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Tracing the impact of self-directed team learning in an Air Traffic Control environment

by

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Declaration

I, Christiaan Gerhardus Joubert (student number: 24218783) hereby declare that all the resources that were consulted are included in the reference list and that this study is my original work and it has not been submitted before for any other degree or examination at any other university.

Christiaan Gerhardus Joubert
October 2006

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Key terms

Air traffic control

Air traffic control training

Continuation training

Human factors

Self-directed learning

Self-directed team

Self-directed team learning

Self-managed work team

Team learning

Teamwork

Summary

Tracing the impact of self-directed team learning in an Air Traffic Control environment

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The aim of self-directed team learning initiatives is to provide a further level of defence against an eventuality by ensuring that air traffic controllers are aware of the sources of human fallibility, and by developing in the individual controllers and air traffic control teams the knowledge, skills and attitudes that will result in the successful management and containment of inadvertent error.

To gain a deeper understanding of self-directed team learning, I investigated the role and contribution of self-directed team learning principles and strategies that were present in the South African Air Force air traffic control team-based work environment. This research study was directed by the following primary research questions: Does self-directed team learning impact on the air traffic control work environment, and what is the nature of self-directed team learning's impact on the air traffic control work environment?

Insights gained as a result of this study contributed to the body of research concerned with learning design, development, implementation and evaluation by self-directed teams as well as the air traffic control discipline.

In this mixed-method study quantitative data collection was performed by means of a self-directed team learning questionnaire and a learning approach questionnaire, whereas qualitative data collection relied on

individual interviews and focus group interviews. This study involved 25 South African Air Force air traffic controllers (from three operational air traffic control centres).

The nature of self-directed team learning's impact on the air traffic control work environment was illustrated by individual and collective (team) views and dynamics. The impact of air traffic control team performances was traced in terms of identified teamwork characteristics, activities, dynamics, performance measures and focus areas and reflective practices. Results of this study indicated that self-directed team learning offered opportunities to individuals and teams to influence air traffic control performances in an air traffic control work environment. A perceived positive relationship between self-directed team learning and air traffic control operational outputs could be traced.

Lastly I concluded that self-directed learning by air traffic control teams had an impact on air traffic control operational outcomes, thus contributing towards a critical air traffic control goal – aviation safety.

CHAPTER 1

BACKGROUND AND ORIENTATION

Figure 1.1 Chapter 1 orientation

Background and orientation	
Problem statement and significance of the study	Problem statement
	Significance of the study
Stating the research questions and defining the topic	Research questions
	Defining the topic: terms and definitions
Research strategy overview	Mode of inquiry
	Research sites and sampling
	Mixed-method data collection plan
	Data analysis strategies
	Validity, reliability and trustworthiness
Ethical considerations	
Outline of chapters	

Compiled by the researcher

1 Background and orientation

The value of self-directed team work requires a concerted measurement of the impact of variables that enable or disable perceived team work effectiveness. The measurement of team performance relies on the team's ability to function as a productive and collaborative entity. It is suggested that a collaborative and productive team is the result of people working and learning individually and collectively. People working together in teams should be able to harness their collective cognitive strategies to learn more about themselves, their team members, the work, and the team by drawing on collaborative dynamics and relationships. Team performance assessment requires the team to periodically pause in order to examine how well it is functioning (French & Bell, 1995: 170).

The relationship between the ability of a self-directed team to learn collectively and the resulting levels of team performance present a challenge. Do learning teams perform more effectively than teams that neglect their learning potential? I intended to establish whether self-directed team learning principles and strategies were present and applicable in the air traffic control team-based learning context, to discover different levels of self-directed team learning, and to describe the role and contribution of self-directed team learning in the air traffic control workplace.

Self-directed team learning, from an operational air traffic control perspective, is viewed as the principal process by which day-to-day workplace operational problem-solving and decision-making is dealt with and whereby innovation occurs. Such learning combines individual learning and team learning processes and strategies, thus allowing for an integration of shared insights, knowledge and mental models.

Self-directed team learning combines individual and team learning efforts. Effective team learning in the workplace relies on human interaction that involves intentional and unintentional cooperation – working well with others may be the most important lifelong skill that learners can learn within a community of practice (Gibbons, 2002: 163 and Lewis & Allan, 2005: 7). Air traffic controllers function in an individualistic and cooperative manner in the workplace. Such a cooperative or team effort signifies a need to integrate individual strengths in order to appreciate collective knowledge, skills and attitudes.

Self-directed learning provides opportunities for the team member to gain new knowledge and insights in order to modify individual behaviour and action (Long, 1990: 106). Worell and Nelson (Long, 1990: 20) identify a need for the learner to apply a self-reinforcement system to the effective maintenance of

his or her own behaviour. The learner thus takes responsibility not only for control of his/her learning process but also for determining the educational process that is required for growth and development. A key distinction in self-directed learning is that the learner takes responsibility for decisions on what is being learned and the means by which learning is to take place (Long, 1990: 37).

According to Long (1990: 43 & 106) educators need to change the paradigm within which the entire educational and learning process is viewed in order to allow for self-directed learning to function effectively. This line of thought is shared by Gibbons (2002: 165), however, the focus is expanded to teamwork and team learning, as an extension of self-directed learning. Teamwork is an essential element of self-directed learning; therefore it is essential that learners become skilful in self-directed learning (Gibbons, 2002: 165). With the assistance from their team members, learners learn to solve many of their own problems, they learn how to be part of the social world around them, and they learn about themselves (Gibbons, 2002: 165 and Lewis & Allan, 2005: 19).

This approach allows the learner (individual) and his/her fellow learners (team members) to construct their own reality by means of self-directed (individualised) and self-directed team learning strategies. Their learning design philosophy is based on individual and collective notions on the nature of "reality" (creating meaning from workplace occurrences and experiences); the nature of "knowledge" (individually and collectively analysing, interpreting, understanding and constructing work-related knowledge); the nature of human interaction (with reference to negotiated, collaborative and shared meaning structures); and the nature of science (a meaning-making activity with the biases and filters accompanying any human activity) (Dills & Romiszowski, 1997: 65).

Learning design is thus an interpretive practice that provides the opportunity to participate, responsibly, in the process of inquiry (Dills & Romiszowski, 1997: 91). Educators studying this learner/team–directed approach have to look at constructive self-directed team learning designs that are based on an assumption that intentional and unintentional learning is a product of both cognitive and social interactions in problem-centred environments or specific communities of practice (Hmelo & Evenson, 2000: 1 and Lewis & Allan, 2005: 7). Such studies rely on an interpretation of existing trends, methods, and techniques that are synonymous with self-directed team learning-strategies in the workplace.

The aim of the study was to trace the impact of self-directed team learning in the South African Air Force air traffic control environment. The South African Air Force (SAAF) is responsible for air traffic control service delivery within the military air traffic control community. The phrase "air traffic control environment" refers to the operational air traffic control workplace, while the term "impact" refers to performance effectiveness assessments of job-specific objectives.

2 Problem statement and significance of the study

Problem statement and significance of the study	Problem statement
	Significance of the study

2.1 Problem statement

Evidence exists that air traffic control team interaction and team resource management is receiving continued attention within the international academic sphere.

Specific objectives in this regard include (ATNS, 2004: 1):

- Enhancing air traffic services staff and management awareness of human factors that could cause or exacerbate incidents that affect the safe, orderly and efficient conduct of operations.
- Enhancing knowledge of human factors and developing resource management skills and attitudes, which, when applied appropriately, could obviate an aircraft operation from incipient accidents and incidents whether perpetrated by technical or human factor failings.
- Implementing acquired knowledge, skills and attitudes to conduct and manage operations, and fully integrating these techniques throughout every facet of the organisation, in order to prevent the onset of incidents and potential accidents.
- Integrating commercially efficient operations with safety.
- Improving the working environment for air traffic services staff.

Because of the potentially catastrophic nature of aviation accidents, enormous and largely successful efforts have been made over the years to reduce errors through improvements in air traffic control training. Despite these efforts, however, incidents and accidents attributable to human factors still persist. The purpose of self-directed team learning initiatives is to provide a further level of defence against an eventuality by ensuring that all staff are aware of the sources of human fallibility and by developing in individual controllers and air traffic control teams the knowledge, skills and attitudes that will result in the successful management and containment of inadvertent error (ATNS, 2004: 5).

Effective self-directed team learning initiatives and their contribution to the safe, orderly and efficient conduct of operations, provide a platform for air traffic control service providers to prepare staff for the challenges of the future based on what is happening in the present (Long, 1990: 100). Extensive academic research has not been conducted within the South-African air traffic control system with

reference to self-directed team learning. Uncertainty prevails regarding the role of self-directed team learning and its contribution to the safe, orderly and efficient flow of air traffic.

To gain a deeper understanding of self-directed team learning, I conducted a performance effectiveness investigation into how air traffic control teams learn and how this learning impacts on overall individual and team performance in the workplace. The role and significance of cognitive strategies utilised from an individual and team learning perspective, and their role in facilitating learning design was be explored. An investigation into this learning process considered: the influence of learner and team differences; the presence and effect of intentional and unintentional learning approaches; and successful and less successful learning strategies as applicable to self-directed team learning.

The problem statement for this study is captured in the following question:

Does self-directed team learning impact on the air traffic control work environment?

2.2 Significance of the study

During the investigation of the problem stated above I intended to:

- Trace the impact of self-directed team learning strategies in the air traffic control workplace;
- Identify, describe and analyse self-directed team learning strategies in the air traffic control workplace;
- Challenge the boundaries of theory, research, practice and assumptions associated with self-directed team learning in the workplace;
- Generate knowledge that will be useful to other disciplines that rely on effective teamwork, both within and outside the aviation environment; and
- Contribute to local and international literature on self-directed team learning within the air traffic control work environment.

3 Stating the research questions and defining the topic

Stating the research questions and defining the topic	Research questions
	Defining the topic: terms and definitions

3.1 Research questions

Air traffic control teamwork is more cognitive and less physical due to task and information sharing, collaborative decision-making and co-operative work in the air traffic control system (Delsart, 2001: 1 – 4). The complexity, speed and reality of technological change and innovation in the air traffic control environment necessitate a more proactive and dynamic approach to individual and team learning. As more people in the workplace start to reflect critically on their practice, question and challenge, in order to expand their collective capacity, the organisation will move towards being a learning organisation (Thomas, 2003: 12 – 15 and Meyer, 1999: 88).

Sharing knowledge, skills and attitudes amongst air traffic control team members is an expected outcome of effective self-directed team learning. This statement implies that team members may be unaware of the knowledge, skills and attitudes they have developed separately. By providing formal and informal opportunities for sharing, understanding and insight of these differences amongst the team members, an air traffic control team develops the way they work through the creation of a collective mental model, thus learning how to learn and work together within their community of practice (Meyer, 1999: 88 and Lewis & Allan, 2005: 7 & 19). Mental models capture dynamic properties that enable the prediction of outcomes and to experience "what-if" scenarios in order to decide on possible courses of action. Establishing and maintaining a collective mental model, by means of individual and team learning efforts, allow for a generative and constructive process (MacLeod, 2001: 36). Team members are challenged both individually and collectively to generate meaning out of situational indicators and construct acceptable solutions, by means of collective mental models. Such a learning and development approach allows team members to view workplace occurrences and practices as opportunities for learning, to give and receive feedback, to share their learning and to give time and attention to individuals. The value of vocational-specific self-directed team learning and the impact thereof on organisational/operational performance is questioned.

This thesis examined the nature, characteristics and impact of self-directed team learning in the air traffic control workplace. The primary focus of the study was on tracing the impact of self-directed team learning in an air traffic control environment. The research was directed by the following primary research questions:

Does self-directed team learning impact on the air traffic control work environment?

and

What is the nature of self-directed team learning impact on the air traffic control work environment?

To explore these primary research questions the following secondary questions and associated objectives were addressed:

Table 1.1 Secondary research questions and associated objectives

Questions	Objectives
Do air traffic controllers perceive a relationship between self-directed team learning and the air traffic control operational output? What is the nature of perceived relationships between self-directed team learning and the air traffic control operational output?	**Tracing present team performance – thus measuring team performance from an individual, collective and organisational perspective.** Identifying and understanding the role of self-directed team learning within the scope of workplace performance.
What are the self-directed team learning dynamics within self-managed air traffic control work teams?	**Tracing present team learning – thus measuring team learning from an individual, collective and organisational perspective.** Measuring dynamics and identifying and describing individual and collective (team) views. Creating deeper understanding of primary and secondary modes of learning by self-directed teams.
Do air traffic controllers perceive a relationship between self-directed team learning and air traffic control workplace continuation training? What is the nature of perceived relationships between self-directed team learning in the air traffic control workplace continuation training scenario?	**Tracing future team learning possibilities – proposed strategies from an individual, collective and organisational perspective.** Understanding how a team sustains continued learning in the workplace.

Compiled by the researcher

3.2 Defining the topic: terms and definitions

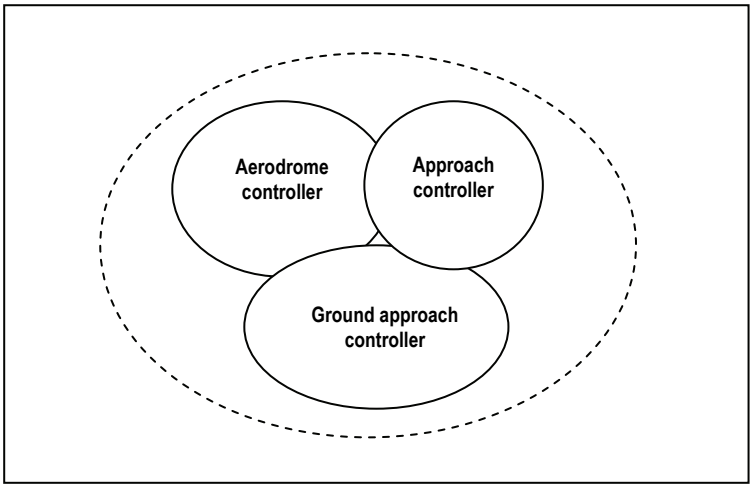
For the purpose of this research, the following terms and abbreviations are provided:

Air traffic control service – Air traffic control (ATC) services are provided by air traffic controllers stationed at air traffic control centres. Air traffic controllers are responsible to direct air traffic on the ground, and in the air in the vicinity of an airport, and along air route traffic airways/routes between

airports. Effective air traffic control is possible because of efficient two-way radio communications, satellite communications and radar that allow controllers to keep track of all the aircraft they are controlling (Crane, 1991: 21). Military air traffic control services include the following (ATNS, 2001: 4):

- Ground Approach Control Service – Air traffic control service for arriving controlled flights in controlled areas during the final stages of the final approach phase.
- Approach Control Service – Air traffic control service for arriving and departing controlled flights.
- Aerodrome Control Service – Air traffic control service for aerodrome traffic.

Figure 1.2 Illustration of the breakdown of military air traffic control services and their interrelatedness



Compiled by the researcher

Air Traffic Controller – A person authorised by the regulating authority to provide air traffic control service. The air traffic control service is provided by an appropriate authority to promote the safe, orderly and expeditious flow of air traffic (Crane, 1991: 21).

Air Traffic Control workplace, Air Traffic Control work environment, Air Traffic Control operational environment – A generic term meaning variously, area control centre, approach control unit or aerodrome control tower (ATNS, 2001: 3).

Collaborative learning – In all situations where learners come together in groups or teams, it suggests a way of dealing with learners which respects and highlights individual group/team members' abilities and contributions. Essentially the team is empowered and takes responsibility for its own learning during collaborative learning sessions. Collaborative learning is thus the result of contextual and discovery learning approaches that result in an analysis of learner experiences (Panitz, 1996: 1-2).

Community of practice – Community of practice refers to a social learning theory that is based on work-based learning. Members of these communities of practice are passionate about their work/field and feel a commitment towards their community/work (Lewis & Allan, 2005: 10). Communities of practice are characterised by (Lewis & Allan, 2005: 7 & 19):

- common purpose identified by participants;
- participants that are likely to be at different stages in their professional life;
- shared efforts to develop professional practice;
- different levels of participation;
- open-ended, not time-bound learning initiatives; and
- a shared understanding of the importance of dialogue and shared narratives.

Cooperative learning – In situations where learners are assisted by defined and structured learning processes in order to accomplish a specific goal a more directive and teacher/facilitator-centred approach is favoured. This cooperative learning approach is based on the creation, analysis and systematic application of learning structures. Cooperative learning emphasises the outcome or product of learning. Viewed from this perspective, cooperative learning does not empower learners (Panitz, 1996: 1-2).

Human factors (HF) – Human factors are about people in their living and working situations; about their relationship with machines, with procedures and with the environment around them; and also their relationships with other people – both individually and in groups. In aviation, human factors involve a set of personal, medical and biological considerations for optimal aircraft and air traffic control operations.

Intentional/formal learning – Learning can occur both consciously and subconsciously from experiencing real-life situations (Long, 1990: 17). Nadler (Long, 1990: 17) describes intentional learning as *"education"*, thereby illustrating that such learning is facilitated by a formal framework and control.

Self-managed work team – Self-managed/self-directed teams have assumed many functions previously performed by management, supervisors and middle managers (French & Bell, 1995: 54). Lawler (French & Bell, 1995: 238) warns that self-managed work teams may run the risk of becoming stagnant and complacent – as a counter measure the development of "an ongoing organisational assessment capability that constantly surfaces issues of organisational effectiveness and renewal" is suggested.

Successful self-managed work teams are characterised by (ATNS, 2003: 24 & 25):

- Shared decision-making authority
- High self-management skill levels
- Members maintaining individuality in the team setting
- Voicing of thoughts, solutions and opinions are encouraged
- High levels of intrinsic motivation
- Little need for formal leadership

Team resource management (TRM) – Encompasses those strategies required for the best use of all available resources – information, equipment and people – to optimise the safety and efficiency of air traffic services. Team resource management enables the effective use of all resources for air traffic control personnel to ensure a safe and efficient operation, in air traffic control, reducing error, avoiding stress and increasing efficiency (IATA: 2003).

Unintentional/informal learning – Learning can occur both consciously and subconsciously from experiencing real-life situations (Long, 1990: 17). Nadler (Long, 1990: 17) describes unintentional learning as being something that occurs independently of any structured or programmed learning activity.

4 Research strategy overview

Research strategy overview	Mode of inquiry
	Research sites and sampling
	Mixed-method data collection plan
	Data analysis strategies
	Validity, reliability and trustworthiness

The research strategy and associated structure of discussion are illustrated in Table 1.2.

