the game” and “yes I forgot about that (players jumping early on lineouts) it is something we need to work on in practice”.
Overall, we were happy with the presentation that we had developed and the analysis that I was providing but I still felt that a need to make some improvement to the coding methods I was utilizing. For instance, I thought that the rating system I utilized to evaluate players was a little harsher that what it should have been (Appendix H). In some cases, this was due to my unfamiliarity with the rating system that Carl was utilizing. In another instance, my error in evaluation occurred because I lacked a general understanding of the player’s responsibilities during certain parts of the game. For example, I had rated one of the players as ineffective in performing rucks, when David felt that he probably should have been rated as effective because “that error wasn’t really his fault”. In another instance, I credited a player with an ineffective pass when David actually felt that the fault should have been assigned to the player receiving the ball (Appendix H).
Overall, we both felt positive about the upcoming team meeting and the analysis I was providing the team. We both decided that it be useful if I could attended an upcoming practice and team meeting, as David could introduce me to the team, I could take a look at what they were working on in practice and I could also see what a team meeting generally “looked like”.

Preparing Analysis for the Coaches as well as the Players: The Team PA Meeting

Before the PA meeting started, I developed a set of objectives:

- Did we provide a focused PA presentation to the players?
- Were the players and coaches engaged in discussion during the meeting?
- Did we address the key issues that David wanted covered during this meeting?
  - Set pieces
  - Consequences of penalties
  - Missed tackles
  - Pathways to success
- Did we provide effective video to support our analysis?

The team meeting occurred in the team’s locker room. This space is quite small as several of the other teams on campus use it as a change room. In fact, we had to pause the meeting on several occasions in order to accommodate other athletes walking through the change room to get their clothes. The room itself is quite dark. There aren’t any windows in the room to let in natural light. There are two banks of lockers on either side of the room and a row of benches that run down its centre. David often uses this
space as a meeting room because it is easy for him to meet with the players before they head to the practice field.

To accommodate this presentation we had to set up a table for my laptop and another table for the projector we were utilizing. We also had to run an extension cord down the middle of the room because it does not have any plugins that would reach the video projector. The benches that ran down the middle of the room did not accommodate the table we were using so I had to kneel next to my laptop while I presented the analysis to the coaches and players.

During the meeting, the coaches stood at the back of the room whereas the players sat around me on the benches. Unfortunately I had to stay crouched next to my laptop during the presentation because several of the players would not have been able to see the screen if I stood.

Although the setting for my first team meeting was not ideal, the message that we delivered was effective. In fact, my initial impression of the meeting was that it went better than we had planned. David’s initial opinion about the presentation was also positive. He felt that we addressed all of his concerns for the meeting. At the conclusion of the meeting, the players and the assistant coaches mentioned that they were very pleased with the focused video clips and performance analysis that they received.

Overall, David and I thought the meeting had met our goals. The players were responsive to the focused video clips and analysis that we provided them. Many of the players asked questions about the analysis as the meeting progressed. These questions
created an opportunity for the players and coaches to engage in constructive discussions over technical and tactical adjustments they could make in their upcoming game. For example, the players agreed that they could make a better effort of creating a "fast ball" during their breakdowns so that their scrum half could get the ball into phase play quicker.

The assistant coaches also took advantage of the focused analysis and asked several unplanned questions of the players which lead to constructive discussion in regards to the tactics that they should be implementing on kick restarts and during set pieces.

During the meeting, David presented the entire team with a tactical problem that he thought was important for them to solve. He referred to the issue verbally. I commented in my journal entry “I thought this might have been a good time for to use video to present the point he was trying to get across”. The video program that we are utilizing has a tool that would allow us to illustrate points visually. I believe that time constraints, comfort levels, and our understanding of the program prevented this from happening but I think that this would have been a key moment that we could have used video-based feedback to reinforce the message we were trying to get across.

The meeting ended up lasting longer than we had planned. This was mainly due to the unplanned discussions that occurred as the players and coaches engaged in constructive dialogue. For example, on one occasion, the players and coaches identified a tactical problem that was affecting the team’s performance during restarts. By pausing
and rewinding the video the players and coaches were able to focus on the cause of the problem and mutually create a course of action to solve it.

At the conclusion of the meeting, the players and coaches thanked me for the analysis. David took over the meeting, as the next course of business was to prepare for the upcoming practice and a tournament that they were attending in a couple of weeks. Overall, I felt that the meeting was an effective use of 12 minutes.

**Reflecting on event: End of an action research phase but what about “put boots on the field”**

The next day, David and I met and reflected upon the goals that we had set for the meeting and evaluated our ability to achieve them. We decided that we had accomplished our goals for the team presentation but we still had some concerns that needed to be address.

David was concerned that some of the players were not able to attend the meeting. He informed me that it was likely that there would be missing players during most of the team meetings as some of the players had other obligations they had to meet. We felt it could be problematic for the team's performance if some of the players were unable to attend the team meetings while others were not.

One of our other concerns was finding a balance between David’s need to maximize the team's use of limited amount of practice time with his need to provide PA to the players. It seemed that the majority of the players were attentive throughout the entire meeting, but David felt that it was likely that some were not. We had to
determine if a weekly PA meeting was going to be an effective use of the team’s practice time or if other methods would be more beneficial. The two main factors were:

- David has between 70-100 players attending each practice. There is a question of how we could have a team meeting with all of these players attending and still manage to keep everyone engaged in the analysis during the meetings.

- David was concerned that the PA meeting would take time from his player’s ability to “put boots on the field” during practice. He only has team practices twice a week and does not “want to take time from these practices to have all of his players involved in meetings.”

Due to changes in the league’s policy half way through the season, we discovered that we would not always have access to weekly video recordings of our games to analyze. This was not that big of a concern for me as it took me up to 9 hours a game to create a PA presentation for the coaches and the team. Finally, the system I was using at this time was very inefficient. I had to code each game, twice, one for the NA and the other to track the PI. Then I had to prepare a summary of the PA for David and the other coaches. Once this was completed, David and I met and we developed a presentation for the players. It was impractical to think that I would have that amount of time on a weekly basis to prepare PA for the team.

With these concerns in mind, we decided that it would be worthwhile to implement another set of revisions to the team’s policies and procedures based on the constraints and needs for PA that we had identified. We would begin the next phase of
this project by addressing these concerns and developing a new set of goals for the next phase of this case study.

**Plan: Develop a YouTube Channel to host a Team Playlist**

The next phase was initiated at the beginning of the team’s season in February and continued until the end of June. During this phase of the case study, we engaged in weekly PA discussions regarding the team’s performance. Although we preferred to meet in person, David and I often found that this was impossible. Therefore, we often found ourselves corresponding through email because of conflicting schedules. Fortunately, we were able to arrange our schedules so that we could meet personally during four, one-hour meetings. During one of these meetings, we were able to address the revisions we made to the team’s PA policies and procedures.

The first three meetings took place in David’s office, and the final meeting occurred outside a coffee shop located near his office. The goal for these meetings was to evaluate the weekly analysis I was providing the team as well as to address our concerns from the previous phase of this study. The format that guided the conversations that occurred during these meetings was informal but purposeful. It generally revolved around three issues: discussing the current week’s analysis, addressing any changes that David wanted to make to the analysis package for the next game, and inquiring into his impression of the PA policies and procedures that were being used in order to revise them.
Revisions to the process

After reflecting on the concerns we had from our first phase of this study, we were able to develop a plan to implement the following revisions to our PA policies.

Our first action was to create a YouTube Channel and playlist to store videos clips of selected gameplay for the players to watch on their own accord. Each week, we created a new playlist that was identified by a label for the week it represented as well as the competition it contained. Each playlist contained up to 18 sub-folders. Each folder contained video clips representing the analysis that we created. Once the analysis was completed and the videos uploaded to YouTube, I sent David a link to the playlist. David then informed his team that the analysis was ready and then sent out a group email to the players so that they could watch the analysis at their convenience.

We planned to increase player engagement in the PA process by creating a set of questions for the players to address in the comment section on the YouTube playlist. The plan was to provide a set of questions for the players to address after watching the videos. David would continue to address PA at the beginning of practices or in person with individual or small groups of players.

We increased the degree of focus and refined the level of context that we provided in our analysis. We accomplished this task by changing and eliminating some of the things in our analysis that David felt were unnecessary, as he “couldn’t work on them during practice”. These changes included forms of passing analysis, such as tendencies in the direction the players were passing as well as the analysis that focused on the handling errors that they players were committing.
David was also concerned that the players might suffer from too much exposure to PA; the idea of “paralysis by analysis”. We agreed that my analysis would focus on:

- Breakdowns
- Set pieces
- Success and Failure attacking from our opponent’s 22-metre line.
- Success and Failure defending our opponent’s 22-metre line.
- Our counter attacks
- Ours and our opponents restarts
- Our kick coverage
- Our pathways to success i.e. how we scored

These aspects of analysis were selected for three main reasons. First, because they were perceived as being important to the teams overall success. Second, because they were items of analysis that could be addressed within in the teams current practice structure. Finally, because they were items of analysis that were already being addressed within the teams current practice schedule and David wanted to track the team’s ability to address these performance issues.

I decided at this time that I would revise the analysis procedures further. I took this opportunity to initiate a policy of analyzing player effectiveness in creating and defending overlaps with perturbations. This modification was based on an initiative founded through my association with Carl. During our work together, we had formed an interest in studying perturbations and their effect on creating overlaps in phase play (see Chapter 4 for more information on my work with Carl on perturbations and Chapter 2
for more information on perturbations). I thought that the findings from this analysis might be interesting for David to look at. However, this policy was eliminated from my work list as David showed little interest in this form of analysis because it was not something that he could address within the team's current practice structure. We agreed that many of the team's strategies concerning phase play relied on a certain type of commitment from the player's individual gameplay. I came to realize from Davis' insights that for example, forwards were expected to smash the line in earlier phases of play without concern for passing the ball to their teammates. This interaction negatively influenced the network analysis against players involved in carrying the ball in the earlier phases of play as it showed that they had a high link to rucks rather than passes. This was a major disappointment for me but also a served as an important lesson because I quickly learned to check with David first before I developed any other changes to our coding procedures.

**Evaluation of YouTube Playlist implementation**

David and I decided that the changes to our PA policy would be effective if:

1. We engaged the majority of our players with the PA. We could evaluate this by looking at the view count that is contained within the YouTube playlist. David would also question his players over their impression of the PA contained on the playlist on a weekly basis.

2. To test whether our PA method was providing effective feedback to our players we would evaluate this by engaging in weekly discussions with the players.

3. We were able to provide weekly analysis to the players.
From this plan we then evaluated the benefits of the YouTube playlist.

**Reflection: Did we achieve our Goals?**

During one of our final meetings, David and I performed a summary evaluation of the goals that we had set for this phase of research. This meeting occurred in David’s office just before the team was about to compete in a playoff game. David was pressed for time and very concerned with getting everyone organized for the playoffs. The following is a brief narrative of the main issues that were addressed while we determined if we had met our goals for the YouTube playlist.