Table 1.2 Research strategy framework

Research strategy focus area	Research strategy discussion point
Departure point	Mode of inquiry
Research venue and participants involved	Research site and sampling
Overall data collection plan	Mixed-method data collection plan
Data collection techniques	Quantitative (quan) and qualitative (QUAL) techniques

Responsibilities of the researcher	Role of the researcher
Analysis of collected data	Data analysis strategies
Value and integrity of data collected	Validity, reliability and trustworthiness

Compiled by the researcher

4.1 Mode of inquiry

A mixed-method strategy allowed me to present a performance effectiveness assessment of air traffic control workplace learning strategies (what is happening?) by analysing reported workplace performance indicators (why is it happening?). This mixed-method strategy combined quantitative data with qualitative data in order to add depth and detail to findings (Swanson & Holton, 1997: 93). This mixed-method strategy is illustrated by the typology quantitative (quan) and qualitative (QUAL). Quantitative data collection made use of a psychometric instrument and a questionnaire whereas qualitative data collection instruments consisted of individual interviews and focus group interviews.

4.2 Research sites and sampling

Approval was obtained from the South African Air Force to perform data collection at the following three sites (these were the only South African Air Force air traffic control centres that provide Aerodrome, Approach and Ground Controlled Approach Control services, and where air traffic controllers function within self-managed work teams)[1]:

- Langebaanweg Air Traffic Control Centre
- Hoedspruit Air Traffic Control Centre
- Makhado Air Traffic Control Centre

In terms of determining the type and size of the sample, I considered that the aim of the study was to collect exploratory data and not to generalise findings. A sub group of the accessible population was investigated (25 selected team members within the identified air traffic control centres) – hence a non-probability convenient sample was used.

4.3 Mixed-method data collection plan

The sequence of data collection, data collection activities, and techniques are depicted in Table 1.3.

[1] Reference: Appendix K

Table 1.3 Mixed-method data collection plan

Sequence	Planned activity and technique
1st	Administer Self-directed Team Questionnaire (SDTLQ)
2nd	Administer Learning Approaches Questionnaire (LAQ)
3rd	Conduct one-to-one interviews
4th	Conduct focus group interviews
5th	Possible follow-up of one-to-one interviews and/or focus group interviews

Compiled by the researcher

4.4 Data analysis strategies

Analysis of data took place during and upon completion of data collection. Qualitative data analysis followed an inductive reasoning mode and quantitative data analysis followed a deductive reasoning mode. Data analysis was aligned to Marshall and Rossman's approach (1989: 112 - 120) and considered (Vaughn, Schumm & Sinagub, 1996: 105 – 113, Marshall & Rossman, 1989: 112 – 120, and de Vos, 1998: 342 - 343):

- organising of data;
- generating categories, themes and patterns;
- evaluating and categorising data for informational adequacy, credibility, and usefulness; and
- using triangulation and crystallisation techniques (McMillan and Schumacher, 2001: 463) to support looking for, and recording of, plausible explanations and interpretations.

4.5 Validity, reliability and trustworthiness

My study relied on valid, authentic and trustworthy methods of collecting and presenting information and interpretations. Hammersley and Atkinson (1983: 191) state that *data in themselves cannot be valid or invalid; what is at issue are the inferences drawn from them*. Maxwell (1992: 284) supports this view by stating that *validity is not an inherent property of a particular method, but pertains to the data, accounts, or conclusions reached by using that method in a particular context for a particular purpose*. I used McMillan and Schumacher's (2001: 408) ten strategies (listed below) to enhance design validity.

- Prolonged and persistent field work that took place at three different research sites.

- Mixed-method strategies were used that comprised qualitative and quantitative data collection techniques.
- Participant language and verbatim accounts were recorded, transcribed and interpreted (Appendix L).
- Low-inference descriptors were used during interviews that ensured understanding of air traffic control terminology by the researcher and respondents (Appendix L).
- An external codifier assisted with the data analysis phase (Appendix J).
- Interview data were mechanically recorded.
- Interpretations of participant meanings were corroborated by an external codifier (Appendix J).
- Participants' meanings were confirmed by means of member checking (Appendix D).
- Participant review opportunities were created by means of member checking (Appendix D).
- Negative cases or discrepant data were recorded and analysed (presented in Chapter 6).

Lincoln and Guba (1985: 290) suggest that trustworthiness be used in qualitative research. Trustworthiness refers to the researcher's interpretation of real-life data. I ensured compliance with Krefting's (1991: 215) strategies that relied on credibility, applicability, consistency, and neutrality to ensure trustworthiness.

5 Ethical considerations

Ethical considerations 

Ethics generally are considered to deal with beliefs about what is right or wrong, proper or improper, good or bad (McMillan & Schumacher, 1989: 197).

I undertook to focus on the research questions and not interfere in any manner that could jeopardise the integrity of data and the study as a whole. The use of research assistants in data collection was not planned. I acknowledged that participation would be voluntarily. No unpleasant or damaging effects on the individual, the team and the setting (workplace) were foreseen. I communicated the aim, objectives, nature and future use of findings to participants prior to commencement of data collection activities. I acknowledge that participation was voluntary and informed consent from participants was a prerequisite.

I complied with the following ethical issues (Du Plooy, 1995: 45-46, 65, 85, 169):

- Protect the rights of human subjects by not causing emotional harm, by not infringing their right to maintain self-respect and human dignity.

- Provide all the facts without distortion or misrepresentation.
- Avoid being biased in the interpretation and presentation of data.
- To use measurements suited to the research problem.
- To not knowingly ascribe greater confidence than the measurements warranted.
- Report conflicting evidence.
- Report any flaws or limitations in the research.

No reasons could be cited as necessary for disclosing the identity of participants, therefore:

- I ensured confidence by not disclosing the identity of respondents.
- Research sites received random numbers in order to protect sites and individuals.

I planned to only visit the air traffic control sites after obtaining consent from corporate and unit management. The importance of air traffic control safety needs and requirements were fully realised by me – these were respected at all times and it was accepted that no infringement would be tolerated. No unprofessional behaviour was required of the participants.

I planned to provide the participants with an opportunity to learn from their participation. Therefore the outcome of my study will be made available to participants and will be communicated by means of internal organisational means.

6 Outline of chapters

Outline of chapters 

Chapter 1. Chapter 1 offers an introduction to the study and the rationale for this research.

Chapter 2. In Chapter 2 a theoretical framework is presented as a platform for this study.

Chapter 3. Chapter 3 offers a conceptual orientation that was deemed appropriate for this study.

Chapter 4. Chapter 4 offers an in-depth research design and methodology discussion and explanation.

Chapter 5. In Chapter 5 results obtained are analysed.

Chapter 6. Chapter 6 presents a discussion of findings and contextualising of results of this study with information from the literature review.

Chapter 7. Chapter 7 presents a final overview of this study with reference to the entire research process.

Figure 1.3 provides an overview of this thesis and the structure thereof.

Figure 1.3 An overview of this thesis and its structure

Chapter 1 – Background and orientation

Background and orientation	
Problem statement and significance of the study	Problem statement
	Significance of the study
Stating the research questions and defining the topic	Research questions
	Defining the topic: terms and definitions
Research strategy overview	Mode of inquiry
	Research sites and sampling
	Mixed-method data collection plan
	Data analysis strategies
	Validity, reliability and trustworthiness
Ethical considerations	
Outline of chapters	

Chapter 2 – Literature review

Literature review structure			Orientation	
			Advantages of the literature review structure	
Section 1	**Impact study and broad literature review focus areas**			
Section 2	**Concept clarification**	Air traffic control Air traffic control training	Teamwork in air traffic control Self-directed team learning	Human factors
Section 3	**Detailed literature investigation**	**Adult learning** • Introduction • Defining adult learning • The adult in self-directed adult learning • Self-directed adult learning characteristics • A functional self-directed adult learning environment • Self-directed learning as a means to facilitate continuation training • Role and relevance of adult learning		
		Learning within teams • Self-directed teams • Teamwork • Learning within a self-directed team • Role and relevance of team learning		
		Self-directed learning • Self-directed learning explored from an individual perspective		

		• Self-directed learning explored from a team perspective • Intentional self-directed team learning and unintentional self-directed team learning • Role and relevance of self-directed learning
		Air traffic control operations • Air traffic control operations/workplace • Air traffic control • Teamwork in air traffic control • Air traffic control teams • Air traffic control operational output • Role and relevance of air traffic control operations
		Air traffic control training • The air traffic control operational training need • Design and development of air traffic control operational training • Air traffic control on-the-job training • Air traffic control continuation training • Role and relevance of air traffic control training
		Human factors • Human factors in air traffic control • Role and relevance of air traffic control human factors
Section 4	**Reflection**	

Chapter 3 – Conceptual orientation

Section 1	Introduction	
Section 2	Philosophical departure	**Humanist paradigm**
		Progressive paradigm
		Technicist-behaviourist paradigm
		Broad philosophical assumptions • Ontological assumptions • Epistemological assumptions • Anthropological assumptions • Methodological assumptions
		Paradigmatic perspective
Section 3	Conceptualising learning	• Learning motives • Learning orientations • Learning approaches • Why do individuals and teams participate in learning?
Section 4	Reflection	

Chapter 4 – Research design and methodology

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	Orienting decisions
Research constraints	
Research possibilities	
Mode of inquiry	
Research setting	Sites

	Sampling
Data collection plan	
Mixed-method data collection techniques	Individual interviews
	Focus group interviews
	Self-directed Team Learning Questionnaire (SDTLQ)
	Learning Approach Questionnaire (LAQ)
Role of the researcher	
Data analysis	
Data validation	Validity
	Reliability
	Trustworthiness
Conclusion	

Chapter 5 – Analysis and presentation of results

Introduction		
Qualitative results	Results of individual interviews	Results: Impact of teamwork on air traffic control workplace performance outcomes
		Results: Impact of self-directed team learning dynamics within self-managed air traffic control work teams
		Results: Impact of self-directed team learning in the air traffic control workplace continuation training scenario
	Results of focus group interviews	Results: Impact of teamwork on air traffic control workplace performance outcomes
		Results: Impact of self-directed team learning dynamics within self-managed air traffic control work teams
		Results: Impact of self-directed team learning in the air traffic control workplace continuation training scenario
Quantitative results	Self-directed Team Learning Questionnaire (SDTLQ) results	Self-directed Team Performance results
		Self-directed Team Learning results
		Team performances and self-directed team learning relationship results
		Continuation training results
	Team learning approaches and self-directed team relationship results	
Conclusion		

Chapter 6 – Discussion of findings and contextualising results

Introduction		
Findings	Self-directed air traffic control team performance results	Aspects identified that advanced my understanding of self-directed air traffic control team performance results
		Relationships inferred from an analysis of self-directed air traffic control team performance results
		Reported practices that influenced my understanding of self-directed air traffic control team performance results
		Summary
	Self-directed air traffic control team learning results	Aspects identified that advanced my understanding of self-directed team learning dynamics within self-managed air traffic control teams
		Relationships inferred from an analysis of self-directed team learning dynamics within self-managed air traffic control teams

		Reported practices that influenced my understanding of self-directed team learning dynamics within self-managed air traffic control teams
		Summary
	Future/continued air traffic control team learning possibilities	Aspects identified that advanced my understanding of future/continued air traffic control team learning possibilities
		Relationships inferred from an analysis of future/continued air traffic control team learning possibilities
		Reported practices that influenced my understanding of future/continued air traffic control team learning possibilities
		Summary
Contextualising results		
Synthesis		

Chapter 7 – Conclusions and recommendations

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CHAPTER 2

LITERATURE REVIEW

Figure 2.1 Chapter 2 orientation

Literature review structure		Orientation Advantages of the literature review structure		
Section 1	**Impact study and broad literature review focus areas**			
Section 2	**Concept clarification**	Air traffic control Air traffic control training	Teamwork in air traffic control Self-directed team learning	Human factors
Section 3	**Detailed literature investigation**	**Adult learning** • Introduction • Defining adult learning • The adult in self-directed adult learning • Self-directed adult learning characteristics • A functional self-directed adult learning environment • Self-directed learning as a means to facilitate continuation training • Role and relevance of adult learning		
		Learning within teams • Self-directed teams • Teamwork • Learning within a self-directed team • Role and relevance of team learning		
		Self-directed learning • Self-directed learning explored from an individual perspective • Self-directed learning explored from a team perspective • Intentional self-directed team learning and unintentional self-directed team learning • Role and relevance of self-directed learning		
		Air traffic control operations • Air traffic control operations/workplace • Air traffic control • Teamwork in air traffic control • Air traffic control teams • Air traffic control operational output • Role and relevance of air traffic control operations		
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Section 4	**Reflection**			

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1 Literature review structure

Literature review structure	Orientation
	Advantages of the literature review structure

1.1 Orientation

The literature review is subdivided into four main sections (Figure 2.1). The first section presents the broad literature review focus.

The second section deals with overall concept clarification. Terms and associated concepts listed below are referred to throughout the study and therefore required early clarification. The following are thus addressed:

- air traffic control;
- air traffic control training concepts;
- human factors concepts;
- the concept of teamwork in air traffic control; and
- self-directed team learning concepts.

The third section is primarily an extension of section one, and secondarily a follow-up from section two, in terms of linking literature findings and own interpretations to associated research sub questions. The third section is considered to be the "heart of the literature review" in terms of its detailed focus. Section four presents the critical evaluation and conclusion.

1.2 Advantages of the literature review structure

This literature review structure allows me to:

- communicate the broad focus of the literature review as linked to the research questions (section one);
- expand on the "working language of the project" in support of the terms and definitions from Chapter 1, by providing a more comprehensive and descriptive concept explanation and elaboration (section two);

- provide specific information that is aligned to the investigation questions, thus allowing me to explore and describe literature findings, which in turn directed the content and highlighted focus areas of the data collection instruments (section three); and
- critically evaluate the information collected and investigated and formulate a conclusion (section four).

2 The broad literature review focus

Section 1	Impact study and broad literature review focus areas

2.1 An impact study

In order to describe the impact of self-directed team learning on the air traffic control work environment it was evident that I had to understand what was meant by the phrase "impact". This understanding directed the literature review focus and the research strategy.

An impact study is typically a multidisciplinary study (a collection of studies and analyses — each of which relates to the other) that allows researchers to focus and react to behaviours, culture, content and practices, by means of research (Readership Institute, 2005: 1). Formal impact studies provide stakeholders with quality information regarding the advantages and disadvantages of the research subject (University of Colorado, 2005: 2). Selection of projects for impact assessment is implemented by means of a careful screening process in order to avoid disappointment with respect to the eventual attainment of useful impact data (NIST, 2003: 46). One of the goals and a possible benefit associated with an impact study is to provide a picture of perceived current reality with the intention to understand such reality and also suggest ways of changing behaviour (Readership Institute, 2005: 1). This objective can be achieved through the use of a number of data collection instruments – interviews, site visits, survey instruments (NIST, 2003: 41-43).

The suitability of an impact study will rely on the research questions and the research intent. The key questions driving an impact study are listed below (Readership Institute, 2005: 1).

- What enablers can be identified to advance and enhance understanding of the research focus area(s)? Impact assessment indicators can include technology/project inputs, outputs/outcomes and result measures (NIST, 2003: 47).

- What relationships can be inferred between aspects/elements that are being studied?
- How do observed practices influence the research focus area(s)?

Impact data can be interpreted and compared if the following requirements are met, as derived and adapted from microeconomic impact studies conducted in the past (NIST, 2003: 48, 50, 51, 53, 54 & 56):

- Effective scenario and site planning and project management. This statement signifies the need to manage research activities as part of a broader programme with content and timing geared to the broader research programme's objectives.
- Equality of coverage by the impact analysis. This statement illustrates the need to ensure adequate sampling at air traffic control centre level (intra-centre).
- Equality of coverage within and across the organisation. This statement illustrates the need to ensure adequate sampling at all air traffic control centres (inter-centre). Low levels of respondent interaction not only reduce the quality of the study, but also inhibit access by the researcher to the research sites, which results in lower levels of impact focused measuring/understanding. As a result, several teams should be targeted during an impact study.
- Similar definitions and indicators. This statement illustrates the need to follow a generic/common research approach.
- Similar quality of impact data. This statement illustrates the need to gather research data in a reliable manner.
- Similar analyses of data. This statement illustrates the need to analyse data in a consistent manner. Unfortunately the ability of an impact analysis to access and to obtain useful impact data may vary across studies, and the amount and quality of impact data obtained directly affect a study's results. This restriction can be alleviated by the researcher's understanding of the relationships between the various focus areas and the associated dynamics within teams that affect these relationships. Such an understanding by the researcher is influenced and directed by a thorough insight and understanding of relevant literature as applicable to the research study.

The aim of the impact study is understood in terms of Hick's (2005: 1) answer to the question: "What do we mean by team effectiveness?" A self-directed team can be considered to be effective if its output is judged to meet or exceed the expectations of the people responsible who receive the output (Hick, 2005: 1). Producing a quality output is, however, not enough to judge the effectiveness of the team. Team

effectiveness is judged by whether the team feels satisfied with its efforts the latter being the primary focus of this impact study (Hick, 2005: 1).

The role and relevance of the impact study is to provide a picture of perceived current reality with the intention to understand. Essential focus areas and their relevance to this study are summarised in Table 2.1.

Table 2.1 Impact study focus areas and associated relevance to the study

Focus areas	Relevance to the study
An impact study provides advantages and disadvantages associated with the research subject.	• Identify the core research focus areas. • Analyse the positive and negative impacts as a result of studying the core focus areas.
Key questions drive an impact study.	Identify and describe: • enablers and impact assessment criteria; • inferred relationships; and • observed practices.
Impact data can be interpreted and compared if stipulated requirements are met.	I need to provide evidence that: • the study is properly planned and managed; • sampling is adequate; and • the research complies with all consistency requirements.

Compiled by the researcher

2.2 Broad literature focus

In order to describe the impact of self-directed team learning on the air traffic control work environment it was evident that I had to at least explore the nature of self-directed learning, self-directed team learning, the air traffic control work environment, the air traffic control team, air traffic control training and indicators of effectiveness in the air traffic control operational environment. These areas were combined with the research subquestions thus allowing for a breakdown of the broad literature review focus as described in Table 2.2.