My knowledge of rugby tactics and individual skills at this level of rugby was still developing. On several occasions, David and I found that my analysis was useful, but the video clips I had selected were ineffective at supporting the analysis. On these occasions, we would work together to edit the clips and pick better examples for the team to watch.

We were not meeting objective two. I noticed that the players were not addressing the weekly comments that I was leaving for them on the YouTube site. Addressing these comments was an important part of this process because it would provide a forum, which the players could engage in constructive dialogue. It would also serve as a means to ensure that all of the players were viewing the analysis. After discussing this problem with David, we agreed that some but not all of the players were benefiting from the analysis on the YouTube channel. We also decided that further revisions might be necessary to address this issue, as we wanted all of the players to be “on the same page”.
Although we were not providing the players with weekly PA of their matches, we were able to provide them with weekly analysis of one form or another. On the weeks that I did not have access to our videos, I performed NA on videos of our upcoming opponent and supplied that information to the team. Fortunately, our ability to adapt to the situation was helping us meet our goals of proving weekly analysis, of some kind, to the players. Although David had some initial concerns about the actual benefit our players were receiving from the scouting reports of our opponents, we agreed that it provided a means for the coaches to, as David stated “focus the players on their upcoming opponents” that would not have otherwise been available to them. This focus provided by the PA was particularly useful for the team during holidays or while the players were preparing for exams. On these occasions, David felt that the “PA provided a reminder to them that they had a game to prepare for when they got back to the team”. As he then stated,

I’m not sure that they actually event watch the videos. If they aren’t in them they won’t watch them. They haven’t been trained to do that. Most of them won’t get anything out of it unless I sit down with them and show them it.

The fact that we were not addressing objectives one and two was a concern. After a lengthy discussion, we determined that the players needed to be actively involved in the PA procedures. We decided that we could accomplish this on a basic level by:

- Including all of the videos in the playlist rather than a limited list that I was creating based on my analysis.
• Changing the policies, I was using to code the videos. I would alter my coding windows and increase the length of all of the videos I made by 5 seconds so that the players and coaches could see the results of all of the items that we analyzed and coded. This alteration was especially important on line breaks, lineouts and scrums because adding five seconds to the video allowed them to see the ensuring phase play. This also allowed the players and coaches to analyze the effectiveness of the set plays they were using after they completed the set pieces.

• Creating a file system within the playlists that allowed the players to have easier access to the videos that they were interested in looking at. Within this file system, each category contained effective and ineffective results. For example, the video clips of effective offensive scrums contained labels that differentiated it from ineffective offensive scrums.

• Creating a dashboard for the coaches and the players that indicated the team’s strengths and weaknesses. It would also include a traffic light system that would notify them of any issues that needed their immediate attention.

The development of how the videos selected based on the network analysis were presented created a suit of choices for the players, enable them to become more actively engaged the materials they read and the inquiries they made into the opponents they would play.

**Final Evaluation of the process**

The final meeting with David occurred on a sunny day outside a coffee shop near his office. The team’s competitive season had just ended a few weeks earlier with a loss
to a rival in the finals. This meeting was a welcome break for David as he was in the process of preparing final evaluations for his team.

The purpose of this meeting was to determine if we were able to meet our objectives for this project, clarify some questions in the themes I had developed for this case study, and determine if there were any changes we could make in the off-season to aid next year’s PA efforts. The following section provides a narrative of the conversation that occurred during this meeting.

**Buy-in from players**

One of the concerns I had during our conversation in regards to the concept of the “buy in” from the players and coaches. I was concerned that the lack of consistent focus on PA was due to a lack of a “buy in” from the players and coaches. David responded by saying,

> The buy in isn’t a problem. It is not a real hard sell. It is like a new athlete. The new athletes want more and more feedback. They want more feedback. If they haven't had video analysis they really like it. The guys that play on the provincial teams have had it and they really like it. They want more feedback if they can get it.

This response was interesting as it implied the benefit of prior education that allowed players to use the feedback from the video analysis effectively.
Video quality

I was also concerned with the consistency of the PA polices that we had developed. It seemed to me that a variety of constraints affected our ability to provide PA to the players. David responded with the following comments,

You had a list right? I can tell you some of them. Video quality, weather, viewing angle. Tripods that can get good video but can be affected by wind and weather. Does it provide good images and good feed in different weather? These are all big concerns. We are filming from different angles and different sides of the field. Where is the best angle and does it, provide a consistent message to the players? The quality of the camera and the quality of the video are things. I think it was consistently done. But I am saying that there are challenges.

All these comments speak to the fact that video cannot give a universal view, it can give feedback that would otherwise be missing, but it can only provide a partial view of the field. Ultimately, the quality of our match video was constrained by our ability to position the cameras on the field.

Time to work with players and time for players to work on PA

The other constraint that I had identified was time. Time to work with players was a constant issue throughout this project. I asked David to comment on this.

Yes, that is the difference between an amateur and a professional player. The priority of the amateur player is finishing school. In theory, they would have staff they would probably have a staff like three of me. The head coach would get a
debriefing from someone like yourself. Then those three guys would sit down with a series of players and actually show them the analysis. The head coach wouldn’t even be there.

Another aspect of time constraint that I had identified was the player’s time and availability. To this point David made the following observations.

Well for example, I haven’t had time to talk to them because of exams. Our team isn’t like others. How can I ask these guys to show up for practice when they have exams to study for? Furthermore, many of them are away for work now that exams are finished. I can’t ask a guy not to work so he can come to a rugby practice. Now that exams are over Thursday or Friday, I hope to do some video with them. I am going to write them down some things on index cards. Three things that will help them. This is based on the stuff that we have been talking about. Hey, if they are going to give you the front of the lineout why are you going to throw it to the back? Like the XX read. We make unforced errors right from the start that you cannot recover from. Those are technical things that we are going to have to straighten out.

It was very interesting to note that despite finishing the season David was still valuing the PA and NA, as a means of helping his players get better, and to learn from their previous games. In fact, David felt that a particular strength of our PA efforts was our ability to adapt to the constraints that we faced throughout the year.

Yes, another thing is that we might change the analysis from week to week. One week we might focus on one thing and then the next time another. We may
change it on our current needs from week to week. That is a good thing for analysis that we can change its focus from week to week.

I mentioned to David that he had made the comment “VA is necessary and that we have to do it more consistently.” However, I was curious as to how he felt that we achieved that goal.

One way was providing the video on YouTube. Using YouTube to provide videos of their set pieces. That was useful. It was useful having a site they could go to.

**Video and wanting to look at everything**

Finally, I asked David about “wanting to look at everything.” I mentioned to him that it came up several times during our conversations that he asked if he could look at the analysis that I showed him. I mentioned to David “it seemed that looking at the match footage seemed to be more important than the analysis itself”. His response indicated to me that his need to view the video was due to the value he put on his own ability to solve performance problems.

There is some research that suggest that observations aren't that accurate. There are some examples where coaches have started working on stuff because of observations that they (performance analysists) made incorrectly. I need to be able to see it myself to make my own judgements!
Planning for next Year’s Campaign: Next cycle of Performance Analysis Development

Based upon the previous evaluation above, David and I formulated a plan that would allow us to implement the following revisions to our PA policies in the upcoming season:

- Maintain the YouTube playlist for players and coaches to watch
- Continue monitoring the same performance metrics but provide more context to the analysis
  - Example on Breakdowns provide Quick/Slow motion replay as well as players involved
- Provide focus to the analysis. The purpose of this change is to limit burnout from PA as well as increase its effectiveness.
  - Videos will be stored in specific folders for the players to view. For example, Scrums (success) and Scrums (Failure).
- Provide all of the video clips in the folders rather than a select few chosen from my analysis, but rather a selection of videos based on my analysis. Purpose is to enable the players to take control of their learning by providing them with the opportunity to analyze the video. It will also take the burden of choice and time from me.
- Support the team’s immediate performance concerns. This are directly related to what the team is “working on in practice”.
- Develop new methods to involve the players in the PA process. The purpose of this change is to give responsibility to players and take time commitment away from David and me.
  - Players will set and monitor unit goals on a weekly basis
  - Players will create monthly team PA meetings based on their findings
  - Team will pick professional team as a model and work towards “playing like them”

It is interesting to note how our plan reflected promoting player inquiry into their own personally play as well as their increased capacity to perceive more in the patterns of game play. Essentially, the infrastructure that we were developing was designed to cultivate intelligent players who could make better choices as they played rugby.

**Final Impression**

In summary, David and I agreed that we were able to provide consistent and effective PA to the players, although it was sometimes challenging. We also agreed that our ability to change the focus of our PA on a week-to-week basis was a bonus and added to the effectiveness of our PA efforts. This was certainly evident during the team’s playoff run when we were able to change our PA policies to address the strengths and weakness of an upcoming opponent.

Although we incorporated several revisions to the PA methods that I had originally created to analyze rugby games; we still agreed that a NA of rugby gameplay could provide effective insight that could inform a coach’s interpretation of his team’s pattern of play. On several occasions, we were able to reaffirm strategies that the team
was trying to accomplish. For example, a NA of the interactions that occurred during a rugby game was able to inform David of the tactics that the team was using on the first two phases of play after a turnover occurred during one of their matches. We also affirmed that NA could identify the natural interactions that occurred during the game. For example, NA identified that large amount of interactions that occurred between the scrum half (9) and the fly half (10).

We also discovered that NA of rugby gameplay was able to affirm many of David’s preconceived notions of his player’s strengths and weaknesses. For instance, we correctly identified that some of the players on the team were very effective at turning the ball over while some of the players on the team had problems passing to one side of their body versus the other.

Like Carl, David felt that the network visualization was hard to understand. In fact, he referred to it as “the gyro metre” on several occasions and felt that it “was too much for his players”. I was hoping to improve the network visualizations by the end of the case study but time constraints, a lack of interest in using this representation and other priorities preceded this task (see Appendix H for a complete list of the changes that were made to this procedure over the course of this case study).
Chapter 5

The research questions of this study were

How can I develop an understanding of the ways in which a network analysis can enhance coaches’ understandings of their team’s performance?

How can I develop an understanding of the ways in which the use of network analysis can be combined with currently utilized performance indicators to inform a coach’s decisions of their teams’ patterns of play in order to improve their teams’ effectiveness?

How as a researcher, can I work with my participants to develop the use of network analysis in a university elite rugby team?

The NA process was developed and refined with Carl, a professional performance analyst, and then the process was further enhanced as the NA was combined with PA and VA to create an emergent process that was embraced by David an elite rugby coach. The following sections offer the key themes that emerged in this study that addresses how the process of integrating NA in an elite team’s PA was achieved.