Table 2.2 Broad literature focus

Subquestions	Broad focus areas
What are the self-directed team learning dynamics within self-managed work teams?	Adult learning Self-directed team learning Self-managed/self-directed teams
Which self-directed team learning features are found in air traffic control teams?	Adult learning Self-directed team learning Air traffic control operations/workplace Air traffic control teams
To what extent do intentional and unintentional levels of self-directed team learning become manifest in the air traffic control workplace?	Adult learning Self directed team learning Intentional self-directed team learning Unintentional self-directed team learning Air traffic control operations/workplace Air traffic control teams
What links exist between self-directed learning principles and team-directed learning strategies in the air traffic control team?	Adult learning Self-directed learning Self-directed team learning Air traffic control operations/workplace Air traffic control teams
What relationships, as perceived by air traffic controllers, exist between self-directed team learning and the air traffic control operational output?	Adult learning Self-directed team learning Air traffic control operational output Air traffic control operations/workplace Air traffic control teams
How is self-directed team learning utilised in the air traffic control workplace continuation training scenario?	Adult learning Self-directed team learning Air traffic control operational output Air traffic control operations/workplace Air traffic control teams Continuation training

Compiled by the researcher

Accordingly the areas that the literature review needed to address were:

- adult learning;
- self-directed learning;
- self-directed teams;
- self-directed team learning;
- air traffic control;
- the air traffic control operational/work environment;
- the air traffic control team;
- air traffic control training; and
- indicators of effectiveness in the air traffic control operational environment.

3 Concept clarification

Section 2	**Concept clarification**	**Air traffic control** **Air traffic control training**	**Teamwork in air traffic control** **Self-directed team learning**	**Human factors**	←

3.1 An overview of air traffic control

Clarification of the aim and objectives of air traffic control within the world of aviation and the roles and responsibilities fulfilled by air traffic controllers serve as the point of departure that is required to ensure common understanding. The aim of air traffic control is to ensure the safe, orderly and expeditious flow of traffic in the air and on the ground. The objectives of air traffic control are to (ATNS, 1999: 1):

- prevent collisions between aircraft;
- prevent collisions between aircraft moving on the manoeuvring area and between aircraft on the manoeuvring area;
- expedite and maintain a safe and orderly flow of air traffic;
- provide advice and information useful for the safe and efficient conduct of flights; and
- notify appropriate organisations regarding aircraft in need of search-and-rescue aid, and assist such organisations as required.

Air traffic controllers make use of methods devised to distribute the traffic over the available airspace in an orderly and economic manner. Air traffic controllers performing within the global air traffic control system have as one of their functions to update flight information for each aircraft. This objective is achieved by considering actual aircraft performance and then modifying it to take account of the present position, expected movements of other aircraft and anticipated conflicts in order to achieve the maximum safety with the minimum inconvenience (Manning, 2000: 257). Air traffic system integrity relies upon qualified and experienced air traffic controllers who provide a professional service within the aviation community.

An investigation into the nature of the air traffic control system suggests the need to view technology and human resources from an integrative perspective. Air traffic controllers find themselves within a system that requires effective interaction with other people, the use of advanced technology (equipment), compliance with rules and procedures, whilst also being subjected to changing physiological and psychological environmental influences. The air traffic control system relies on individual and team-based solutions to manage traffic. However it is reported by Janis (in Isaac & Ruitenberg, 1999: 169) that the lack of a collective or group mental model has been identified as one of the main problems in air traffic control situations. Being qualified as an air traffic controller therefore does not imply that service delivery will ensure a safe orderly and expeditious air traffic control service. The desired levels of air traffic control service delivery also rely upon the individual's ability to perform effectively as part of a team within a demanding environment. The role and relevance of the aim and objectives of air traffic control, as considered for this study, are presented in Table 2.3.

Table 2.3 Air traffic control focus areas and associated relevance to the study

Focus areas	Relevance to the study
Specific air traffic control aims and objectives have been stated.	Understanding of the common purpose kept in mind by air traffic control teams.
Air traffic controllers function within a demanding air traffic control system.	• Identifying environmental influences that air traffic control teams need to cope with. • Identifying the role and impact of compliance with strict rules and standards.
A lack of a common team mental model may adversely impact on safe service delivery.	Discovering the air traffic control team's mental model.

Compiled by the researcher

3.2 An overview of air traffic control training

Individual learning within the air traffic control environment requires a controller to think for him/herself, make plans, take action(s) and evaluate the outcomes. This self-directed learning approach encourages air traffic controllers to consider their own thoughts in order to make the right decisions and to think about these decisions to ensure successful actions (Gibbons, 2002: 7). This description illustrates the presence of metacognition – learning by means of reflection on own thoughts, knowledge and actions (Hacker, Dunlosky & Graesser, 1998: 20).

The nature of effective team learning is not restricted to competence in terms of occupational skills. From a solution-focused perspective the goal of teamwork is to create a culture of positive, supportive interpersonal relationships among team members — solution-focused team learning factors include imparting of information, interpersonal learning, developing socialising techniques and imitative behaviour (Sharry, 2001: 8-10). Individual competence is therefore not a predictor of team competence. Air traffic controllers are highly skilled in the technical aspects of their job but there is a concern about their ability to function as an effective team (Isaac & Ruitenberg, 1999: 188).

The design, development, delivery and evaluation of air traffic control learning initiatives focus on individual competence and team competence in terms of both vocational and human factor outcomes (human factors is an accepted term used in aviation to describe behaviour factors). Formal teaching activities rely on traditional classroom and simulator strategies; however the focus is primarily on vocational/technical air traffic control skills. Human factors and team work training typically include subjects such as teamwork and team roles; communication; human error; stress management; decision-making; situational awareness and safety management. Trollip (1995: 254) stresses that human factor outcomes cannot be achieved effectively by means of traditional classroom strategies — human factor learning strategies need to move strongly towards learners taking more of the responsibility for their learning and development. Human factors, in addition to air traffic control technical skills, influences team performance and team learning intentions and initiatives.

An overview and understanding of air traffic control workplace practices and associated learning strategies assisted me in tracing the nature of the relationship between self-directed team learning and the air traffic control operational output. Formal air traffic control teaching strategies are emphasised during vocational training and human factor development. It is also acknowledged however that informal learning takes place

in a continuous manner in the workplace. Air traffic control workplace-related learning activities assisted me in determining how self-directed team learning is utilised in the air traffic control workplace continuation training scenario.

The role and relevance of air traffic control training, as it is seen for this study, appears in Table 2.4.

Table 2.4 Air traffic control training focus areas and associated relevance to the study

Focus areas	Relevance to the study
Learning takes place from both an individual and team perspective.	An exploration and understanding of reflection by air traffic controllers on their individual thoughts, knowledge and actions and those of their fellow team members, which in turn, contributes towards the team dynamics and team learning dynamics, warrants further study.
Indicators of effective team learning.	Understanding how effective team learning integrates technical skills, imparting of information, interpersonal learning, developing socialising techniques and imitative behaviour.
Air traffic control teamwork relies on the team's ability to operate and learn as a team.	• Identifying and searching for teamwork results that serve as an indicator of team success. • The extent of the relationship between teamwork results and team learning success must be determined and described.
Formal air traffic control training is dependent on classroom and simulator learning experiences that primarily focus on technical skills training.	Understanding of the manner in which individuals and teams manage and integrate continued technical skills learning and human factors learning in the work environment is a challenge.

Compiled by the researcher

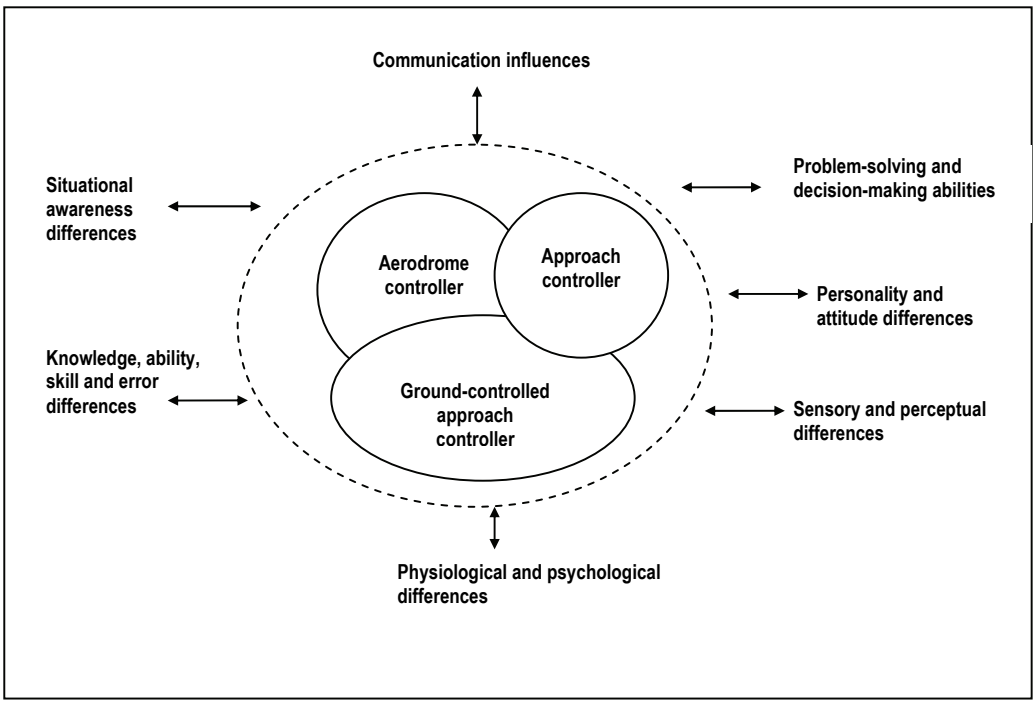
3.3 An overview of human factors

Air traffic control requires specific human behaviour — the application of a skill; being able to control air traffic. However, in order to ensure a safe, orderly and effective flow of traffic, the air traffic controllers need

to operate within a team, which, in turn, calls for an additional skill — the skill to work with others. An understanding of this desired skill requires a human factor explanation. The main objectives of human factors are to enhance the effectiveness and efficiency with which work and other activities, including social interactions, are carried out by people, and also to maintain and enhance certain desirable values (Isaac & Ruitenberg, 1999: 2).

Human factors cannot be separated from the air traffic control skill. Human factors are recognised as being at the heart of developments in the maintenance and improvement of aviation safety (Fuller, Johnston & McDonald, 1995: 1). Human use of complex and integrated systems is limited by the functional capacity of the human (Isaac, 1995: 107). This functional capacity relies upon an integration of air traffic control skills and the ability to understand human behaviour influences in the workplace. This integration is presented in Figure 2.2.

Figure 2.2 Illustrating human factors forces, explained from a team resource management perspective, that impact on the nature of teamwork in air traffic control



Adapted by the researcher from ATNS (2003: 21) and ICAO Circular 217-AN/132 (1989)

The influence of human factors on teamwork can be linked to human performance outcomes as observed from a workplace viewpoint. Performance differences associated with teamwork effectiveness can thus be

explained and understood from a human factors perspective by paying attention to individual and team (ATNS, 2003: 20 & 21) aspects listed below.

- Communication influences that include non-verbal communication, language fluency, listening skills, verbal reasoning, interpretation abilities and understanding.
- Problem-solving and decision-making abilities that include identifying problems, defining problems, constructing solutions, implementing and evaluating problem-solving, attention span, proactive actions and vigilance.
- Situational awareness differences, with reference to the ability to extract relevant and useful environmental cues and information in order to continuously construct reality. Isaac (1995: 108) also emphasises techniques such as imagery (ability to create a clear stable picture) and visualisation (three-dimensional spatial aptitudes) in this regard.
- Personality and attitude differences, with reference to the role of individual personalities, leadership/followership preferences and individual and shared work-related attitudes viewed within a certain corporate context.
- Knowledge, ability, skill and error differences that include differences in work experience, training received, traffic management skills, traffic scanning, dual tasking, error detection, remedial actions, control preferences, risk management, task allocation and prioritisation, and attention management.
- Sensory and perceptual differences, with reference to observation skills, coping and emotional control, individual and shared perceptions, and mental processing.
- Physiological and psychological differences that include adaptation abilities, sleep patterns, relaxation preferences, the effect of shift work, stress and fatigue, levels of boredom and complacency, and overall ability to handle the workload.

Several human factors focus areas have been identified above, which, in turn, identify the team-learning need to design, develop, implement and evaluate the appropriate attitudes, knowledge and skills associated with effective teamwork. It is therefore proposed that the effectiveness of air traffic control workplace learning (self-directed team learning) be studied from both a functional vocational perspective and a human factors perspective.

The role and relevance of human factors, as considered for this study, are presented in Table 2.5.

Table 2.5 Human factors focus areas and associated relevance to the study

Focus areas	Relevance to the study
Human factors and air traffic control are integrated concepts.	A study of air traffic control team outcomes and performance should include human factors and human factors influences.
Human factors can be identified, traced and understood by concentrating on specific indicators.	Human factors influences may be studied and explained in terms of: • team communication results; • individual and team problem-solving and decision-making abilities; • situational awareness maintained by the team; • personality and attitude differences; • individual and team knowledge, ability, skill and error differences; • individual sensory and perceptual differences; and • physiological and psychological differences amongst team members.
Human factors and workplace learning are related concepts.	Evaluating the impact of shared mental models, shared motives, accepted team learning strategies, and other behaviour-related variables present during self-directed team learning is required.

Compiled by the researcher

3.4 An overview of teamwork in air traffic control

An appreciation of air traffic control teamwork relies upon an understanding of the composition and intent of an air traffic control team.

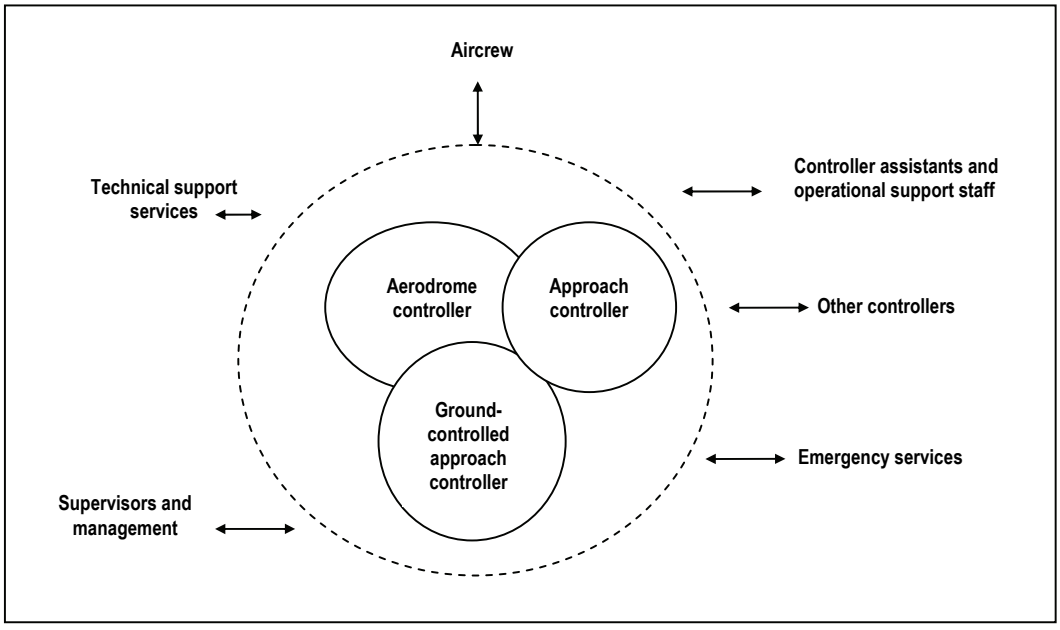
> *An air traffic control team comprises a small number of people with adequate knowledge and complementary skills who are committed to a common purpose and specific performance goals, following a common working approach, for which they hold themselves individually and collectively accountable* (ATNS, 2003: 22).

Teamwork in air traffic control allows for increased safety, by redundancy, to detect and remedy individual errors, whilst also increasing efficiency by the organised use of all resources to improve air traffic management and safety (ATNS, 2003: 20). Successful air traffic control teams share a common mental model.

The air traffic control team nucleus, considered for this study, consists of the aerodrome controller, approach controller and the ground-controlled approach controller. The air traffic control team does, however, not exist in isolation, as illustrated in Figure 2.3. A breakdown of the nature of teamwork in air traffic control (ATNS, 2003: 21) illustrates that teamwork exists between air traffic controllers and

- aircrew;
- controller assistants and operational support staff;
- other air traffic controllers situated on the same site, controllers at remote sites, emergency services and technical support staff; and
- supervisors and managers.

Figure 2.3 Breakdown of the nature of teamwork in air traffic control



Adapted by the researcher from ATNS (2003: 21)

The dynamics of air traffic control teams are found in different forms of collaborative decision-making between members in environments that present high information processing demands (ATNS, 2003: 21-22). Activities take place within, what is termed, *virtual teams*. Virtual air traffic control teams share decision-making tasks, the need for effective communication, respect for individuality, and a mutual striving towards safety, orderliness and efficiency associated with a quality and productive service (ATNS, 2003: 24). Such virtual teams are of necessity self-managed work teams (ATNS, 2003: 24).

The stability of air traffic control teams requires that specific team member competencies be emphasised in air traffic control teamwork. These include (ATNS, 2003: 22-24):

- teamwork skills — focusing on supportive behaviour skills, clear and direct team feedback skills, flexibility in operations and task execution, and effective communication;
- knowledge that is divided into team member generic knowledge (shared knowledge) and team member specific knowledge (involving information that they learn about individual team members); and
- team members' attitudes — team members' specific attitudes and team members' generic attitudes affect teamwork.

The role and relevance of teamwork in air traffic control, as considered for this study, are presented in Table 2.6.

Table 2.6 Air traffic control teamwork focus areas and associated relevance to the study

Focus areas	Relevance to the study
Successful air traffic control teams have stability and share a common mental model.	Assessment of teamwork skills, the team's ability to share knowledge and the team members' attitudes are required.
Effective self-managed/directed air traffic control work teams exhibit certain qualities.	• Assessment of the dynamics, associated with self-managed work team activities and workplace learning, in the air traffic control environment is required. • Effective air traffic control teams share decision-making tasks, the need for effective

	communication, respect for individuality, and a mutual striving towards safety, orderliness and efficiency that can be described in terms of the quality service delivery.

Compiled by the researcher

3.5 An overview of self-directed team learning

The notion of self-directed team learning encompasses individual and team learning approaches. Self-directed team learning brings together strategies from several educational streams, thereby allowing learners to meet their own individual learning needs and those of the team by being actively involved in critically analysing, reflecting on, and responding creatively to their situations (Hammond & Collins, 1991: 13).

Self-direction in learning arguably places specific demands on individuals and teams. At the self-directed individual level, the pursuit of learning issues is influenced by the social context, environmental, personal, and behavioural interplay of learners (Zimmerman & Lebeau, 2000: 308). Self-directed learners require skills that will enable them to define what to learn, the ability to plan and operationalise learning, time management skills, the ability to seek out, use and evaluate resources (Blumberg, 2000: 201). Self-directed team learning involves a continuing evaluation of learning goals, learning activities, personal demands and concerns, and perceptions (Zimmerman & Lebeau, 2000: 309). Team discussions and feedback provide ongoing sources of information for self-evaluation in order to allow the learner to keep up with the team's overall learning (Zimmerman & Lebeau, 2000: 309). Self-directed team learning thus relies on the team member's concerted effort and willingness to enrich and enlarge the collaborative learning effort.