Relationships between researcher and participants

The theme ‘Relationships’ addresses the relationships that formed between the stakeholders of this study. This theme is significant because our capacity to develop these relationships benefitted our understanding how a network analysis (NA) of rugby could inform coaches’ ability to understand their teams’ pattern of play.
By incorporating elements of Stringer’s (1999), principles of CBAR into the design of this case study, I was able to create an effective working relationship with the participants that evolved over the length of the case study. This section addresses the working relationships that formed as well as the principles of CBAR that enhanced my working relationship with the participants. This section concludes with a discussion of what is already known in CBAR area of research and how the findings of this case study connected to these CBAR insights.

The diagram below is a representation of the four cycles of research as they occurred during this case study. Although the diagram presents this process in neat and linear fashion, the truth of the matter is that the cycles actually intertwined and intermixed throughout the study. For a more in-depth description of the events that occurred during these phases, see Appendix C and Appendix D.

![Figure 5. The phases of research as they happened during this case study](image)

At the onset of this case study, I would typify my relationship as an ‘outsider’ to the community that both Carl and David represented (Zuber-Skerritt, 2001). My initial impression was that both participants were indulging me by agreeing to be involved in
this study. In fact, I believe Carl said, “I would say that I am slightly optimistic about the possibilities of this project”.

As the study progressed and the participants’ began to get the impression that I was indeed working with them in order to create a ‘legacy project’ and not ‘a one off situation’, I felt a sense of acceptance in “the inner sanctum” (Zuber-Skerritt, 2001). In fact, I would say that my acceptance occurred shortly after Phase 1 in the study because it was at this point that they started asking me about changes that I could make to the NA process in order to suit their needs.

Several of Stringer’s principles of CBAR (1999) that I included in this study were key in developing the relationship that I formed with the participants. These included empowering the participants with significant tasks, involving the participants in the decision and change-making process, keeping the participants needs first, enacting social change and reoccurring cycles of research.

The following is a list of the Stringer’s principles of CBAR (1999) that I employed during the case study along with a brief description of how these principles related to the relationships that I formed with them:

- Empowerment of participants. The participants were equal partners throughout the project. The changes that we made to the NA methodology were a result of our collective interactions. Everyone played an important and meaningful role in the process of change. In fact, without David’s commitment to this project it would have been impossible to proceed with the practical implementation of the NA
methodology because his role as head coach provides him with an ultimate veto to any changes made within the organization policies.

- Collaboration through participation. The participants were actively involved in the decision and change making process. By involving the participants in the development of the PA process it altered the focus of “an outsider” working for their own benefit to “a group of insiders” working collaboratively on a process that would have benefits for everyone involved in the project and possibly the surrounding community.

- Acquisition of knowledge. The benefits of the participants were the motivating factors of this case study as it focused on developing a NA methodology that benefited their teams. They both realized that the effort that we were putting into this project would have mutual benefits as well as a possible benefit for the rugby community. As David put it, “any analysis is good analysis”. In David’s mind, it is always good to have two sets of eyes on the field.

- Social Change. Creating a situation that allowed the changes to occur was paramount to this projects success. Carl and David are considered forward thinkers and are open to accepting new ideas. It is likely that the participants’ openness to the concept of change allowed this case study to proceed as it did. In fact, without their acceptance this case study might have concluded after one round of evaluation and questioning.

- Cyclic Reflection and Evaluation. In conducting this study, we structured routines for a continuous confrontation of the data (Stringer, 1999). Three phases of inquiry
guided this procession: look, think and act. By proceeding through these phases of change, evaluation implementation and re-evaluation, we were able to adapt to the changing needs of the participants’. Although we had a general plan for implementation, we were aware of the fact that we would have to adapt our plan to the constraints that affect the ‘team’ like player availability and time.

In Reade et al., (2008) study on the relationships between a sport scientist and a coach they found that coaches base their coaching practices on information gained from other coaches and sport training clinics rather than on literature created by sports scientists. Reade et al. (2008) also discovered that there were several barriers preventing coaches from seeking sports knowledge from sports scientists. These barriers included the applicability of the information, dissemination of knowledge and restrictions on the amount of time they had to learn new ideas (Reade et al., 2008).

The insight gained from this case study supports their findings. Being able to modify the NA process to suit Carl and David’s needs played a key role in changing the nature of our working relationship. Interestingly, the modifications that we made during this study were similar to the barriers that the coaches in Reade et al. (2008) mentioned in their study such. These barriers included a coach’s ability to understand new or novel information, a coach’s perception of the applicability of new information to their setting and constraints on their time that affect their ability to accommodate ideas that are not deemed an immediate priority. This could suggest that these barriers are critical points that need to be addressed by other researchers wishing to build relationships with coaches like Carl and David.
The Gyro metre

The theme ‘The Gyro metre’ as well as the underlying theme, ‘I know this already’ refer to the importance that both participants placed on being able to provide and receive feedback as well as the changes we made in the NA process in able to adapt to this need.

The theme ‘The Gyro metre’ originated from a comment that David made in regards to his overall impression of the NA visualization. As he stated, “Yes there is a lot there but we can’t show this to the players, it’s just too much at this point, it will just confuse them.” This theme is significant because it answered one of research questions that were developed for this study; notably, how can I form an understanding of the ways in which a network analysis can enhance a coaches understanding of their team’s performance in rugby?

In terms of the network visualizations, both participants found the NA visualization confusing and complicated to decipher. They also found the process of searching for results within the NA findings, confounding. Both participants articulated the sentiment that “you can always find something after the fact” or “it’s like searching for a needle in a haystack”.

Additionally, they considered the NA concepts of betweeness centrality, nodes, ties and page rank, foreign and unrelated to their understanding of rugby even after I tried to explain how the concepts related to rugby game play. Apparently, this is not uncommon as other research has noted the importance of providing appropriate
information to coaches and performers as it is central to improving both individual and team performances (McGarry T., 2009).

Although we made several efforts to improve the feedback mechanics of the NA process, we were never able to develop it to a point where we were comfortable with the visual representation it provided. Instead, we resorted to several other methods of incorporating the NA findings into visual feedback for the coaches and players, which the participants found more useful. In particular using the NA to identify critical patterns of play that could then be replayed as video clips to show emergent patterns of play. Other research has also identified the importance of visual feedback in the coaching process noting the emphasis coaches placed on utilizing video to highlight “in game performance” (Wright, Carling, & Collins, 2014; Groom & Cushion, 2004, p. 57).

‘I Know this Already’

Another minor theme associated with ‘The Gyro metre’, ‘I know this already’ also developed in relationship to the first research question. The participants’ general impression of NA is that it validates what they already know about their team’s performance. Initially, I interpreted this as a weakness of the NA method as I wanted to be able to provide the participants with new or ‘novel’ information about their team’s game play. Eventually, I came to realize that we should consider this finding as a positive as we were able to verify that the NA process can be modified to analyze the interactions in rugby.

By tracking the participants’ reaction to the analysis or their requests for new analysis, we were able to create a list of NA that the participants considered beneficial:
• Analyzing the interactions that occur between players is beneficial to both participants. For example, being able to understand how phase play starts and ends and which player is ‘big’ or ‘small’ (number of ties) is a benefit to the participants.

• Linking player interactions to performance errors. Both participants found it beneficial to be able to link players to turnovers at the breakdown, as well as set pieces and general phase play.

• Focusing on the consequences of action during set pieces and breakdowns. For example, being able to link players to the breakdown and to the subsequent penalties and scores against was considered beneficial to David.

• The ability to link player interactions to mistakes on offense or defense. For example, linking player’s interactions to turnovers, breakdowns, passing, and kick returns was beneficial to Carl and David.

• Linking player interactions to offensive and defensive play. For instance, understanding which player is scoring tries, which players are tackling and which players are missing tackles was a benefit to David.

• Identifying the significance of a high impact player or “star” on their team’s pattern of play was beneficial both participants.

• Scouting opponents in order to analyze their strengths and weaknesses or tendencies in their patterns of play. For example being able to determine an opponent’s tendencies during lineouts was beneficial to David.
• Being able to examine how their team was scored on or how they scored. Both participants found it beneficial to be able to examine the game play that occurs within the 22-metre line in order to understand how their team scored and was scored upon.

• Being able to analyze how players are able to perturb (change) the flow of the game was beneficial to Carl.

The participants’ general opinion of the NA method is that it has the possibility to provide “interesting” information although there is concern over the practicality of its findings. The participants’ main concerns involve their ability to apply the NA findings, based on the networks developed, to a practice setting in order to aid their player’ development. Other studies have similar findings. For example Reade, Rogers, & Spriggs, (2008), found that their participant coaches were less likely to seek out information from scientific journals as they were from other coaches (p.346). They determined that the coaches in their study perceived that the information from sports scientists was not applicable to their situation or that it was too complicated for them to understand (p. 346). They also found that the coaches in their study were more likely to seek out new information from other coaches that they were acquainted with already. Surprisingly this was not due to trust issues, but issues related to time. The coaches in their study thought that it would take too much of their limited time to seek out sports scientists in order to find new sources of information (Reade, Rogers, & Spriggs, 2008, p. 346)
In addressing the first research question, these findings suggest that the underlying principles guiding the NA process are able to affirm these coaches understanding of their team’s performance, but the NA process has to accommodate their other PA needs if it is to be useful in providing analysis that is applicable to their needs. Ultimately, being able to provide the participants and players with effective feedback that can improve their team’s performance is ‘the bottom line’ for the success of this Network Analysis Performance Analysis (NAPA) method.

**Pre-Conceived Notions**

This section addresses the theme ‘Pre-Conceived Notions’ that relates to the participants’ preconceived impressions of PA. This theme is significant because it aided in the understanding of the first research question; how can I develop an understanding of the way is in which a network analysis can enhance a coaches understanding of their teams’ performance in rugby?

The theme ‘Pre-Conceived Notions’ developed concerning the participants’ impression of PA. By forming an understanding of the ‘normal’ processes and procedures that the participants utilized, we were able to create a framework for our use of the NA process. Although it was generally necessary to work inside of the confines of their PA framework, I found that the participants were open to considering ‘new’ forms of analysis when the time or situation permitted. The theme ‘Pre Conceived Notions’ contains several sub-categories including the following:

- ‘Player development’- Both Carl and David utilized performance analysis to assist in the process of player development throughout the entire season. Carl is a full time
analyst so it is expected that the majority of his workday is spent attending to PA. David, on the other hand, spends between 2-3 hours a week analyzing video. These findings are similar to those of Magwa (2015), who also found that university coaches spend about two to four hours of analyzing video after a game and another two hours post-match analysis (p. 79). David often referred to the use of PA as a tool to develop his player’s confidence. David was very concerned about keeping the message we were providing “positive for the players”. Carl did not worry about this as much as David did. This might have been because he acted as a filter between the analysis and the players whereas the information I was providing David was intended to be consumed directly by the coaches and players.

- ‘Individual skills’- Both participants utilize performance analysis to break down and focus on certain aspects of an athlete’s technical and tactical ability.

- ‘Set pieces’- relates to the participants’ use of PA to analyze scrums, lineouts, kick restarts and set plays. Both participants indicated that they utilize performance analysis during particular phases of the game such as, lineouts, scrums, set plays, kick restarts and kick coverage to evaluate technical and tactical skills of their team. Additionally, they also indicated that they utilize PA to analyze their opponents’ ability to perform set pieces as well.

- ‘Game situations’- relates to the analysis of situations that occur during phase play like 1v1, 2v2, 3v3 or overlaps situations like 2v3. Carl and David utilize performance analysis to look at certain game situations such as one-on-one, two-on-
two or overlap situations when something went wrong, when something needs improving or to serve as a future reference.

- ‘Defensive play’- relates to the use of PA to analyze the defensive play that occurs during rugby gameplay. Both participants analyze their team and their opponents while they are on defense. This analysis includes their patterns of play, their ability to maintain "defensive shape", defensive positioning as well ability to contest at the breakdown. They also evaluate their teams and their opponents’ ability to defend against set pieces and other game situations. Both participants also analyze their opponent’s player rosters in order to determine individual strengths and weaknesses.

- ‘Offensive play’ relates to the use of PA to analyze the offensive play that occurs during a game of rugby. Both participants evaluate their team’s offensive play. This includes phase play, set pieces, passing, and kick coverage. Both participants also utilize PA to evaluate their opponent’s offensive capabilities. This includes phase play tendencies, set plays, set pieces, and kick coverage. Likewise, both participants analyze their opponent’s player rosters to search for strengths and weaknesses across their playing groups.

- ‘Planning’ addresses the participants’ use of PA in aiding their organizations in short and long term planning. Carl as a national coach utilizes PA to perform both short and long term planning. PA also plays a key role in their organizations’ ability to set and maintain performance goals over the duration of a season. David on the other hand, utilizes PA mainly for short term planning. This primarily involves a cyclic process that includes a PA of match video, an evaluation of the findings, planning
for practice, practice, and then competition. Several constraints prevent David from utilizing PA for long term planning including: time for analysis, player availability, an awareness of their opponents’ player roster and availability of match video.

The participants ‘pre conceived notions’ regarding PA are likely results of their coaching philosophies. It has been identified by others that a coach’s use of PA is highly influenced by their philosophy towards coaching (Groom, Cushion, & Nelson, 2011, p. 57). In their study Groom et al., found that the coaches philosophy was “central to the construction and delivery of PA”. This included the timing and style of content, the technical or tactical focus of the PA session as well as the tone that was utilized with the athletes (positive or negative) (Groom, Cushion, & Nelson, 2011, p. 57). Like the coaches in this study, Groom et al., found that their participants’ developed a philosophy of trying to create a positive learning experience for the players while at the same time trying to provide them with the information that they required in order to improve on their previous team and individual performances (Groom, Cushion, & Nelson, 2011, p. 57).

Ultimately, being able to modify the NA process to the meet the participants’ needs was an overriding factor in our ability to create and provide ‘applicable’ analysis during the case study.

I Want to Look at That

This section addresses the theme ‘I Want to Look at That’ which refers to both participants need to look at video alongside the NA findings. This theme developed in
relation to the first research question; how can I develop an understanding of the ways in which a network analysis can enhance a coaches understanding of their teams performance in rugby? By providing a means for the participants to analyze the NA findings alongside the match video, we were able to enhance the effectiveness of the NA process.

Both Carl and David indicated the importance of reviewing the match video in order to confirm the analysis and develop performance solutions. Their need to affirm the analysis with match video is common amongst coaches. For instance, Magwa (2015) noted the importance coaches’ place on viewing PA findings indicating, “it helps the coaches explain what aspects of a performance were executed well as well as those that need to be improved in future performances”(p.31). When I questioned David about his need to ‘look at it’ he indicated that it was important for him to be able to verify the analysis because there have been cases where analyst “have got it wrong” in the past.

The following model reflects the theme “I Want to Look at That” (Figure 8). As I mentioned above, both participants relied upon video analysis to confirm the findings of the NA. The participants expressed this sentiment while evaluating players, evaluating opponents, evaluating performance issues addressed in practice, supporting analysis that did not make sense and while re-affirming analysis that did make sense.

In addressing the first research question, the results from this study suggest that performance analysts and coaches, like those in this case study, require video feedback if the NA process is to be considered informative.
Figure 6. The categories related to the theme 'I Want to Look at That'

This theme speaks to the need to translate the patterns that emerge in a NA over time to events that happen in the game. In a way a bit like the Matrix movie where information streams down the screen that can be interpreted at a different level by Neo, the performance analyst coach translates the NA to then offer verify information with a video clips or sequence of video clips.

A Change in Focus

This section addresses the theme ‘A Change in Focus’ which developed in relationship to the second research question which is how can the use of NA be combined with currently used PI in order to inform a coach’s decision on their team’s patterns of play? The theme ‘A Change in Focus’ originated during a conversation I had with David in which he mentioned that the ability to adapt the analysis process to a team’s changing needs “is a benefit of process we developed”.
The ‘Change in Focus’ or modifications to the process that occurred throughout the duration of the case study resulted from various ‘work cycles’ as well as the constraints that they created. This adapting process played a major role in determining the needs of the participants. Factors such as (1) player availability, (2) video availability, (3) video quality, (4) opponents, (5) importance of the upcoming contest, and (6) time available for analysis, all influenced the needs expressed by the participants.

During this case study, we were able to adapt the NA process to focus on the strengths and weakness of the participants’ team as well as the strengths and weaknesses of their opponents. We were also able to modify the methodology to analyze pathways to success as well as the manner in which their opponents were able to prevent their team form being successful. Finally, we were also able to alter the process in order to analyze the consequences the teams’ actions as well as the consequence of our opponents’ actions as charted in Figure 8.

Changing the focus of their analysis is common amongst other high-performance coaches in rugby. In a recent study, Magwa (2015) found that there was a high degree of flexibility in the coach’s selection of PI from game to game (p.81). Magwa (2015) also determined that “subjective analysis still plays a critical role in the coaches’ analysis of performance” (p.81).

The participants in this study also relied upon their own judgement to select the PI that they were utilizing to evaluate their team’s performance. In some cases, the team’s upcoming opponent determined the choice of PI that we tracked while in others;
it was the technical issues that affected the team’s performance that influenced their choice of PI. For example, David would often place special emphasis on analyzing our effectiveness at executing set pieces if we knew our upcoming opponent was strong in that area of play.

In reference to the research question, these findings suggest that being able to adapt the NA process to include PI that are relevant to Carl and David’s needs is a benefit of the NA process we adopted. We also discovered that being able to change the NA process to incorporate new PI’s based on different time cycles for the participants’ teams was a benefit.

Figure 7 the categories and codes related to the theme 'Change in Focus'
As shown in Figure 9 the NA process was enhanced by our ability to incorporate elements of PA as well as our ability to change the focus of our analysis to suit the changing needs of the participants.

**The Inverted Triangle of Analysis**

Figure 10 shows a ‘consensus model’ of the PA process in practice that evolved through constant discussions with the participants.

![Inverted Triangle Diagram](image)

*Figure 8 a proposed model of analysis detailing the process of PA that occurred during this case study.*

In particular, this model evolved from the themes evident during my practical experiences with David. Fundamentally, this model describes a linear process in which the coach expresses a general tactical concern to the performance analyst. It is likely at this stage of analysis that the coach’s concern arises from a ‘gut feeling’ or some other form of subjective analysis. Then the performance analyst interprets the coach’s needs,
reviews previous match videos, and creates several technical or tactical summaries that inform the coach of the basic issue of concern. The analyst then supplies match video to support the findings. The coach reviews the data and decides if the analysis “makes sense”. Then the coach determines if the issue is a priority for the team and if there is something that can be done in order to solve the problem within the confines of their team’s practice structure. If the answer is yes, the performance analyst provides the coach with feedback that the coach can present to the athletes and other coaches. If the coach feels the issue is not a priority, or that there is not enough time to address it in practice, then it is likely that it will be put on a ‘back burner’ to be evaluated at a later date. This is likely dependent on the influence this issue has on the team’s overall performance. If over time, it becomes apparent that this issue is having a significant impact on the team’s performance then it is likely that the coach will look at the analysis again with the analyst or seek outside advice on how to solve the issue.

Several factors related to the creation of this model inform the second research question; how can the use of NA be combined with currently utilized PI to inform a coaches’ decision of their team’s pattern of play in order to improve their team’s effectiveness? First, the model identifies that coaches still rely upon ‘subjective data’ to inform their coaching decisions. This is consistent with elite rugby coaches as other research has also shown that subjectivity plays a key role in how elite coaches select the PI’s they utilize to monitor performance in rugby (Magwa, 2015). This model also identifies that, in the context of my relationship with David, the coach is the main stimulator for analysis as others have indicated (Wright, Carling, & Collins, 2014, p.
723). This is mainly due to his experience, but also to the fact that he has the ultimate say on how performance issues are addressed within the team. Finally, this model illustrates the important of a “shared mental model” (p. 730). Through our work together, I have learnt what David is likely going to want to ‘look at’. I have also started to get a feeling for what he is going to find important, what he can address during practice and what is going to be a priority based on the cycles the ‘team’ is going through.

**Proposed Interface**

In this final section I present, an interface for a program or app that maintains all of the features we considered beneficial to the NA process along with improvements to those features that we classified as limitations. The design of this interface is based on the data that I collected from my experiences with Carl and David, as well as data collected from my own reflections. Figure 10 provides a representation of this interface’s main panel. Within this panel, the user would be able to analyze and enter data while referring to match video.
Figure 9. A proposed interface representing combined findings of Carl and David during this case study.

If possible, the interface would incorporate a touch screen but would also allow for pointer devices if necessary. There would also be the option to create ‘hot-keys’ to allow for easy access to commonly utilized commands. This feature would be located within a customization panel related to each command. The ‘hot-key’ adaptability is essential part of this interface because ‘hot-keys’ allow the user to code video quickly without having to look away from the screen. The interface would work across several operating systems, which would help teams that have multiple computers running different operating systems.

The section on the right hand part of the interface would provide video and scrolling options. This feature would allow users to advance through match video frame by frame if they found it necessary.

The data entry panel on the bottom of the interface would allow the user to link the players or player units to PI or other forms of analysis. This panel would be fully
customizable to suit the users need. There would also be an option to make corrections
in this panel as well as the ability to review previous entries.

The panel on the left of the interface contains the player nodes or team unit
nodes. It would also be fully customizable. In this panel, the user would be able to link
the players or player units to the analysis in the middle panel. On the bottom part of that
panel, there are three tabs, which would allow the user to enter or receive data for a
single game, a season, or throughout one tournament. This would also be adaptable to
the user’s needs.

The tabs on the top of the interface would provide access to sub panels. These
sub panels would provide a space for the users to focus on issues that they had
predefined as important. For instance, in tab 5, the user would have an option to focus
on lineouts. Within this tab, there would be a graphic summary of the lineout analysis
created by the user. This tab would allow the user to refer to match video in order to
support the analysis that they were reviewing. It also provides users with the option to
look at the network visualization that formed through the analysis. The user would also
have the option to look through all of the network data, or at a specific event.