Self-directed learning is dependent on learning objectives. When identifying learning objectives the impact and role of team members on the generation of learning objectives is considerable. In this way self-direction is work focused and socially supported so that productive self-directed learning processes can follow (Zimmerman & Lebeau, 2000: 303-304). The identification of learning objectives may also be constrained or supported by the team who encounter the problems in the workplace (Zimmerman & Lebeau, 2000: 304). Within the sphere of self-directed team learning the design of individual and shared learning objectives will be influenced by the team in terms of directing the learning focus.

Individual learning objectives cannot be ignored when an individual is participating in self-directed team learning. Such learning objectives are derived from a person's own experience and perceptions, which, in turn, create an individualised learning agenda for the learner (Zimmerman & Lebeau, 2000: 305). Learning objectives can also be derived from a team's own experience and perceptions, which, in turn, create a team-based learning agenda for the learners. Subprocesses associated with the pursuit of learning issues include: planning, using resources, and employing learning strategies (Zimmerman & Lebeau, 2000: 305). Team members may also constrain or support the pursuit of learning issues. Thus self-directed team learning is not simply the sum of individual and team learning objectives. Self-directed team learning is made up of an amalgamation of individual and team objectives.

Self-directed team learning in an air traffic control environment may rely on an intentional learning approach in order to manage such learning intentions. The European Organisation provides an example of an intentional team-learning approach for the Safety of Air Navigation (Eurocontrol, 1996: 23-24) as displayed in Table 2.7.

Table 2.7 An intentional team-learning approach

Setting:	A facilitator (team member) manages the process by which the team arrives at consensus and commitment to decisions and actions.
Main phases of activity	
1	Posing a leading question — clarify the problem statement
2	Brain-storming — focusing on possible solutions
3	Explaining ideas generated to improve common understanding and obtain agreement
4	Clustering ideas and proposed solutions
5	Conceptual mapping — the team identifies the relationships and dependencies of clustered ideas and develops model solutions
6	Compile a decision/action plan
7	Ensure follow-up is completed within the agreed timetable, and that any lessons learned are fed back into the process

Eurocontrol (1996: 23-24)

Self-directed team learning in an air traffic control environment may also rely on leading learning, which suggests a move towards an unintentional triggered learning approach. The role of learning, according to Argyris (1993(a): 5), is to correct errors by changing routine behaviour (referred to as single-loop learning),

and to correct errors by examining the underlying philosophies and values of the environment (referred to as double-loop learning). The quality of learning is thus crucial in detecting and correcting errors, and to meet the challenges of changing environments (Argyris, 1993(a): 5). Argyris (1993(a): 6) identifies the need for individuals and teams to be able to design and implement their behaviour — these theories of action are termed leading-learning. A summary of the basic requirements for leading-learning is presented in Table 2.8.

Table 2.8 Basic requirements for leading-learning

Basic requirement	Focus area
Presenting a real problem that requires a solution and implementation of the solution.	Identifying theories-in-use of participants and defensive reasoning.
Providing a description of the problem that provokes conversation.	• Identifying the conversation type used by participants to assist each other more effectively. • Identifying group dynamics and problem-solving processes.
Encourage expression of thoughts and feelings not discussed.	Identifying typical organisational/environmental defensive routines.

Argyris (1993(a): 16-17)

Learning objectives provide the focus and means in order to realise learning outcomes. Types of outcomes from effective team-directed learning can be categorised as (1) informational, (2) affective and (3) behavioural (Thomas, 2003: 12-15). Essential to the learning process is the ability to communicate; therefore a greater understanding of the way knowledge is coded will increase the power to communicate (Dills & Romiszowski, 1997: 211). The role and impact of communication is inferred in this categorisation because cognitive, affective and connotative outcomes rely on different communication forms. Examples associated with each outcome, viewed from a team member perspective, are included in Table 2.9.

Table 2.9 Examples of outcomes

Outcomes	Examples
Informational, with emphasis on cognitive outcomes	Methods for being more direct with people Understanding each other's roles Realising different ways that exist to achieve the same results Improving listening skills Creating and sharing helpful strategies and ideas
Affective	Questioning own assumptions Changing own behaviour Understanding own personal style Learning to reflect better Improving confidence
Behavioural, also emphasising connotative outcomes	Happy to share work and seek advice of others in the group Identifying specific non-verbal structures and meaning Conforming to acceptable workplace practices

Thomas (2003: 12-15)

The role and relevance of self-directed team learning, as considered for this study, is presented in Table 2.10.

Table 2.10 Self-directed team learning focus areas and associated relevance to the study

Focus areas	Relevance to the study
Effective self-directed team learning requires intentional and or unintentional participation from team members.	• Unfolding how self-directed team learning incorporates the team member's description of his/her critical analysis processes and outcomes, reflection habits and practices, and how he/she responds creatively to situations (learning opportunities). • Discovering the individualised learning agenda.

Self-directed learning from an individual perspective serves as an input into self-directed team learning initiatives.	Determining the individual practices and consequences achieved, as a result of continued evaluation of learning goals, learning activities, personal demands and concerns, and perceptions.
Self-directed team learning encourages individual learning initiatives.	The occurrence of and role of team discussions and feedback that provides ongoing sources of information for self-evaluation.
Self-directed team learning varies between intentional and unintentional learning strategies.	Explaining how self-directed teams plan learning, use resources to learn, and what learning strategies are employed.
Collective mental models rely on both self-directed learning (contextualised from an individual perspective) and team-directed learning (contextualised from a team perspective) in order to integrate vocational and human factors learning.	Collective mental models are also explained by investigating outcomes associated with self-directed team learning (including the cognitive, affective and connotative outcomes and associated communication forms).

Compiled by the researcher

4 Detailed literature investigation

Section 3	Detailed literature investigation	**Adult learning** • Introduction • Defining adult learning • The adult in self-directed adult learning • Self-directed adult learning characteristics • A functional self-directed adult learning environment • Self-directed learning as a means to facilitate continuation training • Role and relevance of adult learning
		Learning within teams • Self-directed teams • Teamwork • Learning within a self-directed team • Role and relevance of team learning
		Self-directed learning • Self-directed learning explored from an individual perspective • Self-directed learning explored from a team perspective • Intentional self-directed team learning and unintentional self-directed team learning • Role and relevance of self-directed learning

		Air traffic control operations • Air traffic control operations/workplace • Air traffic control • Teamwork in air traffic control • Air traffic control teams • Air traffic control operational output • Role and relevance of air traffic control operations
		Air traffic control training • The air traffic control operational training need • Design and development of air traffic control operational training • Air traffic control on-the-job training • Air traffic control continuation training • Role and relevance of air traffic control training
		Human factors • Human factors in air traffic control • Role and relevance of air traffic control human factors

4.1 Point of departure

The detailed literature investigation provides for an in-depth review of those topics and themes central to the study. These topics and themes are the result of a combination of the dissemination of the research question and subquestions and the terms and associated concepts contained above.

The aim of the detailed literature investigation is to provide an academic foundation for this study and to equip the researcher with the necessary knowledge to undertake the research. In this regard it is necessary to cluster essential knowledge matter in order to support coherence of information. This clustering is explained in Figure 2.4.

Figure 2.4 Clustering of essential knowledge matter

Disseminated research questions, terms and concepts		**Detailed literature investigation focus as a result of clustering**
Adult learning Continuation training	→	Adult learning (c.f. § 4.2)

Self-managed/self-directed teams	→	Learning within teams (c.f. § 4.3)
Self-directed team learning Self-directed learning Intentional self-directed team learning Unintentional self-directed team learning	→	Self-directed learning (c.f. § 4.4)
Air traffic control operations/workplace Air traffic control Teamwork in air traffic control Air traffic control teams Air traffic control operational output	→	Air traffic control operations (c.f. § 4.5)
Air traffic control training	→	Air traffic control training (c.f. § 4.6)
Human factors	→	Human factors (c.f. § 4.7)

Compiled by the researcher

4.2 Adult learning

4.2.1 Introduction

Self-directed team learning as postulated in this study relied on quantitative and qualitative contributions from the field of adult learning. Adult learning, therefore, served as the foundation of the detailed literature investigation. Specific areas from the field of adult learning and reasons for selecting these areas are listed below.

- Defining adult learning within the framework of this study — this definition served as an orientation for and understanding of adult learning.

- Understanding the adult in self-directed adult learning — this understanding provided me with the challenges that adults face during their lifelong learning quests and how they manage these challenges.
- Describing self-directed adult learning characteristics — this description allowed me to identify effective self-directed learning occurrences and criteria.
- Exploring what is considered to be a functional self-directed adult learning environment — the results of this exploration assisted me to identify environmental and social enablers that stimulate, foster and hamper adult learning within the specific structure of the study.
- Analysing the role of self-directed learning as a means to facilitate continuation training used by adult learners in the workplace.

4.2.2 Defining adult learning

This section provides information concerning adult learning and the adult learner considered to be relevant to the study.

The notion of adult learning is regarded as being essential in this study. Emphasis is placed on creating an understanding of adult learning in the workplace in order to grasp adult learner expectations, characteristics and dynamics as applicable to both the individual and team roles.

Creating an encompassing definition may possibly not do justice to the true meaning and understanding of adult learning in the workplace. A guiding description is, however, provided that captured the essence and intent of adult learning as applicable to this study.

> *A cooperative venture in non-authoritarian, informal learning the chief purpose of which is to discover the meaning of experience; a quest of the mind which digs down to the roots of the preconceptions which formulate our conduct; a technique of learning for adults which makes education coterminous with life, and hence elevates living itself to the level of an experiment* Lindeman (1925: 3).

This description was accepted because it acknowledges that:

- Adult learning can take place between peers without a pre-condition associated with and linked to authority. This precondition for self-directed learning is also described as an effective relationship

that encourages and supports learning and teaching that takes place on equal terms (Rogers, 2002: 55). The term *collaborative learning* is included in order to indicate that learning may be both structured and quantified (thus favouring a cooperative learning approach) and/or unstructured and qualified (thus favouring a collaborative learning approach) (Panitz, 1996: 1 & 2).

- Workplace experiences serve as both an input and product of learning, especially informal and collaborative learning. This implies that workplace experiences stimulate and initiate learning, whereas workplace learning that has taken place is applied and evaluated in the workplace. This line of thought corresponds with Kolb's (1984: 22) experiential learning theory.
- Intentional and unintentional learning are triggered by stimuli/occurrences which, in turn, create opportunities for reflection. These conscious and/or subconscious reflective learning events do provide opportunities to challenge one's espoused theories and theories-in-use (Argyris, 1982: 87).
- Learning and life cannot be separated, which in turn, also illustrates the role of the social environment within which learning experiences are apparent. The integration of learning and life is the result of intentional and unintentional learning from both a conscious and subconscious experimental perspective.

4.2.3 The adult in self-directed adult learning

An orientation of the adult learner within the context of adult learning served as precondition for understanding the adult in self-directed adult learning. Adult learners in every situation bring with them certain schemata or meaning systems composed of sets of beliefs or assumptions based on their experiences (Mezirow, 1981: 3-24 and Silverman & Casazza, 2000: 21). These schemata may result from workplace learning experiences and are possibly enforced, inter alia, by means of reflection. These schemata form filters through which new information is received and interpreted (Silverman & Casazza, 2000: 21). Equally important to experience are the expectations and agendas which adult learners bring to their learning experience (Rogers, 2002: 9). According to Rogers (2002: 71) adult learners:

- are in the middle of a process of growth, not at the start of a process;
- bring with them a package of experience and values;
- come to education with intentions;
- bring expectations about the learning process;
- have competing interests; and
- already have their own set of learning patterns.

The adult, when viewed from a self-directed adult learning perspective can be assisted to become increasingly more self-directed when given appropriate learning tools, resources, experiences and encouragement (Brockett & Hiemstra, 1991: 104 & 105). A conducive self-directed learning environment is characterised by the presence of these enablers. Such a conducive learning environment stimulates self-directed learning, provided that the adult learner is motivated and ready to make optimal use of learning opportunities. These learning opportunities require from an individual, often also assisted by a group or team, the ability, motivation and potential to identify, understand, apply and evaluate such learning. Belenky, Clinchy, Goldberger and Tarule (1986: 12) suggest various positions associated with a person's way of knowing and reasoning. These positions are:

- Silence — the learner sees knowledge as being held by an external authority.
- Received knowing — knowledge comes from an external source. Knowledge is constructed from opinions of others and by collecting ideas from others.
- Subjective knowing — knowing is intuitive rather than based on evidence, which illustrates the learner's own dependent thinking.
- Procedural knowledge — procedures for processing of information is developed, which shapes independent thinking.
- Constructed knowledge — knowledge is contextual and the knower is part of the context. Informed judgments and evaluative distinctions among perspectives are also present.

Within the self-directed adult learning context there should thus be a need to access knowledge held by another person (team member). Access is most likely the result of interacting with others with the aim of directing own learning and assuming responsibility for own learning. Such learning (knowledge and reasoning based) takes different forms such as testing intuitive and dependent thoughts, challenging independent thoughts, and constructing meaning by adding onto existing schemata.

The adult in self-directed adult learning brings specific learning filters, learning preferences, ways of dealing with knowledge, and reasoning strategies into the self-directed learning situation. These individual differences (and possible similarities) add to the overall dynamics associated with self-directed team learning. The need to uncover individual learning approaches, differences and similarities was identified as a precondition for research activities that were aimed at exploring, creating understanding and reporting of self-directed team learning.

4.2.4 Self-directed adult learning characteristics

Effective adult learning relies on the individual's willingness to accept responsibility for his/her own learning. Brookfield (1986: 17) states that in the field of adult learning, there is an assumption that self-directed learning is a sign of maturity and that being characterised as an independent learner is more likely to lead to success. Such independent learners are thus considered to be more analytical, inner-directed, and individualistic and have a stronger sense of self-identity, whereas dependent learners are extrinsically oriented, and in more need of external reinforcement. Learning outcomes are attributed to either internal or external factors and referred to as *locus of control* (Rotter, 1966: 1 and Silverman & Casazza, 2000: 22). Brookfield's (1986: 17) work has, however, shown that successful self-directed learners exhibit characteristics of dependency rather than independency. Learning activities of dependent learners are placed within a social context, and they cite people as the most important learning resource (Brookfield, 1986: 17). This line of reasoning suggests that self-directed learning within a team context may be effective in terms of overall impact on the team members. Effective self-directed adult learning is therefore linked to an external locus of control that favours dependency.

Self-directed adult learning relies on an approach and process that facilitates the design, development and evaluation of own learning. Learning is more effective when adult learners direct their own learning experiences, tailoring them to their unique needs and circumstances (Goleman, 1998: 28). Adults develop expertise in domains indirectly through experience (thus the notion of tacit knowledge). However, they are unable to articulate their knowledge base; rather they depend on an implicit memory (Silverman & Casazza, 2000: 33 and Mezirow, 1985: 17). Tacit knowledge or practical know-how is the kind of knowledge one acquires on the job or in everyday situations (Torff & Sternberg, 1998: 116). In general tacit knowledge is unspoken, underemphasised, and conveyed in an indirect manner (Torff & Sternberg, 1998: 116). Sternberg, Wagner, Williams and Horvath (1995: 912-927) outlined three categories of tacit knowledge:

- Tacit knowledge that is procedural in nature, taking the form of "knowing how" (procedural knowledge) rather than knowing what (declarative knowledge).
- Tacit knowledge that is practically useful; it is directed towards attainment of goals that people value.
- Tacit knowledge that is acquired under conditions of low environmental support; one often gains tacit knowledge on one's own, without much direct instruction.

Cognitive learning and development can also be understood by means of Sternberg's (1988: 10) triarchic theory. This theory presents an analytical phase when the learner frequently processes information by analysing how to solve a given problem and then monitoring and evaluating the effectiveness of the solution (Silverman and Casazza, 2000: 34). Once the solution is implemented, knowledge is acquired by sorting out the most relevant information for storage and connecting it to prior knowledge. The process follows a linear format and is characterised by an internal, mental methodology (Silverman & Casazza, 2000: 34). Metacognition — the self-awareness of cognitive processing strategies and the ability to control them — plays a significant role in learning (Silverman & Casazza, 2000: 49). The self-directed adult learning approach is thus characterised by an analysis of experiences (based on problem-solving and decision-making), reflection as an evaluation technique, and experimenting by recalling knowledge from memory.

The links between self-directed individual learning and self-directed team learning are found in the differences between people. People may not be aware of the different ways they process information, but because information is being processed all the time, it is easy to assume that the behaviour is automatic and that everyone else behaves (processes) in the same way (Silverman & Casazza, 2000: 48). It is not until something particularly difficult or out of the ordinary occurs that people begin to question why they are not "getting it" (Silverman & Casazza, 2000: 48). Then they may start to critically reflect on the individual nature of their own strategies and styles, as they relate to learning (Silverman & Casazza, 2000: 48). Self-directed adult learning is also characterised by different individual information processing processes; initiated by non-routine occurrences.

An analysis and understanding of differences amongst individual adult learners summarises and explains the characteristics of self-directed adult learners. Differences identified amongst adult learners from both an individual and team-based perspective, within a workplace environment, are concerned and characterised by the following (Silverman & Casazza, 2000: 74 - 85):

- **Self-esteem**. In this regard self-esteem refers to a person's overall assessment of personal adequacy or worth. It is postulated that successful experiences lead to enhanced self-esteem. Being valued by others is therefore viewed as a very important factor for positive self-esteem. A sense of having power or influence over events leads to enhanced self-esteem. These behaviour patterns are synonymous with teamwork. Some of the most powerful enhancement techniques for promoting self-esteem include being accepting and caring, providing consistent and positive feedback, and giving positive self-feedback.

- **Self-efficacy**. Self-efficacy refers to what promotes belief in the ability to perform a particular task. Although self-efficacy beliefs are closely proximate to ability levels, there is a motivational effect for success at activities that are within the expected performance range of the individual. The concept of self-efficacy or one's own belief about the ability to be successful in a given situation helps one to determine how much effort will be expended in learning (Bandura, 1977: 191-215 and Silverman & Casazza, 2000: 24 & 25). High self-efficacy beliefs result in enhanced efforts during difficult tasks, reduced stress in taxing situations, and the choice of goals that are challenging, and that sustain interest and involvement (Silverman & Casazza, 2000: 25). Low self-efficacy beliefs result in reduced effort, tendencies to give up when faced with difficult tasks, increased attention to personal deficiencies, the development of avoidance behaviour, increased anxiety and stress, and the likelihood of lowered aspirations (Silverman & Casazza, 2000: 25). The team's social state and joint competence influences individual and team self-efficacy beliefs. It can thus be expected that high levels of espoused and/or observed competence and social synergy will support greater levels of self-efficacy. According to Bandura (1986: 22) there are four sources of efficacy beliefs:

  - Mastery experiences that reinforce beliefs of competence (successes tend to raise a person's level of self-judgement, whereas failures tend to lower it).
  - Vicarious experiences that influence self-efficacy beliefs by offering individuals the opportunity to observe others similar to themselves performing well (it has been noted that observing others as they model successful behaviour can help raise an individual's own self-appraisal if there is some similarity between them).
  - Social behaviour which involves pressure to meet expectations of others to perform or belong. For example participation in a group learning activity can be facilitated by others in the group seeking a common goal. In order to produce a change, social persuasion must be accompanied by other influences.
  - Physiological and emotional states that influence one's beliefs of competence. People functioning in a supportive psychological environment, tend to have higher self-efficacy beliefs that enable them to better handle difficult situations that may arise.

- **Self-concept**. Self-concept refers to a person's judgment of his/her competence or skill in comparison to those of others. Adult learners possess self-concepts that accurately or inaccurately reflect their actual or perceived competence. The self-concept principle can also be observed in teams that hold or project professional competence (for example sport teams and other self-directed teams) as related to their performance and impact on overall goal attainment.

The exploration of self-directed adult learning characteristics indicated that self-directed learning may occur at both the individual and team levels. Learning at both these levels is characterised by differences that exist between individuals (intra and interpersonal differences) and teams (intra- and inter-team differences). Central to these differences is the impact of self-efficacy, self-esteem and self-concept principles. In addition metacognition was identified as an important aspect when attempting to understand individual and team cognitive processing approaches and strategies, and the influences that these have on self-directed learning efforts.

4.2.5 A functional self-directed adult learning environment

Individuals and teams exist within a social surrounding. The social surrounding includes the workplace/work setting. Learning for individuals and social systems (such as teams and organisations) must be studied together (Argyris, 1982: 474). Individual theories-in-use are based on the social system and culture in which individuals are embedded (Argyris, 1982: 474). Although individual and social systems are identifiable as separate entities, learning (such as double-loop learning) cannot occur without both of them being taken into account (Argyris, 1982: 474). Bruffee (1993: 3), furthermore states that knowledge is non-foundational and is a socially constructed sociolinguistic entity and that learning is inherently an interdependent, sociolinguistic process. Physical environments designed for interaction also promote learning engagements; the result being that a more open and inviting atmosphere will foster the exchange of ideas (Silverman & Casazza, 2000: 27). A self-directed adult learning study is thus not complete without prior consideration of the role and influence of the environment within which activities take place that contribute to learning.

Within the workplace a certain enabling or disabling climate exists. The implied climate illustrates the willingness or unwillingness of individuals and/or teams to invest intentionally or unintentionally in learning strategies. This specific social climate explains the degree to which persons help each other express themselves and create opportunities for individual growth and development (Silverman & Casazza, 2000: 29). Growth and development includes, however, is not restricted to experiential learning and reflection but also considers intentional learning initiatives. Thus approaches may be promoted within the workplace that facilitate the engagement of learners in group activities and have them “acting out” or using directly the skills which are the goal, rather than learning about them as abstractions for later application (Thorpe, 2000: 176-177). A self-directed adult learning study is incomplete without prior consideration of the role and influence of the enabling or disabling climate that prevails.

The learning environment and learning climate, viewed from a social perspective, are closely related and interdependent. The motivational climate (intrinsic and extrinsic) that relates to effective and successful learning from experience, is arguably dependent on environmental cues, occurrences and support that encourages such learning. An effective climate can thus be described as "I can /want to learn"; whereas the supportive environment can be described as "I am provided with resources and incentives to learn".

The workplace and the extended social setting (such as interaction with colleagues outside the immediate workplace) also influence learning. Knowledge is the outcome of a process of learning through social interaction and the subjective interpretation of each person's experience (Thorpe, 2000: 176). Such interaction can take place in an informal manner (for example during a lunch break or the change-room). The potential for such social interaction has been one of the single most important perceived benefits of information and communication for flexible learning, where groups of learners can interact and learn to learn together (Thorpe, 2000: 177).

A functional self-directed adult learning environment is made up of:

- a supportive learning environment;
- an enabling learning climate; and
- a complementary extended social setting.

The functional self-directed adult learning environment is furthermore dependent upon intentional/formal and/or unintentional/informal learning interventions.

4.2.6 Self-directed learning as a means to facilitate continuation training

Continuation training is regarded as training and learning activities (formal and/or informal) that are aimed at providing the necessary knowledge, skills and attitudes to employees in a proactive and/or reactive manner in order to ensure and sustain continued workplace competence. Continuation training encompasses learning at all levels in the organisation and is seen as movement towards becoming a learning organisation (Meyer, 1999: 90). Continuation training therefore aims to improve individual and team performance by empowering employees to learn continuously.

How is knowledge continuously distributed within an organisation? The distribution of knowledge occurs when feedback loops are integrated into work activity within and between teams (Owen, 2000: 332). In aviation organisations knowledge is acquired through pre-service and in-service training as well as through everyday work practice (Owen, 2000: 329). Organisations have a variety of processes and structures in place for remembering important events and learning from them (Owen, 2000: 333). Formal continuation training efforts correspond with traditional formal training and learning initiatives. These include scheduled lessons, lectures and practical refresher training. Conversations, story telling, revisiting/remodelling a scenario, evaluating a specific occurrence in terms of the regulating rules serve as some examples of informal learning; individuals share experiences so that learning is transferred to others (Owen, 2000: 333). Air traffic control continuation training (from an informal perspective), also focuses on a controller's experience where something dramatic happens, perhaps because of a controller's performance (or lack thereof), a system deficiency or an unexpected event (Owen, 2000: 334).

Within a high technology and fast changing work environment the continuation training contribution can be qualified in terms of self-directed incremental learning and unlearning (Meyer, 1999: 92). Continuation training thus stimulates incremental learning (building upon existing knowledge and skills) and ensures that required unlearning takes place (obsolete knowledge is discarded to make room for something new).

Self-directed learning, as a means to facilitate continuation training, ensures that real learning takes place in teams when team members learn from each other, learn from their achievements and mistakes, and continuously invest in learning optimisation opportunities.

4.2.7 Role and relevance of adult learning

The detailed role and relevance of adult learning, as considered for this study, are presented in Table 2.11.

Table 2.11 Adult learning focus areas and associated relevance to the study

Focus areas	Relevance to the study
Adult learning	Explore the influences of the following on learning that takes place in the work environment: • authority structures internal and external to the team; • learning support structures;

	• workplace experiences (viewed as an input and output of learning); • informal learning opportunities; • intentional and unintentional learning occurrences; and • environmental enablers/disablers.
The adult in self-directed adult learning	• Trace the expectations and agendas which adult learners bring to their learning experience. • Determine how knowledge is constructed by individuals as a result of learning. • Explore individual learning approaches. • Explore the role of interaction with others as a means to direct own learning and to assume responsibility for own learning.
Self-directed adult learning characteristics	• Identify the individual's level of willingness to accept responsibility for his/her own learning. • Explore the reported learning locus of control and individual learning approaches. • Explain the role of how analysis of experiences (based on problem-solving and decision-making), reflection as an evaluation technique, and experimenting by recalling knowledge from memory contributes towards self-directed adult learning results. • Record and analyse occurrences reported that provide insight into different individual information processes, as initiated by non-routine occurrences. • Allow respondents to elaborate on their use of self-esteem techniques, self-efficacy beliefs and self-concept status.
A functional self-directed adult learning environment	• Consider the role and influence of the environment.

	• Consider the role and influence of the climate. • Consider the role and influence of the complementary extended social setting.
Self-directed learning as a means to facilitate continuation training	• Determine the occurrence and aim of continuation training from both an individual and team perspective. • Explore the manner in which self-directed learning influences continuation training. • Identify cases of incremental learning and unlearning.

Compiled by the researcher

4.3 Learning within teams

This section provides insight into the practices, processes and dynamics that describe learning within self-directed/managed teams.

4.3.1 Self-directed teams

In order to understand the notion of the self-directed team it is necessary to explore the team concept. Primary informal teams are normally small face-to-face groups, a close-knit team based on mutual acceptance of roles — each member is influenced by the others and a sense of loyalty exists, founded on regular contact (Rogers, 2002: 171). The primary informal team will structure itself in the way the group members relate to each other in order to achieve a common goal (thus a task team), however, not ignoring socio-emotional influences of the team (Rogers, 2002: 173). The team, which has become a preferred term in organisational psychology (Guzzo & Dickson, 1996: 307-338), refers to small groups that work together on a common set of tasks. A work team is a group of individuals who see themselves and are seen by others as a social entity, which is interdependent because of the tasks performed as members of a group (Yancey, 2005: 1). Work teams are embedded in one or more larger social systems, performing tasks that affect others (Yancey, 2005: 1). Teams are a particular type of work group (Salas, Bowers & Edens, 2001: 13). A key distinguishing element of a team is that a team has both individual-participant and team accountability (Katzenback & Smith, 1993: 111-120). In this context a team comprises a group of air traffic controllers who have complementary skills and a common set of performance goals and standards and who act with mutual responsibility and accountability (Katzenback & Smith, 1993: 111-120). The responsibility

for and consequences of decisions made by air traffic controllers are of an individualised nature within air traffic control teams (Salas, Bowers & Edens, 2001: 33). A team's willingness to accept individual and collective roles and responsibilities with the aim of achieving a common goal; while also assuming accountability for its own process and risk management strategies signify a higher order team — a self-directed work team.

Self-directed work teams, also known as self-managing teams, represent a revolutionary approach to the way work is organised and performed (Williams, 2004: 1-5). Instead of organising work based on the traditional Taylor model — reducing a process to individual steps — work becomes restructured around whole processes (Williams, 2004: 1-5). Self-directed work teams represent an approach to organisational design that goes beyond quality circles or ad-hoc problem-solving teams (Williams, 2004: 1-5). Self-directed work teams are natural work groups that work together to perform a function (Williams, 2004: 1-5). Self-directed work teams manage themselves and the work processes that deliver a service (Irwin & Rocine, 1994: 10). Self-directed work teams are multiskilled and team members are encouraged to continuously develop skills and knowledge (Irwin & Rocine, 1994: 10). They not only do the work, they also take on the management of the work (Williams, 2004: 1-5). There must be interdependence and joint responsibility for outputs if there is to be a self-directed work team (Williams, 2004: 1-5). Self-directed work teams have resulted in (Williams, 2004: 1-5):

- improved quality, productivity and service;
- greater flexibility;
- reduced operating costs; and
- faster response to technological change.

The theoretical foundation of the self-directed team is explained by Yancey (2005: 1). The theoretical foundation proposed is a result of Yancey's (2005: 1) analyses of team effectiveness models. She identified the following characteristics (Yancey, 2005: 1):

- The social environment is open and supportive, with a focus on learning, without authority-directed problem-solving. Team members feel that they are equals with other team members, and there is an underlying commitment to team performance rather than individual performance.
- The self-directed team constitutes a variety of people with different experiences and areas of expertise. Strong interpersonal relationships allow the team to function more openly, sharing knowledge and experience.

- Communication is very important between team members and those outside the team.
- Participation is emphasised and all ideas are listened to without domination by a strong team member, thereby keeping the team open to creativity and thinking everything through thoroughly.
- The team has clearly defined goals to which all team members are committed and to which they aspire.
- Leadership is a shared group responsibility, not a delegated position. Because team members have different skills and abilities, the leadership role will likely change as the goals and dynamics of the team change.

Is an air traffic control team a self-directed work team? The air traffic control team's task and responsibilities are structured in terms of individual roles and a team role. This implies that the air traffic control team work is structured around the entire safe, orderly and effective air traffic control process. No one controller is thus more important than the other because the work is characterised by a common effort. Responsibility is shared in terms of the overall output (in case of an air traffic control incident it is not uncommon to investigate the performance of the entire team on shift). Air traffic control teams need to consider a variety of influences when performing their work (such as prevailing weather conditions, serviceability of equipment, traffic intensity, available controllers and emergencies) and are therefore as a team responsible to manage the workload during a shift by means of a collective work approach within a prescribed procedural and regulatory framework. An air traffic control work team is regarded as a self-directed work team.

4.3.2 Teamwork

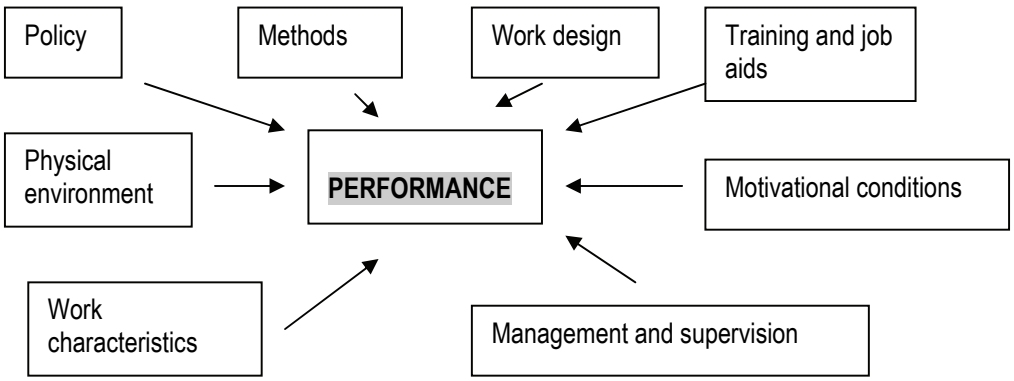
Teamwork describes the activities and associated dynamics that are present within a team at work.

Influences on worker performance, workgroup performance and organisational performance are illustrated by Dills and Romiszowski (1977: 193) in Figure 2.5. Influences on performance as presented by Dills and Romiszowski (1977: 193) do not pay specific attention to the intra-team actions, initiatives and enablers. Dills and Romiszowski's (1977: 193) model is useful when considering organisational structural and support mechanisms that need to exist in order to create an environment that will support and enhance performance. Gee's (2002: 3) model presented in Figure 2.6 elaborates on the work of Dills and Romiszowski (1977: 193) by paying more attention to the behavioural dynamics present within a team, which focuses on:

- commitment;

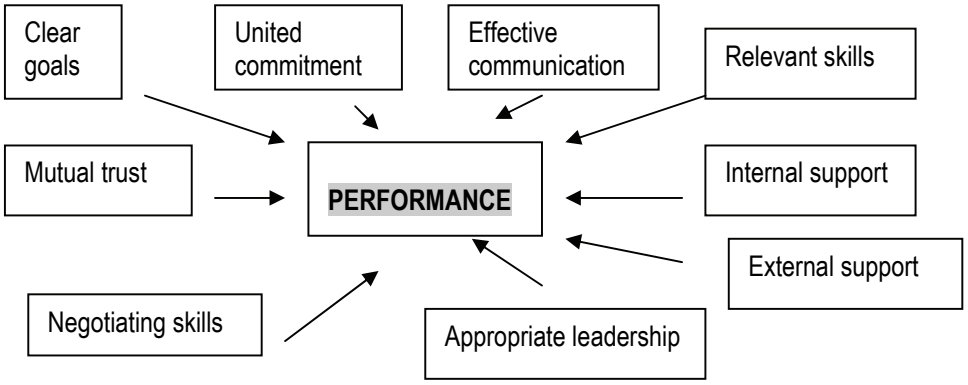
- skills;
- support;
- communication; and
- trust.

Figure 2.5 Influences on performance



Adapted by the researcher from Dills and Romiszowski (1977: 193)

Figure 2.6 Behavioural dynamics present within a team

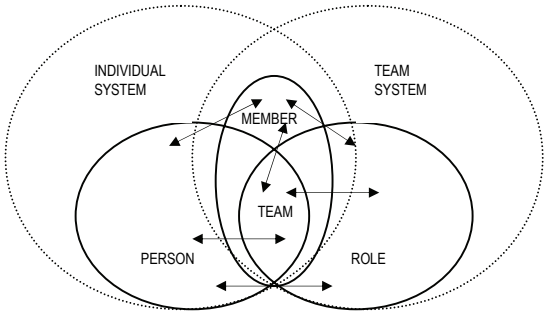


Adapted by the researcher from Gee's (2002: 3)

The dynamics of a team and individual interaction within a team are described with reference to a system that is in interaction with its environment. Such a dynamic system has a selective, semi-permeable boundary, which allows energy to enter into the team that challenges the status quo of the team — illustrating the presence of subsystems within the team. These subsystems regulate and provide energy for the relationships between the person, the member, the role and the team. Challenges therefore occur at the

personal level, the member role level, the team role, and/or at the level of the team as a whole (Barnes, Ernst & Hyde, 1999: 120-122 and Gee, 2002: 3). Simmonds (2004: 41-43) states that it is important to keep task, team and individual performance in balance. Performance management is thus described as a strategic relationship process based on continuous cycles of reflection, feedback and improvement. These relationships serve as input and output for each of the systems, as depicted by the arrows in Figure 2.7 (Agazarian & Peters, 1981: 44 and Simmonds, 2004: 42).

Figure 2.7 Relationships between the systems of the person, member, role and team



Adapted by the researcher from Agazarian and Peters (1981: 44) and Simmonds (2004: 42)

Impact as a result of a team action/activity/influence (such as self-directed team learning) can thus be measured at:

- individual level;
- team level; and
- in the output of the team.

The choice of teamwork as a solution to workplace challenges (including workplace learning) is directed by, inter alia, the following considerations:

- expected benefit associated with team work;
- complexity and intensity of the desired solution;
- complexity, intensity and immediate challenges of the process to be followed; and
- levels of responsibility and maturity that are required in terms of goal realisation.

Teams are successful at fostering hope and the expectation of change, which are not available in individual work. (Sharry, 2001: 10). The opportunities to assist colleagues by means of teamwork afford members a

chance to be of value and to contribute meaningfully to the team. This act of assistance necessitates listening to and focusing on defined concerns (Sharry, 2001: 12). The benefit associated with team work in this regard is captured in the spirit of interdependence amongst team members that directs and drives the team towards success.

Teams that focus on solutions will aim to ensure that the team is primarily positive and focused, that team members interact directly with one another, and that team members generate and integrate their own solutions as opposed to simply taking on board external solutions (Sharry, 2001: 44). A solution focused approach in teams is not about denying that problems exist but about ensuring that solutions get more attention within the team's discussions (Sharry, 2001: 48). It is thus postulated that the more complex the solution is, the more reliance there should be on effective teamwork.