The final tab labeled YouTube contains the media creation and media sharing
features. This panel would provide the user with the option to manage video, create
video feedback, merge video feedback with infographics, as well as provide an option to
upload video to a media sharing service of their choice. It would also have a function to
share the video summaries with other coaches, analysts and players on the team.
In summary, this interface is a representation of my experience working with Carl and David during this case study. It also represents my experience functioning as PA for David during the latter portion of the case study. The data that informed the interfaces design is based on these experiences. Although it is purely a concept at this point, it is possible that this information has the potential to serve as a catalyst for future software developers looking to create PA software for coaches, performance analysts or athletes.
Conclusion

This study sought to understand how the application of a network analysis could inform a coach of their team’s patterns of play in an effort to aid their team’s performance. The study used open-ended interviews, where the meanings around participants’ experiences were co-created using my first-hand knowledge of the sport of rugby as well as my relationships that formed with each participant. The study utilized inductive reasoning through a process of evaluation and constant comparison as a guiding framework to allow categories and themes to develop.

The narratives within this study are not to be understood as generalizable results. Each narrative was unique to the particular participant and provided a window into their lived experiences. My hopes in portraying the results as narratives was to uphold their emotion, merit, insightfulness, and authenticity, in order to enhance the reader’s affinity to each participant.

This study made five major findings in relationship to the research questions. First, the findings of this study suggest that incorporating elements of community based action research into the design of a case study provided the researcher with an opportunity to build effective working relationships with Carl and David. These principles included empowering participants, providing participants with significant tasks, collaboration through participation, acquisition of knowledge, social change and cyclical reflection and evaluation. Through these relationships, it became possible to dissolve barriers that would normally prevent coaches from seeking knowledge from sports scientists. Specifically, it was identified that these barriers included; their
impression that the information was not relative to their specific situation; their impression that the information did not meet their specific needs and finally; that the information they were providing was not practical. In answering the third research questions, the findings of this study suggest that the implementation of several of Stringer’s principles of Community based action research into the design of a case study provided me with an opportunity to build effective working relationships with Carl and David. Through these relationships, it became possible to dissolve barriers that would normally prevent coaches from seeking knowledge from sports scientists. These findings also suggest that it is possible that an implementation of CBAR by other researchers could help reduce the barriers that have prevented other sport scientists from working with coaches like those in this study.

Second, two major themes “The Gyro metre” and “I know this already” developed. These themes were related to the importance that both participants placed on being able to provide and receive feedback as well as the changes we made in the network analysis process in able to adapt to this need. The theme ‘The Gyro metre’ originated from a comment that David made in regards to his overall impression of the network analysis visualization. As he stated, “Yes there is a lot there but we can’t show this to the players, it’s just too much at this point, it will just confuse them.”

In relation to the second research question, how can NA be combined with currently utilized PI, these findings suggest that providing coaches with effective feedback that can inform them of their player’s performance is critical to the performance analysis process. In order to accomplish this task, the network analysis process needs to
incorporate elements of other forms of performance analysis. Ultimately, the findings of this study suggest that being able to provide the participants and players with effective feedback that can improve their team’s performance is ‘the bottom line’ for the success of this Network Analysis method.

Third, a theme ‘Pre-Conceived Notions’ was identified. The theme ‘Pre-Conceived Notions relates to the participants’ preconceived impressions of PA and developed from a code I had used to identify the participants initial impression of PA. By forming an understanding of the ‘normal’ processes and procedures that the participants utilized, we were able to create a framework for our use of the Network analysis process. Although the findings of this study suggest that it was generally necessary to work inside of the confines of the participants PA framework, I did find that the participants were open to considering ‘new’ forms of analysis when the time or situation permitted. In terms of the first research question, how can network analysis be combined with other forms of performance indicators; my findings suggest that modifying the network analysis process to meet the participant’s needs was an overriding factor in our ability to create and provide applicable analysis during this case study.

The nest finding is related to the theme ‘I Want to Look at That’ which refers to both participants need to look at video alongside the NA findings. This theme developed in relation to the first research question; how can I develop an understanding of the ways in which a network analysis can enhance a coaches understanding of their teams performance in rugby? My findings suggest Performance analysts and coaches,
like those in this case study, require video feedback if the network analysis process is to be considered informative.

The next finding ‘A Change in Focus’ developed in relationship to the second research question which is how can the use of NA be combined with currently used PI in order to inform a coach’s decision on their team’s patterns of play? The theme ‘A change in Focus’ along with the three sub-themes: ‘Strengths and Weaknesses’, ‘Pathways to Success’ and ‘Actions and Consequences’ was the next finding of this study. The sub themes relate to the policies of our analysis process that we altered in order to meet the needs of the coaches as well as the team. In relationship to the second research question, the findings of this study suggest that creating a PA process that was adaptable to the coaches changing needs as well as the time cycles that the team proceeded through, was considered a key benefit of the NA process that we developed.

In addition to these findings, I was able to develop a model of the performance analysis process that we utilized during this study. This model highlights a process in which a coach initiates performance analysis based on a ‘hunch’ or some form of subjective analysis. Through a process of evaluation and refinement of the PA cycle, the coach and performance analyst provide visual feedback to their players with the ultimate goal of improving their overall performance.

**Recommendations**

During my role as a researcher and an analyst over the duration of this study, I was able to get a feeling for what I needed to improve my efficiency while analyzing match data and creating feedback that I could provide to Carl and David. During this
seven-month period, I was able to develop a concept for a user interface for a program or application. This program would maintain all of the features we considered beneficial to the NA process along with several improvements to those features that we classified as limitations. The data that I collected while working with Carl and David influenced the design of this interface. Although it is purely a concept at this point, it is possible that this information has the potential to serve as a catalyst for future software developers looking to create PA software for coaches, performance analysts or athletes.
Bibliography


http://www.longomatch.org/


https://nodexl.codeplex.com/


Appendix A: Participant Consent Form

Quantifying the Individual and Group network Dynamics of a Rugby Sevens Team

You are invited to appear in a study entitled Quantifying the Individual and Group Network Dynamics of a Rugby Sevens Team that is being conducted by Patrick Carr.

Patrick Carr is a Graduate Student in the department of EDCI at the University of Victoria and you may contact him if you have further questions by phone at 250-478-8747 or by email at otismilo0123@gmail.com.

As a Graduate student, I am required to conduct research as part of the requirements for a degree in a masters program. It is being conducted under the supervision of Dr Tim Hopper. You may contact my supervisor at 250 721 8385.

Purpose and Objectives

The principle purpose of this research project is prepare a study based on the development of a visually based feedback system for rugby sevens coaches. As a secondary goal is to create a video that focuses on the development of skill and how coaches and teachers are using video analysis and feedback to inform their coaching decisions and aid the
development and skill of their athletes. The research question that I am attempting to answer is “How does video …”.

**Importance of this Research**

Research of this type is important because technical advances and cost reductions have made the use of video analysis and feedback tools readily available to the public. Our objective is to provide student teachers and coaches with an informative inquiry into the topic of visual analysis and feedback so as to inform and refine their current practices.

**Participants Selection**

You are being asked to participate in this study because you are a participant of this rugby camp and are interacting with a coach during the camp.

**Benefits**

The potential benefits of your participation in this research includes the refinement of coaches, teachers and athletes understanding of the use and benefits of visual analysis and feedback systems currently available to the public. The final video, and findings, at your request, will be shared with you for feedback and discussion.

**Voluntary Participation**

Your participation in this video must be completely voluntary. If you do decide to participate, you may request to withdraw your segment from my video at any time without any consequences or any explanation. If you do withdraw from the study your data will destroyed.
Researcher’s Relationship with Participants

The researcher’s relationship to potential participants is purely professional. To help prevent this relationship from influencing your decision to participate, the following steps to prevent coercion have been taken

You can withdraw from the project at any time by contacting the researcher or the course supervisor

Anonymity

In terms of protecting your anonymity in any papers or presentations made in relation to data collected in this project your name will be changed and any descriptions identifying you or people related to you will be change to project your anonymity.

Confidentiality

Your confidentiality and the confidentiality of the data will be protected by any recorded data being stored in a locked filing cabinet. Any typed data will be held in a password projected computer storage device.

Dissemination of Results

It is anticipated that the results of this study will be shared with others in the following ways in class presentation for graduate class “EPHE585 Qualitative research genres applied to education, health and society” and a final report written for the class and read by the course instructor. Furthermore, the data from this research will be included in a video focusing on coaches and teachers use of video analysis in their practice.

Disposal of Data
Data from this study will be disposed of 6 months after the course requirements have been complete and marks have been posted. A video will be posted on YouTube as a permanent tool to help inform teachers and coaches about the topic of video analysis and feedback systems.

Contacts

Individuals that may be contacted regarding this study include Patrick Carr. Dr Tim Hopper, course instructor and research supervisor – 250 721 8385 or e-mail thopper@uvic.ca

In addition, you may verify the ethical approval of this study, or raise any concerns you might have, by contacting the Associate Vice-President, Research at the University of Victoria (250-472-4545).

Your signature below indicates that you understand the above conditions of participation in this study and that you have had the opportunity to have your questions answered by the researchers.

________________________  ______________________  ________________
Name of Participant       Signature                   Date

A copy of this consent will be left with you, and a copy will be taken by the researcher.
Appendix B: A Time Table Summarizing the Events, Carl

1. Develop a network analysis based methodology for analyzing rugby.
2. Code two rugby games to apply methodology
   a. Refine methodology based on the first attempt at coding
3. Approval from ethics committee received September 15/2014. Recruitment of Carl and David achieved.
4. Initial presentation made in Carl’s office, September 22, 2014
   a. Refinement of methods necessary to match Participants 1's focus and methods
   b. Need to minimize handling of data to reduce possible errors
   c. Calum provides data from coded games to ensure consistency in data
   d. Change of focus to analyze scoring attempts on offense and defense
   e. Refine coding methods to comply with Carl's standards.
   f. I want to look at that-Need to provide visual support for network finding
   g. A new series of current games analyzed based on Carl's area of interest in an effort to increase sample size of data.
   h. We will look for extreme examples of KPI to verify NA usefulness and accuracy
5. Re-Evaluation meeting in Carl’s office with Carl, October 01, 2014
   a. Provide focus to network presentation
      i. It is to convoluted to make sense of the data
      ii. Need to improve visual representation of data
         1. We want the visualization to represent Fewell et al.
         2. Communication
         3. Improve my understanding of Carl’s coding methods so that we do not need to rely on his data sets.
6. Final Evaluation: A new series of games will be analyzed based on Carl's area of interest, Carl’s Office, November 03, 2014
   a. Scout a key opponent through two tournaments worth of games (10 games).
      i. How they score through their use of perturbations
      ii. Who is the key impact player on their team and how do they score
      iii. How does their opponents scored by using perturbation attempts
      iv. Which player is able to score the most against them and how are they able to score.
      v. Develop a new set of methods to analyze perturbation attempts
      vi. Link Findings to video
      vii. Develop a database to track NA findings over a period of 10 games
viii. Develop a visual based personation method to report the findings to Carl. Consider Carl's time restrictions.