Work process complexity influences teamwork. When team-centred interactions dominate team processes the members will interact directly with each other, rather than in turn via a facilitator. Success in this context depends on the high levels of maturity, trust, peer support, encouragement and respect of team members, which, in turn, allow members to effectively share the group time and to take turns between listening and speaking (Sharry, 2001: 49). There is a general consensus in the literature that a team cannot function without a collective goal or shared task (Johnson & Johnson, 1994, and Sharry, 2001: 80).

Effective teams rely on an agreed method/approach to follow, cohesion and pride amongst team members, and shared identity, high hopes and expectations (Sharry, 2001: 80-84 and Simmonds, 2004: 40-43). Ultimately goal achievement resides with the effort of the team, viewed from an individual and collective perspective. A common and shared understanding of the goal, processes, required solution and desired team performance serve as the basic elements of effective teamwork.

An investigation into the desired team performance is known when team dynamics are explored. Team dynamics can be said to exist when it possesses the following qualities (Jacques, 1991: 13 and Gee, 2002: 3):

- Collective perception — members are collectively conscious of their existence as a team.
- Needs — members join the team because they believe it will satisfy some needs or provide some rewards.
- Shared aims — members have common aims or ideals that to some extent bind them together. The achievement of aims is presumably one of the rewards.

- Interdependence — members are interdependent inasmuch as they are affected by and respond to any event that affects any of the team's other members.
- Social organisation — a team can be seen as a social unit with norms, roles, statuses, power and emotional relationships.
- Interaction — members influence and respond to each other in the process of communicating, whether they are face-to-face or otherwise deployed. The sense of "team" or "group" exists even when members are not collected at the same place.
- Cohesiveness — members want to remain in the team, to contribute to its well-being and aims, and to join in its activities.
- Membership — two or more people interacting for longer than a few minutes constitute a team.

Team success is not to be assumed when a team consists of motivated, competent and empowered individuals. Team members need to realise that teamwork may not always be effective. A team may become dysfunctional, develop a group thinking mentality, or become disruptive leading to arguments and discord within the team (Hick, 2005: 1).

Team members are also influenced by the work and extended external social environment. Thus teams operate at both a task and socio-emotional level. Furthermore, teams can be viewed as functioning within both intrinsic and extrinsic dimensions.

Table 2.12 demonstrates the interrelationships between the four aspects in a matrix format (Jacques, 1991: 72 & 73). Importantly, Table 2.12 also indicates types of aims and purposes to be considered in team teaching and learning initiatives.

Table 2.12 Types of aims and purposes in group teaching

	Task	Socio-emotional
INTRINSIC	Expressing selves in subject	Greater sensitivity to others
	Judging ideas	Judging self in relation to others
	Examining assumptions	Encouraging self-confidence
	Listening attentively	Personal development
	Tolerating ambiguity	Tolerating ambiguity
	Learning about groups	Awareness of others' strengths and weaknesses
EXTRINSIC	Follow-up to lecture	Giving support
	Understanding text	Stimulating to further work
	Improving staff relations	Evaluating feelings about learning experiences
	Gauging learning progress	Having identifiable groups to belong to
	Giving guidance	

Jacques (1991: 72 & 73)

Organisations also need a more effective approach to the analysis and training of complex resource management skills at both the individual and team levels (Salas, Bowers & Edens, 2001: 9). A team's task and socio-emotional characteristics influence the effectiveness of goal achievement, the effort of the team (viewed from an individual and collective perspective), the dynamic spirit of the team, and team learning considerations.

Operations in high technology, complex and demanding work environments elect to make use of a teamwork approach due to the associated direct and indirect benefits as a result of effective teamwork.

Some of these benefits associated with effective teamwork are presented below.

- There is a growing awareness of the importance of resource management skills related to decision-making, team coordination, and planning, especially in organisations where work teams perform complex, time-constrained, and critical tasks (Salas, Bowers & Edens, 2001: 9).

- Teamwork, open lines of communication, cooperation, listening, and speaking one's own mind (Goleman, 2004: 148). The single most important factor in maximising the excellence of a group's product is the degree to which the members were able to create a state of internal harmony, which let them take advantage of the full talent of their members (Goleman, 2004: 161). Many things people do at work depend on their ability to call on a loose network of fellow workers; different tasks can mean calling on different members of the network (Goleman, 2004: 161). This creates an opportunity for ad hoc groups, each with a membership tailored to offer an optimal array of talents, expertise, and placement (Goleman, 2004: 161).

- From a solution-focused perspective the benefit of effective teamwork is found in the positive, supportive interpersonal communication among team members. Solution-focused teams accept the important role of continuous learning and development, therefore learning includes imparting of information, interpersonal learning, developing socialising techniques and imitative behaviour (Sharry, 2001: 8-10).

- Effective informal networks consist of at least three varieties: communication webs — who talks to whom; expertise networks, based on which people are turned to for advice; and trust networks (Goleman, 2004: 162). These networks rely on effective coordination of efforts in teamwork, being leaders in building consensus, being able to see things from the perspective of others, persuasiveness, and promoting cooperation while avoiding conflicts (Goleman, 2004: 163). Other skills displayed by team members include (Goleman, 2004: 163):

    - Taking the initiative;
    - being self-motivated enough to take on responsibilities above and beyond their stated job; and

- self-management in the sense of regulating their time and work commitments.

Teamwork, as a human activity, also provides different levels of performance, outcomes and effectiveness. This is especially true when analysing the results of air traffic control teamwork. Varying levels of success are reported in air traffic control teamwork. Air traffic control team feedback and debriefings are limited to what the team did incorrectly and failed to specify how the team could ameliorate its performance or inform the team members about what they should practice in order to improve their resource management skills (Salas, Bowers & Edens, 2001: 14).

Situational awareness is commonly used as an indicator of overall air traffic control team effectiveness. Situational awareness is the perception of the elements in the environment within a particular time and volume of space, the comprehension of their meaning, and the projection of their status in the near future (Cavcar & Cavcar, 2004: 147). The ultimate goal of teamwork is to ensure and maintain effective team situational awareness within and between air traffic control teams. The indicators of effective and ineffective team situational awareness are portrayed in Table 2.13 (Henderson, Endsley & Hayward, 2000: 416) — with specific applicability to the air traffic control work team.

Table 2.13 Effective and ineffective team situational awareness

Characteristics of ineffective teams	Characteristics of effective teams
Fell into the situational awareness "black hole": thus one member would lead others off	Self-checking: checked against others at each step
Did not share pertinent information: a group norm	Coordinated information sharing: to obtain information from each other
Failure to prioritise: members went in their own directions, and the group lost track of the main goal	Prioritised effort: contingencies were set up
Relied on expectations: unprepared to deal with false expectations	Questioning as a group: a group norm

Henderson, Endsley & Hayward (2000: 416)

Teamwork, from a self-directed viewpoint, acknowledges the dynamics of all the interdependent interactions that exist within a team. These interactions are regulated by direct and indirect individual and team control actions/activities/influences (such as self-directed team learning) and can therefore be quantified and/or

qualified. A common and shared understanding of the goal, processes, problems, required solutions and desired team performance serve as the basic elements of effective teamwork that can be learned within a self-directed team.

4.3.3 Learning within a self-directed team

Team learning is an adaptation of action learning and is fundamental to the performance of a self-directed team (McCann, 2005: 2). Team learning is vital because teams, not individuals, are the fundamental learning unit in modern organisations. This is where the "rubber meets the road"; unless teams can learn, the organisation cannot learn (Senge, 1990: 10). People have always come together in teams or groups to create and achieve outcomes that they could not possibly have done alone (Sharry, 2001: 2). These team activities involve, amongst others to plan or carry out tasks, to teach or learn, or to dialogue and resolve disagreements (Sharry, 2001: 2). Solution-focused teamwork aims to establish collective and mutually beneficial goals and to harness the team's resources, skills and strengths towards empowering team members to make realistic steps towards goal attainment (Sharry, 2001: 2). In this respect Sharry (2001: 2) quotes the following Hasidic story:

> *"I will show you Hell; the Lord said to the rabbi, whom he took to a large room full of miserable looking people. They all sat around an appetising cauldron of food, but none could eat. The only spoons in the room had long handles, which were long enough to reach the cauldron and scoop up some food, but too long to get the food into one's mouth. As a result, all were frustrated and starving. I will now show you Heaven; the Lord said and took the rabbi to another room. This room was identical, with a large group of people sitting around the same cauldron with the same long spoons. But they looked content, satisfied and definitely well-fed. What is the difference? asked the puzzled rabbi. Ahh; replied the Lord, the group in the second room has mastered an important skill – they have learnt how to feed one another. "*

Empowerment of the team requires the willingness from every team member and the whole team to continuously learn from, amongst other things, their own experiences, problems and concerns in the workplace. Self-directed teamwork is essentially about helping people to make fuller use of observations and experiences to enhance their participation in team activities (Barnes, Ernst & Hyde, 1999: 1). One person's formulation of a problem, or exploration of a dilemma, may contain many points of connection to others' experiences (Brookfield, 1990: 39). Self-directed learning within a team can be stimulated by problem-based learning (Schmidt & Moust, 2000: 21). Blumberg (2000: 199) states that an analysis of

research evidence supports the hypothesis that learners participating in problem-based learning demonstrate self-directed learning skills. Problem-based learning makes use of phenomena or events that can be observed in daily life, or important theoretical or practical issues (Schmidt & Moust, 2000: 21). A seven-step procedure designed by Schmidt and Moust (2000: 21-23) facilitates problem-based learning. The seven-step procedure is presented in Table 2.14.

Table 2.14 Overview of the seven-step procedure

1	Clarify unknown terms and concepts in the problem description.
2	Define the problem.
3	Analyse the problem; "brainstorm"; try to produce different explanations for the problem.
4	Criticise the explanations proposed and try to produce a coherent description of the problem.
5	Formulate learning issues for self-directed learning purposes.
6	Fill the gaps with knowledge through self-study.
7	Share findings with the team and try to integrate the knowledge acquired into a comprehensive explanation — also check for learning and understanding.

Schmidt and Moust (2000: 23)

The benefit of learning and interacting within the team context can be described from both an individual and team perspective. To create effective learning, teams must be aware of the broad social structures, the face-to-face interpersonal structures, and deeper individual structures that can both empower and constrain (Ober, Yanowitz & Kantor, 1996: 50). Foulkes (Barnes, Ernst & Hyde, 1999: 26) describes a team as a matrix, thereby indicating the complex relationships between individuals, subgroups and the entire team. Such a matrix can be understood and described as the shared common ground that determines the meaning, spirit and significance of all that happens to a team. This implies that each individual in the team contributes to the complex and dynamic network of team relationships. The safety of a team allows team members to rediscover and work through problems, misunderstandings and difficulties through interaction with the team. Individuals within a team are exposed to others, who do not see the world in a similar way (Barnes, Ernst & Hyde, 1999: 28).

It is acknowledged that conflict may exist within teams due to the differences found in team members. Conflict is viewed as one of the risks/disadvantages associated with teamwork and team learning. Other disadvantages of teamwork in learning are (Rogers, 2002: 177-178):

- The pressure to conformity, the suggestibility that the team exerts on the individual member, can promote imitation, not the free exercise of experiment.
- The status offered by the team may become restrictive. The individual may become typecast by other teams into a set role and may thus find it hard to break out and adopt another role.
- The closeness of the team, as each member engages in the activities, may become a threat to some of the more individualistic learners. The group may be strong enough to deter experimentation by those who are less confident.
- Some members may find it difficult to cope with the wide range of experiences and views that others see as the richness of the adult learning group.
- The pace set by the team may not meet or satisfy the needs of an individual member. Teams may be intolerant of those members who are regarded as moving too fast or too slow.

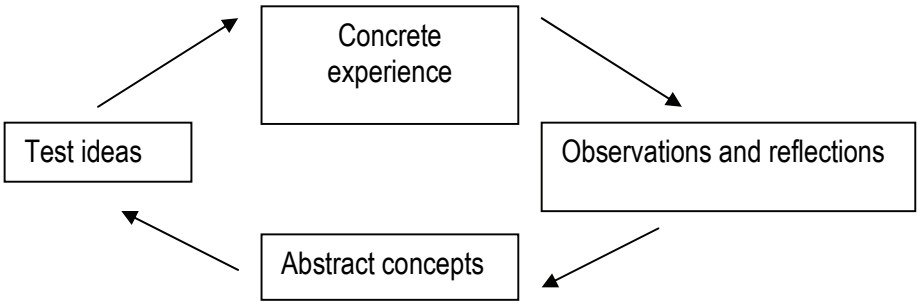
The following problems or megatraps (Rayner, 1996: 5) may also contribute to ineffective team performance and team learning within a self-directed team context:

- **Strategic blunders** imply that no organisation structure is immune to the strains and pressures of changing conditions, threats and management. Teams thus cannot cover up for organisational strategic blunders.
- **Collision of work cultures** means that changes to a team's charter and membership will likely lead to a regression in its overall operating and learning effectiveness.
- **Inability to transfer learning** refers to the tendency to dismiss what is often significant achievement that hampers both the credibility and assumed relevance of team member involvement.

The challenges (focus areas) researchers are faced with when studying self-directed learning within a team context are understood with reference to Kolb's (1984) explanation of learning. Learning is at the centre of our ability to adapt to the most trivial and the most profound environmental demands, thus facilitating the crucial process necessary for knowing a world rich with experience and opportunity (West, Farmer & Wolff, 1991: 1). The workplace learning experience is considered to be generative in the sense that learners generate meaning out of information/experiences presented to them (MacLeod, 2001: 36). Workplace

learning can also be constructive in that learners can construct skills and knowledge through interactions with their surroundings (MacLeod, 2001: 36). Adults need to be motivated to learn; they need to see the relevance of what they are learning and they need to discover things for themselves (MacLeod, 2001: 24 and Goleman, 1998: 28). This adult approach to learning is described by Kolb's (1984) learning cycle (MacLeod, 2001: 24 & 25); appearing below in Figure 2.8.

Figure 2.8 Kolb's learning cycle



Kolb (1984) in MacLeod (2001: 24 & 25)

The role of experiences in continuous learning is highlighted by Kolb's (1984) model. It is implied, from a process-based theory, that learning is accomplished by critically analysing experience and acting on the basis of that analysis (Rogers, 2002: 107). Learning results from informal learning networked activities and information exchanges (Brookfield, 1985: 8). Learners act and serve as skill models and resource consultants to fellow learners of varying levels of expertise (Brookfield, 1985: 8). Kolb's (1984) model reflects an informal mechanism by which people learn and is explained in terms of the following (MacLeod, 2001: 24 & 25):

- **Concrete experience** refers to daily experiences as experienced by adults. These are own experiences and experiences of others (Rogers, 2002: 108).
- **Observations and reflections** refer to a cause and effect analysis that takes place in order to spot any gaps in understanding. Critical reflection comprises a process of asking questions about experience in the light of other experience (Rogers, 2002: 108). Critical reflection will lead in some cases to the development of generalisations (abstract conceptualisation) (Rogers, 2002: 108).
- **Abstract concepts** signify that experiences are analysed to create new ideas, concepts and structures (Rogers, 2002: 110). Rules are created to explain phenomena. Generalisations are also constructed to apply to similar, related or other situations.
- **Test ideas** in new situations.

Barclay (1996: 29) expands on Kolb's (1984) model when she suggests the following learning styles:

- **Activists** — those who involve themselves fully and thrive on new experiences.
- **Reflectors** — those who like to stand back and ponder experiences.
- **Theorists** — those who adapt and integrate observations into sound theories.
- **Pragmatists** — those who are keen to try out new ideas, theories and techniques to see if they work in practice.

Kolb's model (1984) also forms the foundation of the four specific phases and approaches of team learning proposed by Kasl, Dechant and Marsick (1993: 144 & 145). Phase one — Contained learning — proposes that learning, if any, is contained within the individual members. Phase two — Collected learning — occurs when individuals begin to share information and meaning perspectives. However, there is not yet an experience of having knowledge that is uniquely the team's own. Phase 3 — Constructed learning — allows the team to create knowledge of its own by integrating individuals' knowledge and meaning perspectives. Phase 4 — Continuous learning — prevails when the team institutes measures and processes to transform experiences into knowledge. From the above it becomes evident that people learn differently, however, it would seem that experience is a necessary (but not the only) contributor towards effective learning. It is also necessary to reflect on learning approaches and experiences, and to ensure that a continuous learning intention prevails.

Romiszowski (1984: 157) summarises the theoretical principles underlying teamwork into two basic principles. The first being that a team has its own "being" or "reality", with specific characteristics of behaviour and secondly that individuals, when integrated into a group, are affected by the specific behaviour dynamics of the group. Nine team activities that can influence behaviour and team learning initiatives are suggested by McCann (2005: 1). Learning opportunities may be found in the following team activities (McCann, 2005: 1):

- Advising — gathering and reporting information.
- Innovating — creating and experimenting with ideas.
- Promoting — exploring and presenting opportunities.
- Developing — assessing and testing the applicability of new approaches.
- Organising — establishing and implementing ways of making things work.
- Producing — concluding and delivering outputs.

- Inspecting — controlling and auditing the working of systems.
- Maintaining — upholding and safeguarding standards and processes.
- Linking — coordinating and integrating the work of others.

Romiszowski (1984: 158) identifies five principal advantages of teamwork in the educational or training context (presented in Table 2.15).

Table 2.15 Principal advantages of teamwork

1	Work in teams satisfies a social necessity — with reference to the development of social skills such as cooperation, coordination, problem-solving and decision-making.
2	Work in teams promotes intellectual development — with reference to the development of rational thought.
3	Work in teams humanises the teacher-learner relationship — authority is removed from the teacher, which leads to greater interest and motivation of the learners.
4	Teamwork promotes the development of personality — personality growth is the result of interaction between the individual and the team.
5	Teamwork promotes creativity — team discussions, interchanges and collaboration tend to break down conventions, mental inertia and other barriers to innovative thinking.