7. Several Informal discussions via email or phone correspondence November 01, 2014 until April 01, 2015.
Appendix C: A Time Table Summarizing the Events, David

1. Meeting 1 in David's Office, December 05, 2015
   a. Initial inquiry into perception of performance analysis and network analysis
   b. Results: Modify current NA procedures
   c. Change in methods needed to accommodate David’s analysis needs, and methods
   d. Change in focus needed to accommodate David’s analysis needs
      i. Change in focus to basic rugby principles
      ii. We need to refine the focus of the PA and eliminate the redundant and non-essential analysis.
      iii. Link analysis to video
      iv. Evaluate a set of current games based on modified methods and focus

2. Meeting 2 in David's Office, December 12, 2015
   a. Evaluate analysis
   b. Increase focus
   c. Modify coding methods
   d. Make the graphics representing the network findings easier to understand
   e. Create a presentation for the entire team
   f. Focus on David's key areas of interest
      i. Breakdowns
      ii. Set Pieces
      iii. Lineouts
      iv. Scrums
      v. Restarts
      vi. Scoring opportunities
      vii. Phase Play during scoring opportunities
      viii. Focus on consequences of actions taken by the players
      ix. Increase knowledge of tactics, strategies and coaching points used by David

3. Practice Attendance with David, Practice Field, January 12, 2015
   a. To develop and understanding of what a practice entails
   b. To understand how the teams practices reflect the interests expressed by David

   a. Purpose was to evaluate the possibility of purchasing new software and hardware for performing VA and PA.
b. We wanted to update our analysis process by improving the quality of the video and software we were using.

c. We decided that the cost and ease of use of new software and hardware were restrictive to their implementation. We would find alternative methods.

   a. Meet the players and other coaching staff
   b. Observe Current VA policies and procedures
   c. Observe players reaction to VA

6. Meeting 5 in David's Office, January 16
   a. Develop a VA presentation for coaches and players
   b. Select game footage to best match analysis
   c. Develop a format for the meeting
   d. Meeting lasts 9 Minutes
   e. 2 good points for every one bad point
   f. Keep the analysis basic
   g. Keep the feedback positive
   h. Provide feedback for forwards and backs
   i. Team Meeting with David, Coaching staff, and players in Team Room, January 17, 2015
   j. Provide analysis to coaches and players based on previous meeting

7. Evaluation Meeting with David and coaching staff, January 17, 2015
   a. Evaluate team meeting
   b. Develop new PA policies and procedures based on the discussion
   c. Getting Players on the same page
   d. We had to consider the limitation of David's Time, the player’s as well as the Researchers Time
   e. Making the coding process more efficient
   f. Making the process of selecting video representations of the data less time consuming
   g. Player engagement vs time on the field
   h. Improving the focus and visual representation of the analysis
   i. Creation of You-Tube Channel, February 02, 2015
      i. Minimize David's time commitment
      ii. Players can access the PA at their own time
      iii. Players can view what they are interested in
      iv. Create a Playlist of videos reflecting the team’s performance needs for the week.
      v. A new play-list structure developed to store sorted videos.
   Individual folders with labels based on the competition’s date and opponent so the videos are easy to access.
vi. Develop Traffic light to focus players on current performance issues

vii. Players will provide feedback on the videos based on the performance issues for that week.

j. Possibility of evaluating players with pre-existing criteria.

8. Meeting 5 in David's office, April 07, 2015
   a. Evaluate You-Tube Channel, traffic light and PA methods
   b. Findings
      i. Include all of the video breakdowns for players to view
      ii. Improve the sorting system to make it easier for the players to find the video they need
      iii. Improve communication with David
         1. Traffic system is redundant as David already produces a weekly summary of performance issues. My PA should address this summary.
         2. David is not concerned with players providing feedback on the You-Tube site. They already have enough to do.
         3. Positive feedback from David and players. Players are getting good use out of this service.

9. Meeting 5 with David, Pre Championship Meeting, David's office, April 21, 2015
   a. Modify PA methods to focus on one opponent
   b. Increase PA available to team and coaches
   c. Final Meeting in David's Office Clarification Meeting and Plan for Next Year, Coffee shop, April 29, 2015
   d. Maintain existing YouTube channel format
   e. Team will set goals and monitor using PA
   f. Use video to reinforces a point and introduce new ideas to the players
   g. Positives
      i. Able to accommodate changing focus during the season
      ii. Free analysis software and storage solution
      iii. Analysis on a weekly basis
      iv. Visual representations of analysis
      v. Time savings for David
      vi. Players have access to coded video
   h. Constraints
      i. Video quality
      ii. Access to video
      iii. Software
         1. Linking NA to video
         2. Storing and analyzing data from an entire season
3. Maintaining network data over an entire season
4. Maintaining the integrity of the networks over a game and entire season
5. Visual feedback
   iv. Computer compatibility
   v. Making time for the analysis
Appendix D: Team PA Meeting: Feedback Mechanics

This meeting established the processes David normally utilized to provide PA to his players.

Purpose of PA:

Providing feedback to the players in order to develop a player’s skill and improve overall team effectiveness.

Duration of the meeting:

David provides his players with a three-minute video clip for the players to view. The meeting lasts twenty minutes. Ten of those minutes are spent addressing performance analysis.

Time of feedback:

Video feedback in the form of a three-minute segment of video taken from a competition that occurred 4 days prior to the meeting.

Purpose:

During the first portion of the meeting, David and the players address a tactical situation that confounded them during a previous game. The purpose of the activity is to address the situation and develop alternative strategies to utilize in future performances. During the second part of the meeting, David provided scouting details on their opponent’s strengths and weaknesses.

David selects these performance issues based on the coaching staff’s ability to address them within their practice structure.
Format:

David utilizes the concept of consequences and actions to guide his discussion with the players. The meeting contains three segments; with the first portion of the meeting addressing office matters, the second, performance analysis, and the last portion of the meeting addressing the days practice and upcoming games.

Flow of information and form of feedback:

The flow of analysis during the meeting is generally linear. David guides the discussion. He addresses the player’s choice of strategy, and suggests alternatives that would be more effective in a similar situation. The players engage in constructive dialogue with David in regards to the implementation this strategy in future games.

David provides the players with PA during the remainder of the meeting. David selects the points of analysis based on an evaluation of his opponent’s prior games and his knowledge of their roster and his understanding of tendencies in their patterns of play.

David relies primarily upon corrective feedback during this portion of the meeting. In some cases, he utilizes positive feedback to reinforce effective gameplay. He avoids the use of negative feedback because his aim was to maintain a positive message during the meeting. He provides feedback to the team as a whole and at player units. He avoids directing feedback to individual players during the meeting.

While providing PA to the players David focused on:

- Discussing their opponents impact players
• Discussing their opponents set pieces
• Discussing their opponents patterns of play
• Discussing their opponents strengths and weaknesses while on offense
• Discussing their opponents ability to contest at the breakdown

Positives:
• An opportunity to provide the team with video feedback
• Engaging with the team in problem solving dialogue
• Support effective demonstrations of technical ability.
• An opportunity to highlight ineffective displays of technical ability.

Negatives:
• 3-minute match video lacks focus
• Much of the analysis lacks visual support. David provides most of the feedback to the players verbally.
• The meeting takes time from the player’s ability to put their “boots on the field”.
• Is the meeting an effective use of time for all the players? There is a question over how many of the players are actually engaged in the content during the meeting.
Appendix E: Team PA Meeting 2: Feedback Mechanics

Combining NA with PI and Focused Video Clips in order to provide the players with PA. Will it be useful to do this with the players on a regular basis?

Duration:

The meeting lasts 20 Minutes. The meeting is broken into halves. The first half is dedicated to PA the second half is dedicated to office matters and practice preparation.

Purpose:

The purpose of the meeting is to provide PA to the players and coaches in the form of focused visual feedback. There are several performance related issues affecting the team's effectiveness and David wanted to address them through video feedback and PI.

Duration of feedback:

The Researcher creates feedback by analyzing a game with Longomatch and NA and then creates focused video clips based on that analysis. The game occurs 4 days before the meeting. The duration of the meeting is sixteen minutes although it was only expected to last nine minutes.

Format:

David and the Researcher create a series of focused video clips which focus on performance issues identified through NA and PA in a previous meeting. The researcher presents a series of focused video clips to the players. The Researcher as well as David
and the assistant coaches provide well timed prompts during the meeting to engage the players in constructive dialog.

Flow of information:

The Researcher and David guide the flow of information. The players have opportunities to engage in constructive conversation with David as well as the other coaches. The assistant coaches also engage in constructive conversation with the researcher in regards to the feedback they are receiving. At the end of the meeting, David provides a tactical problem for the players to solve. David leads the conversation during this portion of the meeting.

Type of Feedback:

The primary form of feedback utilized during the meeting is positive and constructive. Each video clip is designed to present 3 effective examples and 1 that is ineffective. The focus of the feedback is to reinforce the effective displays and engage the team in constructive conversation over how to address the one ineffective display. The Researcher, David as well as the assistant coaches direct feedback to the team, player units and individual players. The team and team units receive positive feedback as well as constructive feedback whereas individual players primarily receive positive feedback.

Topics covered:

The focus of this information was to provide the players with feedback on several technical issues that were hampering the team’s performance including:
• How they scored including patterns of play and players responsible for scoring

• Scrums and lineouts, were they effective or not, consequences of scrums and lineouts breakdowns, who was involved, if they were effective or not, consequences of breakdowns

• Kick restarts, who was involved, consequences of kick restarts

Positives:

• Focused video clips

• Longomatch provides the ability to forward and rewind video clips frame by frame or clip by clip in able to add detail to the analysis.

• Longomatch provides the ability to look at things not covered in the analysis

• Longomatch provides the ability to provide a statistic overlay to reference during the meeting

• Longomatch is free

• Minimizes David’s time commitment to creating the video

• Provides coaches and players with PA

• Engages the players and coaches in constructive conversations

• Address team goals

• A focused message. General impression that the amount of time was just right.
Negatives:

- Getting all of the players on the same page. Not all of the players can be at the meeting on a regular basis.
- NA visualization is too convoluted to be used during this meeting.
- Creating a regular time for the meeting is impossible. There won’t be time for a meeting over the next month because the team is getting ready to go away on a tournament and then preparing to play in a sevens tournament when they get back.
- Player engagement. There was a question over how useful the meeting was for most of the players that attended. David felt that many of the players would have been better served with their “boots on the field”.
- A risk that meeting on a regular basis would overload the players with information “Paralysis by analysis”.

Appendix F: YouTube Channel: Feedback Mechanics

Purpose:

Develop a system to provide players with weekly analysis without taking their boots from the field. Minimize the amount of time David's has to commit to performing PA. Minimize the amount of time the Researcher has to commit to performing PA.

Type of Feedback:

The Researcher utilized video clips taken from the previous week's contest. Longomatch is utilized to code the videos and create focused video clips and Na. The YouTube playlist contains a full copy of the game as well as focused video clips arranged in "effective" and "ineffective" folders. The effective folder is located before the ineffective folder in the playlist in order to emphasize the effective skill and send a positive message to the players.

The players are provided with access to the playlist. They are expected to analyze the content of the playlist before the upcoming game.

The playlist is designed to send a positive message to the player although there is the potential that the message may be taken negatively by some of the players. The playlists are titled effective and ineffective. The effective folder is positioned before the ineffective folder. Players have the opportunity to view whatever analysis they are interested in.

Topics Covered:

The researcher has a standard list of items to include in the playlist including:

- Set Pieces
173

- Lineouts
- Scurms
- Kick restarts
- Breakdowns
- Scoring Opportunities
- Defending against opponents scoring opportunities
- Consequences of action
- Special plays that are of note
- Kick coverage

David may include variations in this list based on his perception of the teams needs for that week. On some occasions, David may ask for a scouting report on an upcoming opponent.

Flow of information:

The flow of PA is linear. David's needs determine the form of PA that will be supplied to the players. The players have access to PA on their own time 24 hours a day, seven days a week. They have the possibility to discuss the PA amongst each other and with the coaches, which creates a later flow of information.

Positives:

- Provides weekly PA to the coaches and players
- Provides focused feedback to the coaches and players
- Provides a positive message to the coaches and players
- Provides the coaches and players with PA on upcoming opponents
- Allows David to create game plans for upcoming opponents
- Allows the coaches to analyze performance goals throughout the season
- Minimizes the amount of time David needs to spend performing PA
- Players receive PA but do not have to take "their boots off the field".

Negatives:

- Quality of video effects the ability to perform analysis
- Quality of video effects the message presented in the video clips
- The researcher has to perform two forms of analysis which takes time
• There is not an official method for the coaches to clarify the player's understanding of tactical situations.
• There is not a method to check on the players to ensure that they are watching the videos.
• There is not an official method for the players to engage with the coaches in constructive conversation of tactical issues.
Appendix G: The Development of the Video and Network Analysis Methodology Utilized during this Case Study.

Before my first interview occurred with Carl, it was necessary to determine if it was possible to adapt the method of NA to study the interactions that occur during rugby game play. Fortunately, I had a model to work from as researchers like Fewell et al., (2012) and Passos et al., (2011), have successfully adapted the NA method to other territory invasion games like basketball and water polo. Therefore, I postulated that it would be possible to adapt their methods in order to analyze rugby. I was especially interested in the work of Fewel et al, (2012), because of their ability to create an effective visual representation of basketball gameplay as shown in Figure 10.

![Network Analysis Diagram](image)

Figure 10 A summary of NBA Passing Networks modified from Fewell et al., (2012)

I was also interested in the work of Passos et al., (2011) because of their ability to modify the NA process in order analyze the interactions that occurred during the sport of water polo as shown in Figure 11 below.
The next step of this process was to adapt the methods that Fewell et al., (2012) and Passos et al., (2011) had previously developed in an effort to create my method of analyzing rugby with NA. I utilized the IRB’s Beginners Guide to Rugby Union (Webb, 2008) as well as information from the article Performance indicators in rugby union by Mike Hughes et al., (2012) as a foundation to support my modifications and to base my analysis on.

I found that adapting NA to analyze rugby was not the simple process as I hoped it would be. Two teams of fifteen players, thirty athletes in total, compete on the field at one time in rugby. Additionally, rugby has a complex set of rules that lead to set pieces that occur throughout the game. Furthermore, I also had to include the tries as well as the key performance indicators (KPI) that were important in rugby. In either case, the number of items that I was hoping to represent in my analysis was much larger than the
five or ten players that were currently being analyzed in the other studies I was working from (Passos, et al., 2011; Fewell et al., 2012). Unfortunately, the inclusion of ten players as well as all of the set pieces and KPI that occur during a game had a direct impact on the quality of the network visualization that I was trying to achieve. My initial ‘gut feeling’ was that the network visualizations that I created were “bogged down” with information that was hard to understand. Fortunately, I was able to acquire a copy of Node XL, which is a freeware plug-in for Microsoft Excel, which automates the process of performing and presenting NA (Smith M., 2016). Along with the benefit of automating the NA process, Node XL has the added benefit of creating network visualizations that are similar to the ones developed by Fewell et al., 2012.

**Choosing the Match Videos**

For the portion of the study that includes Carl, three match videos from the 2014 Commonwealth Games were analyzed. Carl selected these matches because he felt they were representative of the gameplay that his team normally exhibits. Due to the public nature of this data, no ethical permission was needed from the various teams. These games were purposely selected; therefore, there was no randomization during the data collection that occurred in the selection of these games.

For the portion of the study that included David, one of their recent contests was selected for analysis. Due to the public nature of this data, no ethical permission was needed from the various teams that were represented in the match video. David chose this match video based on its clarity and because it represented a game that that was a
close contest for the team. This ensured that the data from the analysis would be accurate and representative of the team’s normal strategic gameplay.

The Analysis Procedure

The match videos were analyzed on a 19inch Dell monitor located 2 feet from the viewer to ensure accuracy and reduce eye strain. An Acer model I5-3210 laptop with a 15.6 inch monitor was utilized to analyze game play videos. The match video was transferred into Windows Media for evaluation. Office Excel 2013 was utilized to record the game play notation. I waited one-day in-between analysis efforts in order to order to prevent investigator burnout that could affect the data analyses.

The analysis procedure that I utilized incorporated three phases. During the first phase of analysis the starting lineups, player numbers and positions were identified and recorded on a notebook. During the second phase, notational analysis was utilized to cross check consistency and ensure the reliability of the analysis (Figure 12).

![Table showing the analysis process](image)

**Figure 12. An example of the notational analysis utilized during the analysis process.**

On the third and final phase, a network analysis of game play notation was created in order to focus on the following points of analysis:
• How can a team’s offensive pattern of play (strategy) be captured through a network analysis and metrics?

• How can a team’s defensive pattern of play (strategy) be captured through network analysis and metrics?

• How does a team’s pattern of play change when under the pressure of scoring a try or being scored on?

• How can network analysis be used to quantify the effect of an individual on the overall function of their team?

• How can preferential attachments amongst network agents be identified and exploited by opposing teams?

• How does the network analysis of a team’s performance inform a coach’s perception of a player’s value to a team?

• How does network analysis of a team’s performance relate to performance indicators already utilized and accepted rugby teams?

The Network Analysis Procedure

In examining a group with network analyses, the first task is to define the ties, nodes and boundaries of the network and the qualities that were attributed to them (Lusher et al., 2010, p. 215). For the purpose of these introductory networks, the boundary of our networks was limited to games played by the participant’s opponents. In order to analyze the interactions that occurred during the game of rugby, the networks that I developed contained player and non-player ties.
- Player ties reflect the interaction of two players passing to another. The ties were weighted by a measure of passing accuracy and by the frequency of the interaction that occurred between the two players (Fewell et al., 2012, p.2).

- Non-player ties reflected the interactions that occurred between players and non-player events such as a try, ruck, scrum, turnover, possession gained/taken and penalty gained/taken. The ties were weighted by their frequency during the game (Fewell et al., 2012, p.2).

The networks contained two types of nodes. The first type of node was a player node that represented one of the players on the field. These nodes were labelled for the player number that they represented as well as a measure of betweenness centrality or clustering coefficient that will be discussed later in this section (Duch et al., 2010; Fewell et al., 2012). The second type of node was a non-player node. These nodes represented events that occurred during the game. For example, a try, ruck, scrum or turnover are examples of a non-player node contained in the network. These non-player events, like the player nodes, were weighted for their betweenness centrality and clustering coefficient (Fewell et al., 2012, p. 2; Duch et al., 2010, p. 2).

Notational analysis occurred when the team being analyzed gained possession of the ball. It proceeded until the end of the possession at which time an entry was made indicating that a try had been scored or a turnover had occurred. At the conclusion of play, a Player node and the interaction that occurred was recorded. At certain points during the analysis I found it necessary to rewind or pause the match footage in order to ensure the accuracy of the analysis. At the conclusion of the video, the match footage
was reviewed and the notational analysis was compared to the match footage being played at full speed in order to ensure the reliability of the notational analysis.

Once the task of notational analysis was accomplished, the next step in the NA process involved entering the notational analysis into a directed game flow matrix where it was is possible to visually analyze the interactions that occurred amongst the players (see Figure 11 above). In the case of rugby analysis, this matrix took the form of a 15x15 table that included all of the players as well as the source of possession entry and exit events (Lusher et al., 2010, p. 216). The first row in the game flow matrix indicated the start of the interaction (where the ball originated) and the second row indicated the end of the interaction (where the ball ended its path).

The next step in this process involved an analysis of the data in the game flow matrix. Each column in the matrix contains a number relating to the amount of times the nodes interacts with the other nodes in the matrix (Lusher et al., 2010, p.216). To aid in the analysis of rugby gameplay, the data from the analysis was transferred to the matrix in such a way as to create a directed game flow matrix. Creating a directed game flow matrix was necessary because it provided an opportunity to track the direction of the interactions that occurred between players and between players and events that occurred during the game like scrums, tackles or tries.

By visually examining the game flow matrix, it was possible to get a basic understanding of the key interactions that occurred during the game or in some cases, did not occur during the game. For example in Figure 11 above it is possible to see that Player 6 was not at all involved in the passing network that formed during this game of
water polo as there are no indications that this player interacted with his teammates. If that players was involved in the offense then there would have been a number reflecting that interaction within the game flow matrix.

The next step in this procedure was to create a directional game flow network, which takes the form of a graph containing arcs and vertices (Lusher et al., 2010, p. 216). By applying various form of topological and mathematical measurements to this game flow network, it is possible to create several forms of analysis including:

- Out degree and in degree of a node which indicates which player interactions are more or less likely to occur than others (Lusher et al., 2010, p.219),
- Reciprocity, which is a measure of the tendency for two players to pass to each other (Lusher et al., 2010, p.222),
- Transitivity, which is a measurement of the tendency for the players to form triadic relationships with each other called cohesive bonds (Lusher et al., 2010, p.219),
- Cohesive Subgroups, which is a measurement that indicates teammates who, because of their cohesive ties, form a clique within their team (Lusher et al., 2010, p.219).
- Degree centrality, which measures the extent to which a player or non-player node interacts directly with another node.
- Betweenness centrality, which measures the extent to which a player or non-player node interacts indirectly with another node. This measurement reflect how important the player is to the function of the team(Duch et al., 2010).
From a tactical point of view, teams should be aiming to have their team members have similar betweenness scores (Peña & Touchette, 2012, p. 3).