Romiszowski (1984: 158)

Self-directed learning within a work team relies primarily on informal mechanisms. This statement is supported by the notion that learning through teams relies on certain assumptions and principles (Jacques, 1991: 211), those being that:

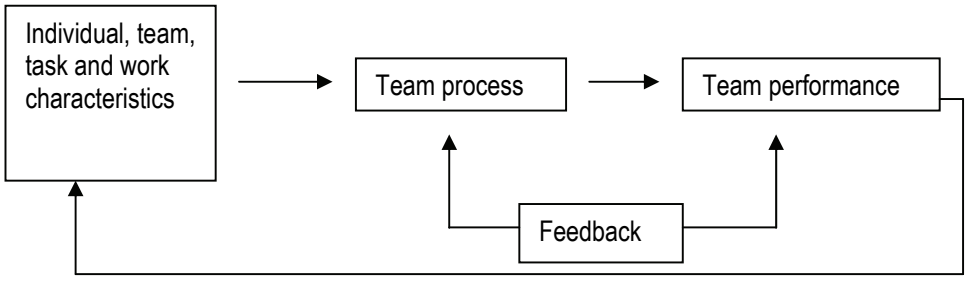
- Accent is on the "whole person" learning; learning that involves thinking, feeling and behaviour.
- There must be practice of behaviour and skills — practice that is informed by guided experience and constructive feedback.
- There should be a strong focus on the present because it helps in the learning and monitoring of skills.
- There should be general acceptance that everyone has unique styles of personal behaviour, different needs and their own way of seeing the world.
- Emphasis should be on the "social self" rather than the "inner world" of participants.

- Personal change is best achieved where there is a judicious blend of support and challenge.
- The primary orientation should be towards the development of skills, but these should be seen within a wider framework of attitudes and values.

Learning within a group or team context makes it more difficult for the learner to remain passive, uninvolved in the discussions taking place or uncommitted to the achievement of the set objectives (Romiszowski, 1984: 157). The supposition is that team members are willing not just to learn, but also to learn how to learn and to integrate this into their future development (Jacques, 1991: 211). Thus learning is a cyclical process and includes taking risks, willingness to share, acceptance of feelings and the ability to monitor one's own experience and progress (Jacques, 1991: 211). "Experience is not what happens to you, it's what you do with what happens to you" (Jacques, 1991: 211).

Self-directed team learning requires an understanding of the process that enables such learning from a team perspective. A group-analytical approach to teamwork allows researchers to observe and understand an individual's behaviour within a team, the team's response to such behaviour and the underlying reasons for the team's response and any resulting behaviour (Barnes, Ernst & Hyde, 1999: 4). During research conducted to help medical students to develop their scientific judgement, it was found that through team interaction participants can be helped to mutually test and modify internal schemata (reference the team member's basic reactions, expectations, assumptions and attitudes) (Barnes, Ernst & Hyde, 1999: 1 & 2). Salas, Dickinson, Converse and Tannenbaum (1992: 3-29) and Anderson and Henley (1995: 310) present an integrated model of team performance and training. This model (Figure 2.9) emphasises the links that exist in self-directed team learning between the individual, the team and the work effort/results.

Figure 2.9 Integrated model of team performance and training



Salas, Dickinson, Converse and Tannenbaum (1992: 3- 29) and Anderson and Henley (1995: 310)

Team development, viewed from a systems approach, shows that a team member joins a team as an individual and begins to interact with others in the team. The team member then moves across a psychological boundary to become part of a system — the team. Further development of the person, within the limitations of the team, occurs when he/she becomes part of the team as a whole, thus realising that he/she is influenced by and in turn influences the system. Becoming part of a self-directed team requires learning and development by the team member. Such learning will not be restricted to task behaviour only. Contemporary life places a premium on the ability of people to get on with each other, to be able to handle interpersonal problems rather than to avoid them, and to do so constructively and creatively (Jacques, 1991: 21). It is possible to practice these qualities in small-group work when learning is not subject to purely work limitations (Jacques, 1991: 21). This serves as recognition that people's emotions are a necessary part of their existence and that learning should not only focus on the rational/intellectual person, but also on behavioural aspects such as passion, anxieties and convictions (Jacques, 1991: 21). Finally the person will also typically move into a team role as he/she finds him/herself performing a team role or roles (Barnes, Ernst & Hyde, 1999: 121).

Self-directed team learning requires an understanding of the process that enables such learning from an individual perspective. Individuals bring different perspectives, qualities and characteristics to learning situations due to individual differences in aptitude, personality and learning style, attitude and motivation, information processing (memory span, processing speed), prior experience and stress (MacLeod, 2001: 26). The question posed in this regard is: "Is it possible to create knowledge that is valid and actionable in everyday life and whose use in everyday life by practitioners is an opportunity for a valid test of knowledge?" (Argyris, 1993(b): 249). The answer to this question, in turn, should add to our understanding of organisations and organisational learning and especially to our understanding of ways to change the status quo (Argyris, 1993(b): 249). The essential requirement for creating such knowledge is to have a theory of action that can be used to diagnose and understand individual, group, intergroup and organisational behaviour (Argyris, 1993(b): 249). These theories of action (normative theories that do not claim an objective truth) will explain how individuals/teams embrace reality in order to manage it effectively (Argyris, 1993(b): 249). Theories of action are at the core of human competence, self-esteem, and self-efficacy (Argyris, 1993(b): 250). Individuals gain confidence by acting in ways that they and others evaluate as effective (Argyris, 1993(b): 250). Individuals ensure that these effective actions will continue by creating organisational patterns that encourage learning (Argyris, 1993(b): 250). For theories of action to be tested in everyday life, it must be possible to derive from them the actual behaviour required for effectiveness — theories of action must produce actionable knowledge (Argyris, 1993(b): 250). Theories of action need to be usable to describe and understand reality, invent new solutions to problems, and prescribe what actions

are to be taken, how they are to be implemented, and how the effectiveness of the implementation is to be evaluated (Argyris, 1993(b): 250).

Team learning discourages the individual to remain passive, uninvolved or removed from learning experiences. Team learning encourages team members to make fuller use of observations and experiences, especially during workplace problem-solving actions, with the aim of enhancing their participation in team activities. Team learning harnesses the team's resources, skills and strengths towards empowering team members to take realistic steps towards goal attainment. Team learning experiences are considered to be generative in the sense that learners generate meaning out of information/experiences — signifying a readiness for self-directed learning.

4.3.4 Role and relevance of team learning

The detailed role and relevance of team learning, as considered for this study, is presented in Table 2.16.

Table 2.16 Team learning focus areas and associated relevance to the study

Focus areas	Relevance to the study
An air traffic control work team is regarded as a self-directed work team.	Obtain evidence that will support the statement/generalisation that the air traffic control team is a self-directed work team.
Impact as a result of a team action/activity/influence (such as self-directed team learning) can thus be measured at: • individual level; • team level; and • output level of the team.	Measure/explain/trace impact influences at: • individual level; • team level; and • output level of the team.
Benefits associated with effective teamwork and disadvantages associated with teamwork.	• Explore team dynamics found in air traffic control teams. • Identify and explore benefits and disadvantages reported by teams and determine the impact of these on team efforts.

Team members are influenced by the work and extended external social environment.	Describe the social environment and trace the impact thereof on team performance and team learning intentions.
Teams, not individuals, are the fundamental learning unit in modern organisations.	Investigate to what extent the following team learning enablers achieve the following within air traffic control teams: • solution-focused teamwork; • empowerment; • problem-based learning; • use of workplace learning opportunities; • group analytical approaches; and • theories of action.

Compiled by the researcher

4.4 Self-directed learning

This section provides insight into self-directed learning. Self-directed learning is explored from an individual, team, intentional and unintentional learning perspective.

4.4.1 Self-directed learning explored from an individual perspective

An exploratory study of the individual's involvement in self-directed learning allows one to understand the dynamics associated with self-directed learning experiences. According to Knowles (1984: 2-4) and Hammond and Collins (1991: 16) self-directed learning provides learners with an opportunity to diagnose learning needs and choose educational goals, strategies and evaluation techniques, while satisfying conventional institutional demands on standards. This point of view does not emphasise critical awareness and social interaction. Hammond and Collins (1991: 13) and Goleman (1998: 28 & 29) adapted Knowles's (1984: 6 & 9-12) original definition of self-directed adult learning in order to define the critical self-directed learning process. The aim of this process is to allow learners to take greater responsibility and control of their learning. The critical self-directed learning process allows learners to take the initiative, with the support and collaboration of others in order to (Hammond & Collins, 1991: 13):

- increase self- and social awareness;
- critically analyse and reflect on their situations;

- diagnose their learning needs with specific reference to competencies they have helped identify;
- formulate socially and personally relevant learning goals;
- identify human and material resources for learning;
- choose and implement appropriate learning strategies; and
- reflect on and evaluate their learning.

The field of adult education has long embraced such ideas as autonomy, independence, and personal development of adult learners (Brockett & Hiemstra, 1991: 7). Self-directed learning is any increase in knowledge, skill, accomplishment, or personal development that an individual selects and brings about by his or her own efforts using any method in any circumstances at any time (Gibbons, 2002: 2 and Goleman, 1998: 28). Self-directed learning brings together strategies from several educational streams, thereby allowing learners to meet their own individual learning needs by being actively involved in critically analysing, reflecting on, and responding, creatively to, their situations (Hammond & Collins, 1991: 13). Self-directed learning integrates competence-based education principles in order to allow learners to develop specific competencies they will need to function effectively in the real world (Hammond & Collins, 1991: 16-17). In self-directed learning, the learners set own goals, make plans and initiate action, whilst also assuming responsibility for assessments of learning and/or competence (Gibbons, 2002: 3 and Goleman, 1998: 28). All of these in some way stress the role of individual learners in the learning process (Brockett & Hiemstra, 1991: 7).

The purpose of learning is about more than survival; it is also about development and the growth of the individual (Dixon, 1994: 31). Self-direction in learning can be seen as a means, or vehicle, by means of which individuals can more fully realise their greatest potential as human beings (Brockett and Hiemstra, 1991: 122). Brockett and Hiemstra (1991:84-99) provide a summary of qualitative studies of self-directed learning that have been conducted in order to gain a better understanding of the self-directed learning phenomena (refer to Table 2.17).

Table 2.17 A summary of qualitative studies of self-directed learning

Study by:	Findings of the study
Gibbons, Bailey, Comeau, Schmuck, Seymour and Wallace (1980: 41 - 56)	Gibbons and his colleagues drew several conclusions about differences in assumptions that underlie self-directed learning and formal schooling. A list of their conclusions is presented (Gibbons, et al., 1980: 41-56). • There is much greater diversity in the kinds of expertise and skills needed by the self-educated experts than is generally stressed in formal schooling. • The expertise developed by individuals appears to have grown out of extracurricular activities. • Self-directed learners focus their efforts on their area of expertise. • A strong, active, experiential orientation to the learning efforts was noted. • Successful self-directed learners tend to possess characteristics that enabled them to pursue their areas of expertise despite great odds, failures, and disapproval.
Brookfield (1981, 15 - 27)	Brookfield (1981: 20) identified three attitudes toward learning that seemed to be shared by many of the independent learners; these learners • tended to view their involvement in learning activities as ongoing, with no identified end point; • did not limit their studies to conventional study boundaries; and • believed themselves to belong to a larger fellowship of learning. While individuals assumed primary responsibility for planning and carrying out learning activities, the learners did not work in isolation from others who shared their interest. Learners emphasised their identification as being a part of a group of individuals with a common interest and they expressed both a spirit of cooperation (willingness to share information and expertise) and competitiveness. It was seen as important by learners to have their abilities recognised by their peers through awards and competitive success.

Lean and Sisco (1981: 28 & 29)	Lean and Sisco (1981: 28 & 29) investigated self-directed learning among rural adults and their major findings related to self-direction are listed. • Learning is seen as part of everyday living as people are continually challenged by their environments to solve problems as well as explore interests. • Thinking is connected to times when people are alone, usually doing mundane or repetitive chores or tasks. • The ways people talked about how they go about their self-directed learning varied. • Learning was enjoyed because it was managed at an own pace without anybody judging the learners. • Both men and women expressed a belief in the value of commonsense thinking and rational problem-solving. • Times were recognised when answers to problems were obtained through non-rational means.

Adapted by the researcher from Brockett and Hiemstra (1991: 84-99)

Individual self-directed learning is not a linear, dominant formal and restrictive process. Self-directed learning is influenced by the individual's level of experience, expertise, curiosity, motivation, reflective abilities and willingness to participate with others. These self-directed learner characteristics are furthermore dependent upon conditions that will stimulate self-directed learning.

Individual self-directed learning relies on conditions that will stimulate, foster and facilitate effective learning. Self-directed learning by individuals is frequently inhibited by the absence of a guiding model or plan (Brockett & Hiemstra, 1991: 106). Brockett and Hiemstra (1991: 30) suggest that optimal conditions for learning result when there is a balance, or congruence, between the learner's level of self-direction and the extent to which opportunity for self-directed learning is possible in a given situation (Brockett & Hiemstra, 1991: 30). Self-direction in learning is characterised by the following (Brockett & Hiemstra, 1991: 10-17):

- Self-directedness is best viewed as a continuum rather than some dichotomous model. Self-direction exists, to a greater or lesser degree, in all persons and in all learning situations.

- Self-directed learning is not limited to learning in isolation or learning on an independent basis. Self-directedness assumes that the learner accepts primary responsibility for and control over decisions on planning, implementing, and evaluating the learning experience. This may happen in isolation or in a group.
- Positive educational results come from self-direction in learning, such as increased retention, greater interest in the subject, and an enhanced self-concept.
- Self-directed learning facilitates a wide variety of learning activities and approaches, including personal investigation, self-guided reading, group work, and working/consulting with experts.

The self-directed learning design process consists of five principles. These principles explain how individuals typically structure their own self-directed learning. The self-directed learning principles are as follows (Gibbons, 2002: 9-11):

- Learning experiences should be congruent with a life of learning, the natural ways of learning, and the unique methods by which learners learn best.
- Learning experiences should be adapted to the maturation, transformation, and transitions that learners experience.
- Learning experiences should be concerned with all aspects of a full life (personal, social, technical domains of human experience).
- Learning in self-directed learning programmes should employ a full range of human capacities, including senses, emotions, intellects and actions.
- Self-directed learning should be conducted in settings suited to their development.

The self-directed learning design input relies upon the three ways that individuals come to know something, according to Dixon (1994: 120):

- Direct experiences;
- verbal transmissions of information; and
- reorganising of what is known into a new configuration.

The individual self-directed learning experience development phase is explained in terms of theories that people use to direct their learning and associated actions. If people understand and are in control of their reasoning processes, they will also understand the casual theories they use to design and implement their

actions (Argyris, 1982: 471). Human beings are taught how to act in ways to be in control, especially when they are dealing with issues that can be embarrassing or threatening (Argyris, 1990: 12). People transform these lessons into theories of action (Argyris, 1990: 12). The theories of action, in turn, contain rules that are used to design and implement the actions in everyday life (Argyris, 1990: 12). Human beings seek to be in control of their actions; they feel good when they are able to produce the consequences that they intend (Argyris, 1990: 12). Humans abhor feelings of being out of control (Argyris, 1990: 12). Humans have programs in their heads about how to be in control, in order to negate embarrassment or threat (Argyris, 1990: 13). These programs exist in the human mind in two different ways (Argyris, 1990: 13 & 23):

- The first way is the set of beliefs, attitudes and value that people hold about how to manage their lives (espoused theories of action). These theories of action are often written or talked about (Argyris, 1982: 85). Whenever people are dealing with non-programmed, difficult, and threatening situations, they do not act congruently with their espoused theories (Argyris, 1982: 85).
- The second way is the actual rules they use to manage their beliefs (theories-in-use). Theories-in-use are used when people take action. The theory that actually governs a person's actions is the theory-in-use.

The individual may, or may not be aware of the incompatibility of the two theories.

Model 1 theory-in-use has the following four governing values (Argyris, 1993(b): 52):

- achieve your intended purpose;
- maximise winning and minimise losing;
- suppress negative feelings; and
- behave according to what you consider rational.

The most prevalent action strategies that arise from Model 1 are the following (Argyris, 1993(b): 52):

- advocate your position;
- evaluate the thoughts and actions of others (and your own thoughts and actions); and
- attribute causes for whatever you are trying to understand.

Model 1 tells the individuals to craft their positions, evaluations, and attributions in ways that inhibit inquiries into them and tests them with other's logic. The consequences of Model 1 strategies are likely to be defensiveness, misunderstanding, and self-fulfilling and self-sealing processes (Argyris, 1993(b): 52).

Model 2 theories are, at the outset, espoused theories. The challenge for individuals is to transform their espoused theories into theories-in-use by learning a new set of skills and a new set of governing values (Argyris, 1993(b): 54). The governing values of Model 2 are (Argyris, 1993(b): 55):

- valid information,
- informed choice, and
- vigilant monitoring of the implementation of the choice in order to detect and correct error.

Model 2 behaviours are crafted into action strategies that openly illustrate how the actors reached their evaluations or attributions and how they crafted them to encourage inquiry and testing by others (Argyris, 1993(b): 55). As a consequence defensive routines that are anti learning are minimised and double-loop learning is facilitated (Argyris, 1993(b): 55).

Human behaviour, in any situation, represents the most satisfactory solution people can find, consistent with their governing variables (Argyris, 1982: 86). These variables are (Argyris, 1982: 86):

- to achieve the purpose as the actor defines it;
- win, do not lose;
- suppress negative feelings; and
- emphasise rationality.

The biggest problem and challenge is to translate espoused theories into theories-in-use (Argyris, 1982: 469).

People programmed with Model 1 theories of action produce Model 1 group and organisational dynamics that include a quasi-resolution of conflict, uncertainty, avoidance, mistrust, conformity, face saving, intergroup rivalry, invalid information for important problems and valid information for unimportant ones, misperception, miscommunication, and parochial interests (Argyris, 1982: 88). These, in turn, produce ineffective problem-solving and decision-making (Argyris, 1982: 88). Model 1 theory-in-use has embedded in it casual theory that states that if people behave according to Model 1 action strategies in order to satisfy

any combination of the four governing values, then the consequences stipulated in the columns in Table 2.18 should occur (Argyris, 1982: 89).

Table 2.18 Model 1 Theory-in-use

1 ***Governing variable for action***	*2* ***Action strategy for actor and toward environment***	*3* ***Consequences for behavioural world***	*4* ***Consequences for learning***	*5* ***Effectiveness***
Achieve the purpose as actor perceives them	Design and manage environment so that actor is in control over factors relevant to him/her	Actor seen as defensive	Self-sealing processes	
Maximise winning and minimise losing	Own and control task	Defensive interpersonal and group relationships	Single-loop learning	Decreased effectiveness
Minimise eliciting negative feelings	Unilaterally protect self	Defensive norms	Little public testing of theories	
Be rational and minimise emotionality	Unilaterally protect others from being hurt	Low freedom of choice, internal commitment, and risk taking		

Argyris (1982: 87)

Model 2 has a casual theory embedded in it, parallel to the theory embedded in Model 1 (Argyris, 1982: 101). That is, if people behave according to Model 2 action strategies in order to satisfy Model 2 governing values, then certain consequences (Table 2.19) will follow (Argyris, 1982: 101). Every Model 2 action is evaluated in terms of the degree, to which it helps the people involved, generate valid and useful information (including relevant feelings), in order to solve the problem in such a way that it remains solved, and do so without reducing the present level of problem-solving effectiveness (Argyris, 1982: 103).