- Closeness centrality, which measures the extent to which the player and non-player nodes are directly or indirectly connected to the rest of the network (Peña & Touchette, 2012).

- Clustering coefficient which measures the degree to which the players in cluster together. From a tactical point of view, a higher clustering coefficient is indicative of a team, which is spreading the ball amongst its members (Peña & Touchette, 2012, p. 3).

Fortunately, there are software packages like Node XL, and Cytoscape that performed all of these calculations automatically and presented them in the form of a visual graph similar to those in Figure 11 above.

**Reliability of Video and Network Analysis**

For the part of the study involving Carl, Carl and I cross-evaluated the network data from one of the games to ensure the reliability of data entries. In the part of the study involving David, David and I cross-evaluated the network data from the gameplay footage and one of the scrimmages to ensure the reliability of the data entries (M. D. Hughes & Bartlett, 2002). In cases of a disagreement between the participant and the researcher, a new and mutually agreed upon value was entered in place of the number in question.
Changes to the NA procedure

As this case study progressed, it became necessary to make several changes to the NA procedure. Most of these changes were made in order to save my time, David and Carl’s time, add focus to the network or to meet the changing needs of the participants (see Chapter 5 for more details). The following section explains the cause and effect for each of the changes that I made to the NA procedure as this study progressed.

After Meeting One

- I created time stamps so I could refer analysis to video. Being able to ‘see what that looks like’ is very important to Carl and David. It almost seems like the visual is more important than the statistics. The time stamps were effective but still fiddly and time consuming to create and utilize.

- I added focus to the NA by focusing on Events and their Consequences. This entailed analyzing penalties and turnovers and linking them to the impact, they had on the team’s performance. I utilized network analysis to link the players to the events and then the events to their consequences.

- I tried to condensing the network so it was not as jumbled in appearance. This was accomplished my manually editing the look of the network within the Node Xl program.

- I created a scoring chance network for David but this was not an interest for him and seemed to be a waste of time. I learn that just because something interested Carl it did not mean that it would be interesting to David. This was likely because David
was more interested in analysis that addressed the team’s immediate performance concerns and issues that could be addressed within their team’s current practice structure.

- At this point in the study, David was not as interested in analyzing phase play. This changed as the study progressed. Later in the study, we examined the amount of phases it took for the team to score or to be scored against.

- Being able to track events and being able to relate them to video became a priority I wanted to be able to do it quickly so not to waste our time. I went on a tangent finding ways to do this. First I added new network codes and inserted time stamps on the side of the excel document. While showing David the analysis I would physically find the time stamp location on the video.

- I tried to use iMovie on my iPad to edit the videos but my iPad had storage issues, which limited the amount of videos I could create and store. Furthermore, I found that it was time consuming to transfer videos from the internet to my iPad. Overall, this method proved to be too much of a hindrance and I scrapped this idea.

- During my meeting with David I found it difficult to link the video to the analysis I was discussing. It did not seem to take long at the time but when I went back and listened to my copy of our interviews, I noticed that there was a definite lapse in our communication. This mainly occurred as I manually searched through the video file to find the time stamp I was after.

- My lack of technical understanding also came through as I coded several things differently that David would have. These differences were mainly due to David’s
intent for the analysis. He was more intent on utilizing the video as an instructional tool versus my focus on analyzing overall player performance. For example, while analyzing tackles I initially found that I was very ‘hard’ on the players with my evaluations. I based my evaluations on the IRB coaching manual *Coaching Sevens: A Practical Guide to Coaching Seven-A-Side Rugby*, and in my mind, the players either made the tackle or they did not (Smith L., 2015). David notified me I was a little miss-guided and that in a real world there were many factors that influenced a player’s ability to make a tackle. These factors included the location of the tackle, the type of tackle, the size of the player being tackled and the size of the player making the tackle and finally the position of the player making the tackle. He notified me that how I rate the players should “depended on what the ratings were for”. In this particular instance, he thought that they would be for “instructional purposes” and you “don’t always want to be giving the players negative feedback”.

- Overall, I decided that the current method I was utilizing to analyze games was not working as well as I hoped. I tried a series of new methods. In one method, I uploaded match video onto YouTube. YouTube has a video editor that I utilized to create time stamps in the video. Ultimately I found this process time consuming and cumbersome as I had to switch between the YouTube video editor and the excel file in order to refer to the network data.

- I also tried utilizing the video analysis package Dartfish to code the videos and then transfer the code to my network (Dartfish, 2016). Unfortunately, I found that the two processes were not compatible. I found that Dartfish was very ‘event driven’
and I needed to be able to focus on the interactions that occurred during the game. In addition, the Dartfish program I was utilizing was older and not very intuitive to use. Furthermore, the user interface was cumbersome and I found it a challenge to create and change the tagging windows I utilized to create my code. This was a problem because we changed the focus of our analysis weekly.

- Fortunately, I was able to find a program called Longomatch (Fluendo.com, 2016). This program was a video analysis program like Dartfish but it was open source so it was free to use. Longomatch addressed all of the problems I had with Dartfish and as a bonus, provided me with a video complier and video creation feature which made it easy for me to create and upload videos to YouTube.

- At the end of this phase, we identified several constraints that became an issue for our analysis.
  - Time. Keeping the meetings short with David but still trying to show the analysis and the video.
  - Time: Time it took to perform the analysis. I wanted to make sure that the time it took would be practical for a coach or assistant coach.
  - Time it would take to present this information to an athlete
  - Time: Coding fifteen players is much harder than seven.
  - Time: Difficulty coding. Coding a new team is hard. I did not know the players. I found it harder to see the players during certain events like scrums and breakdowns. Quality of the video made it hard to see the players during certain times of the game and in certain parts of the field.
o Cost: Keeping the cost of everything to a minimum or event free. David had a budget but he did not want to spend much money on upgrading his PA methods.

o Cost of Software: We wanted to use GAMEBREAKER but it was too costly (Sportstec, 2016). Upgrading Dartfish was also expensive and we were not sure we wanted to continue using that program.

o Cost of Hardware: Storage: Storage space for David was an issue. He had limited space on his Dropbox to store games. I wanted to use an app for my iPad to code games but my iPads limited space did not allow me to store games on it and code them.

o Cost of Hardware: Compatibility: Compatibility of hard ware was an issue for David and I. He had an apple and I a pc. We had complications when we tried to share files with an external hard drive because of compatibility issues.

**YouTube**

The next phase in the development of our analysis methodology involved incorporating the use of YouTube as a means to store and share the video clips that I created. Our goals during this phase of the case study dictated the method I utilized to analyze the match video, create the network analysis and select the clips that were uploaded to the YouTube site.
My goal during this phase of the case study was to be able to take the match video from the game, analyze it and upload it within two days of the games completion. This was to ensure that David and the coaching team would have some form of PA to guide their practice efforts for the week. I was able to transfer the player interactions and the events into Node XL to form the network analysis. The next step in this process was to render the video clips within Longomatch and post them on YouTube in a private playlist. I inserted the analysis that I created from Longomatch and Node XL into the comment box for each of the playlists that I created. In the case of the network findings, I would translate them to into a language that I thought would be easier for everyone to understand. For instance, instead of referring to the betweenness centrality of a player I would talk about which player was more involved in the offense than another.

Once I finished uploading the videos, I would send David an email, which would include any comments I had made while coding the video and a link to the playlist. David would analyze the videos and then forward the link to the other coaches and the players so that they would also have access to the analysis and the videos. The players were expected to watch the video in preparation for the team practice that occurred each Thursday. The videos were kept on the site for the entire season so that they could be referred to later if needed.

Along with our own match videos, I was also responsible for analyzing our opponent’s match videos and making this analysis available to the coaching staff and players. This analysis often included our opponent’s set pieces and scoring
opportunities. There were some instances where we might change the focus of our analysis based on our prior knowledge of our opponent’s strengths and weaknesses.
## Appendix H: A Time Table of the Interactions, that occurred with David

<table>
<thead>
<tr>
<th>Event</th>
<th>Date</th>
<th>Location</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meeting 1 With David</td>
<td>December 05/2015</td>
<td>David’s Office</td>
<td>Initial Meeting/Introductions/Initial Questions</td>
</tr>
<tr>
<td>Meeting 2 with David</td>
<td>December 12/2015</td>
<td>David’s Office</td>
<td>Evaluate Analysis From First Game Against JB/Prepare for future analysis</td>
</tr>
<tr>
<td>Personal Reflection of Meeting 2 with David</td>
<td>January 05/2015</td>
<td>Campus Parking Lot</td>
<td>Evaluate meeting with David/Plan for future analysis</td>
</tr>
<tr>
<td>Practice Attendance</td>
<td>January 12/2015</td>
<td>Practice Field</td>
<td>Understanding of what a practice looks like</td>
</tr>
<tr>
<td>Meeting with David and PA</td>
<td>January 12/2015</td>
<td>PA’s Office</td>
<td>Evaluate possibility of new software and hardware for VA</td>
</tr>
<tr>
<td>Attending Pre-Practice Procedures</td>
<td>January 12/2015</td>
<td>Team Room/Playing Field</td>
<td>Meet the players/Observe Current VA procedures</td>
</tr>
<tr>
<td>Pre VA Presentation Meeting with David</td>
<td>January 16/2015</td>
<td>David’s Office</td>
<td>Develop VA Presentation for Players</td>
</tr>
<tr>
<td>Reflections on Team VA Presentation</td>
<td>January 17/2015</td>
<td>Team Room</td>
<td>Provide VA to Players/Evaluate VA Procedures/Plan for future VA</td>
</tr>
<tr>
<td>Meeting 3 with David</td>
<td>February 02/2015</td>
<td>David’s Office</td>
<td>Develop new VA Procedures based on Experience with David and Team</td>
</tr>
<tr>
<td>Researchers Journal Entry</td>
<td>April 07/2015</td>
<td>At home in office</td>
<td>Evaluation of Current VA Procedures/YouTube Files/Traffic light</td>
</tr>
<tr>
<td>Evaluation Meeting with David</td>
<td>April 12/2015</td>
<td>David’s Office</td>
<td>Evaluate Current VA procedures/plan for future VA</td>
</tr>
<tr>
<td>Meeting 4 with David</td>
<td>April 21/2015</td>
<td>David’s Office</td>
<td>Pre Championship/Evaluation of YouTube Channel/Evaluation of Traffic light</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Event</th>
<th>Date</th>
<th>Location</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Email Correspondence with Assistant Coach</td>
<td>April 29/2015</td>
<td>Via Email - At Home</td>
<td>Pre Championships/ Rick wanting me to work on TOP evaluation</td>
</tr>
<tr>
<td>Meeting 5 with David</td>
<td>June 30/2015</td>
<td>Campus Coffee Shop</td>
<td>Clarification of themes/questions/common understanding/plan for next year</td>
</tr>
</tbody>
</table>