Table 2.19 Model 2 Theory-in-use

1 ***Governing variable for action***	*2* ***Action strategy for actor and toward environment***	*3* ***Consequences for behavioural world***	*4* ***Consequences for learning***	*5* ***Effectiveness***
Valid information	Design situations or encounters in which participants can be origins and experience high personal causation	Actor experienced as minimally defensive	Disconfirmable processes	
Free and informed choice	Task is jointly controlled	Minimally defensive interpersonal relations and group dynamics	Double-loop learning	Increased effectiveness
Internal commitment to the choice and constant monitoring of the	Protection of self is a joint enterprise and oriented toward growth	Learning-oriented norms	Frequent public testing of theories	

implementation	Bilateral protection of others	High freedom of choice, internal commitment, and risk taking		

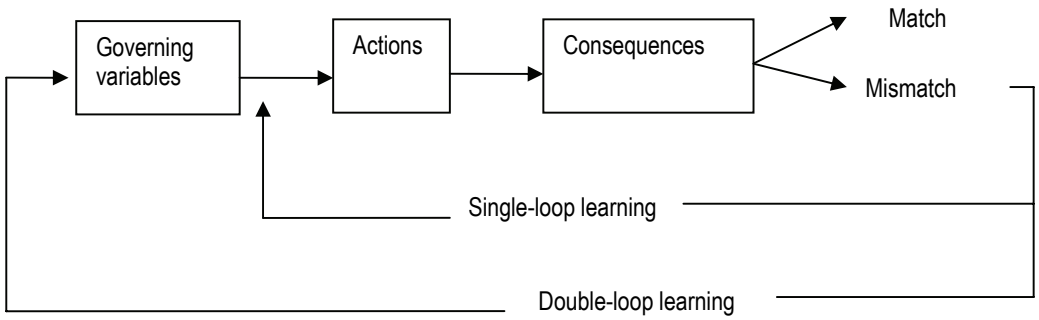
Argyris (1982: 102)

The behavioural strategies of Model 2 involve (Argyris, 1982: 103 & 104):

- Sharing power with anyone who has competence and who is relevant to deciding or implementing the action.
- Shared definition of the task and control over the environment.
- Face-saving actions (when required) are planned jointly with the people involved.
- Building viable decision-making networks in which the major function of the group is to maximise the contributions of each member; when a synthesis is developed, the widest possible exploration of views has occurred.
- The presentation of evaluations and attributions, by the creator, in ways that encourage open and constructive confrontation.
- An increase in feelings of free choice and internal commitment.
- The probability that errors and failures will be communicated openly and that actors will learn from the feedback.
- An increase in the effectiveness of decision-making and monitoring of decisions and policies.
- An emphasis on double-loop learning, in which the basic assumptions behind ideas or policies are confronted, and in which the processes are disconfirmable, not self-sealing. Double-loop learning activities will lead people to question the basis of their sense of competence and confidence, as well as their capacity to create the kind of justice that they value (Argyris, 1982: 453). Single-loop and double-loop learning are presented in Figure 2.10. Single-loop learning occurs when matches are created, or when mismatches are corrected by changing actions (Argyris, 1992: 68). Double-loop learning occurs when mismatches are corrected by first examining and altering the governing variables and then the actions (Argyris, 1992: 68). Governing variables are the preferred states that individuals strive to satisfy when they are acting (Argyris, 1992: 68). These governing variables are not the underlying beliefs or values people espouse (Argyris, 1992: 68). They are the

variables that can be inferred, by observing the actions of individuals acting as agents for the organisation, to drive and guide their actions (Argyris, 1992: 68).

Figure 2.10 Single-loop and double-loop learning



Argyris (1992: 68)

When studying self-directed learning explored from an individual perspective it is necessary to understand:

- individual learners in the learning process;
- theories and previous studies that explain individual self-directed learning;
- self-directed learning principles;
- the self-directed learning design and development activities performed by individuals; and
- the impact of individual self-directed learning.

4.4.2 Self-directed learning explored from a team perspective

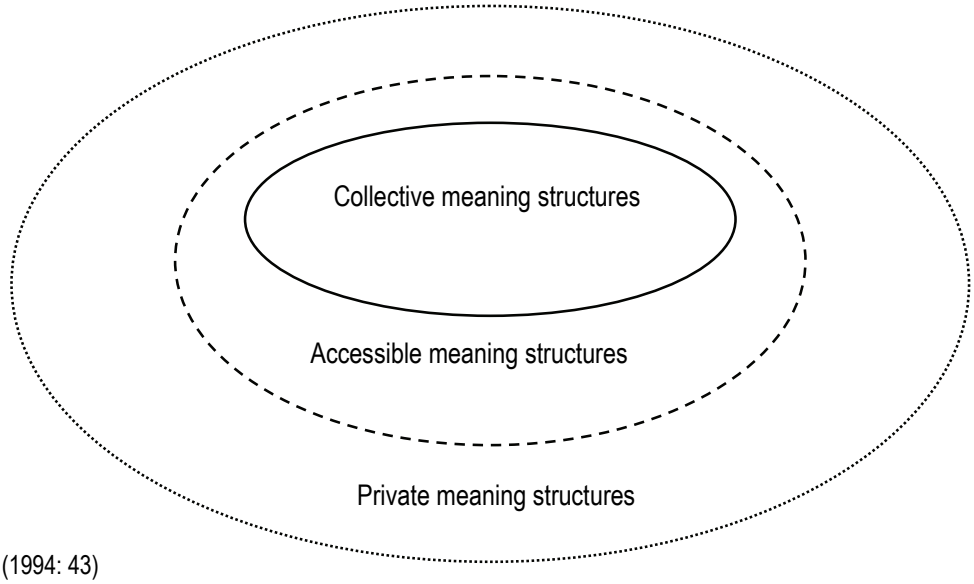
Extended and complex work environments have made it difficult for individuals to single-handedly conceptualise and solve all workplace problems and challenges. Johnson and Johnson (1991: 17) state:

> *"There is a great deal of research indicating that, if a student-student interdependence is structured carefully and appropriately, students will achieve at a higher level, use higher level reasoning strategies more frequently, have higher levels of achievement motivation, be more intrinsically motivated, develop more positive interpersonal relationships with each other, value the subject area being studied more, have higher self-esteem, and be more skilled interpersonally".*

Dixon (1994: 36-43) explores organisational learning from a meaning structure perspective (refer to Figure 2.11). This macro-organisational context used by Dixon (1994: 36) is also considered to be applicable to

the microteam level. What follows is a meaning structure review from Dixon's (1994: 36-43) adopted and adapted organisational perspective. The entire cognitive map (meaning structures) of each team member is not available to others in the team (Dixon, 1994: 36-43). Those parts of the team member's cognitive map which he/she is willing to share with other team members are referred to as the accessible meaning structure (Dixon, 1994: 37). Collective meaning structures are those which team members hold jointly — these include shared norms, strategies, policies, procedures, practices and assumptions (Dixon, 1994: 39). Those parts of the team member's cognitive map which he/she is reluctant or unwilling to share are referred to as private meaning structures (Dixon, 1994: 42 & 43). Private meaning structures contribute to a limited capacity for team learning.

Figure 2.11 Meaning structures



Dixon (1994: 43)

Team learning is cyclical and ongoing; changing team structures take time and are influenced by a specific team's challenges and desires (Ober, Yanowitz & Kantor, 1996: 50). Team learning is strengthened by making more of team member's private meaning structures accessible so that they can influence other team members, as well as making the collective meaning structures accessible so that they can be tested and altered (Dixon, 1994: 43). Accessible meaning structures as transformed by Dixon (1994: 69-93) also illustrate a resemblance with Kolb's (1984) learning cycle. This resemblance is described by means of the following steps:

- Step 1. Encouraging the generation of information. This is the responsibility of all team members.
- Step 2. Integrating the generated information into the team context.

- Step 3. Collectively interpreting the information. Conditions that support collective interpretation are:

    - distribution of information and expertise;
    - honouring of egalitarian values (freedom to speak openly, mutual respect and equality within the team);
    - organisational support for team interaction; and
    - facilitation of processes, skills and opportunities that enhance team and organisational dialogue. Organisational dialogue will:

        - provide team members with accurate and complete information;
        - confirm other's personal competence;
        - make reasoning explicit;
        - allow the members to voice their perspectives;
        - reconsider ones own position when confronted with convincing data;
        - regard own assertions and those of others as hypotheses to be tested; and
        - challenge errors in others' reasoning or data.

- Step 4. Authority to take responsible action based on the intrepid meaning.

Self-directed learning in the team context is dependent upon metacognitive competencies. Metacognition refers to an awareness of learning strategies by learners and the employment of particular strategies both consciously and deliberately (West, Farmer & Wolff, 1991: 18). Zimmerman (1990: 4) describes self-regulated learners as those who are metacognitively, motivationally and behaviourally active participants in their own learning. The three universal aspects of the process are (Zimmerman, 1990: 4):

- Metacognition as the component that directs planning, organising, self-monitoring, and self-evaluating.
- Motivation that relates to high efficacy and attribution, as well as to an intrinsic interest in the learning task.
- Behaviour that supports the process for selecting, structuring, and creating an environment that is considered to be optimal for learning (Silverman & Casazza, 2000: 214).

Metacognitive skills help a person understand and regulate cognitive performances (Schraw, 1998: 90). Self-directed learning is built on metacognitive competencies (Gibbons, 2002: 7). Metacognitive skills are described in terms of the relationship that exists between knowledge of cognition and regulation of cognition (Schraw, 1998: 91 & 92). Knowledge of cognition consists of stable information on one's cognitive processes, including knowledge of one's strengths and weaknesses as a learner, knowledge of strategies, and knowledge about when and where to use strategies (Schraw, 1998: 91 & 92). Regulation of cognition consists of planning, monitoring, and correcting one's online (workplace) performance (Schraw, 1998: 91 & 92).

The challenge for team learning design is to plan the instruction and learning in such a way that the participants can use one more of the cognitive strategies (a collection of known ways that people learn) to learn and to mentally process the content (West, Farmer & Wolff, 1991: 22). Mental models, at the individual level, refers to the mental structures that serve as mechanisms which enable individuals to describe functions and forms of tasks, explain and observe integration of tasks, and anticipate future task requirements (Rouse & Morris, 1986: 349-363). At the team level, Cannon-Bowers, Salas and Converse (1993: 221-246) described shared mental models as the organised bodies of knowledge by team members that enable them to form accurate explanations and expectations for tasks, coordinate actions, and adapt their behaviour to demands of the task and other team members. Kraiger and Wenzel (1997: 2) suggested that shared mental models are the means by which team members share task information and establish mutual expectations for complementary task behaviour. An important aspect of shared mental models among team members is knowledge of how the accomplishment of one member's role facilitates or hinders the accomplishment of the other team members' roles. Intellectual involvement and active cognitive processing is essential in the use of cognitive strategies (West, Farmer & Wolff, 1991: 27). It is very likely that the use of cognitive strategies will increase learning, which often will motivate learners for further effort and learning (West, Farmer & Wolff, 1991: 28). Reinforcement strategies increase the probability of positive responses occurring again (West, Farmer & Wolff, 1991: 29).

During the design of self-directed team learning it is required from learners to decide exactly what they are going to learn, plan the learning, manage own time, effort and resources, assign activities, and record experiences (Gibbons, 2002: 69). The essential five elements of self-directed team learning as derived from the work of Gibbons (2002: 11-13) are:

- learners control as much of the learning experience as possible;
- learners focus on skill development;

- learners learn to challenge themselves to ensure their best possible performance;
- learners manage themselves and the learning initiatives; and
- learners assume full responsibility for self-motivation and self-assessment.

The self-directed team learning development phase is explained in terms of theories that teams use to direct their learning and associated actions. The word "action" conjures up images of individuals doing, executing and implementing. The focus is thus on behaviour imbued with meaning by individuals as they interact with others in the world of practice (Argyris, 1993(a): 1 & 2). Action is not simply the discovery of new ideas or the development of new policies; it is the implementation of these ideas or policies and the evaluation of the implementation's effectiveness (Argyris, 1993(a): 2). Learning occurs when errors are detected and corrected (Argyris, 1993(a): 3). Learning also occurs when we produce a match between intentions and results for the first time (Argyris, 1993(a): 3). Learning, defined in this context, is intimately connected to action because of the three reasons listed below (Argyris, 1993(a): 3).

- It is unlikely that we as individuals have all possible solutions readily stored in our heads to fully cover the richness and uniqueness of a situation and situational demands. There will always be a gap between stored knowledge and the knowledge required to act effectively in a given situation. In order to fill the gap, learning about the new context in the new context is required.
- After the knowledge gap has been relatively closed, it is unlikely that the action we design and implement will be adequate. Most contexts or situations that concern us are constantly changing. There is thus a continual need for vigilant monitoring of our and others' actions. These processes too require learning, often performed iteratively.
- Learning is not only required in order to act effectively; it is also necessary in order to codify effective action, so that it can be reliably repeated when appropriate. This means that effective actions are not only stored as rules in actor's heads; it means that their requirements are known publicly, usually in the form of formal and informal policies and routines that are rewarded by organisational cultures.

When studying self-directed learning explored from a team perspective it is necessary to understand:

- teams and team members in the learning process;
- theories and previous studies that explain self-directed team learning;
- self-directed team learning principles;
- the self-directed team learning design and development activities; and

- the impact of self-directed team learning on team performance.

4.4.3 Intentional self-directed team learning and unintentional self-directed team learning

The relevance of intentional self-directed and unintentional self-directed learning at both the individual (team member) and collective level (team) is questioned. Self-directed team learning, explored from an organisational learning perspective, suggests that collective learning is primarily intentional. Organisational learning is the intentional use of learning processes at the individual, team and system level to continuously transform the organisation (Dixon, 1994: 5). Dixon (1994: 5) also admits that accidental learning does occur; however, the lack of intentional learning processes contributes to inefficient learning. Intentional learning passes through four stages as part of a cycle (Dixon, 1994: 7). The four stages are (Dixon, 1994: 7):

- **Stage 1**. The widespread generation of knowledge.
- **Stage 2**. Integration of the new information into the organisational context.
- **Stage 3**. Collective interpretation of information.
- **Stage 4**. Organisational members take responsible action based on the interpreted meaning.

Intentional and purposeful learning suggests that the adult is actively struggling with reality, rather than only being responsive to stimuli (Rogers, 2002: 121). This suggests that they are directed by more or less clearly perceived learning objectives, which in turn directs learning — resulting in self-directed learning (Rogers, 2002: 12 & 121). The three characteristics related to self-directed learning activities, are (Rogers, 2002: 122-124):

- Learning episodes are episodic (they come in short bursts of relatively intensive activity), and not continuous.
- Goals are usually concrete tasks or immediate issues that are felt to be important – in general aimed at the solution of a particular problem within a specific context. The approach followed is not usually an academic approach (the focus is on solving a one-off concrete situation and not concerned with a subject). Learning is rarely pursued in a systematic way and limited to the task at hand. This form of learning is rarely sequential. Learning does not draw on compartmentalised knowledge; rather it draws on knowledge from different fields of study. Learning episodes are

aimed at immediate rather than future application (learning is achieved in the process of carrying out a particular task or meeting a specific situation).

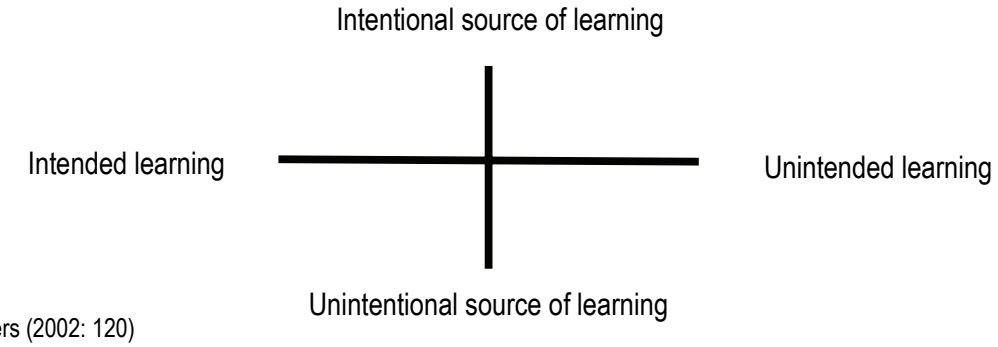
- Most learning episodes are directed towards specific goals, however there is little interest in overall principles. Few attempts are usually made to draw general conclusions from the particular instance learned. The team member normally brings the process of investigation to a close, storing away the learning gained for another day once the immediate situation has been resolved, the goal attained or the problem solved.

The role and impact of unintentional learning as a self-directed learning preference requires further investigation. Spear and Mocker's (1984: 1-10) conclusions seem to challenge the often-accepted view that self-directed learning is a clearly deliberate, well planned, and linear process. They postulate that self-directed learners, rather than pre-planning their learning projects, tend to select a course from limited alternatives which occur fortuitously within their environment, and which structures their learning projects (Spear & Mocker, 1984: 4). A study conducted by Verespej (1998: 43 & 44) found that 62% of what employees needed to know was acquired through informal learning in the workplace. These conclusions were reached after two years of research inside the manufacturing plants of high performance plants in the United States (Verespej, 1998: 43 & 44). Verespej (1998: 43 & 44) reported that only 12% to 18% of the workers surveyed said that formal training taught them skills needed to succeed in a self-directed team environment. Brookfield (1985: 7) supports this view when he states that self-directed learning theorists and researchers challenge the assumption that adult learning can occur only in the presence of an accredited and professionally certified teacher. The learning activities of successful self-directed learners are placed within a social context, and other people are cited as the most important learning resource —peers and fellow learners provide information, serve as skill models, and act as reinforces of learning (Brookfield, 1985: 9). Brookfield (1985: 7) identifies the self-directed learner as one who pursues learning with minimum assistance from external sources. Self-directed learning cannot take place without the aid of external sources of assistance, both human and material (Brookfield, 1985: 7). Bellis and van Zyl (1993: 6) state that organisations that only invest in formal and intentional learning opportunities may feel uncomfortable with concepts such as team learning and self-directed learning. They state that an overriding emphasis on intentional learning has taken attention away from the natural opportunities for learning that occur every day in a person's life (Bellis & van Zyl, 1993: 26). People can learn informally from their interactions with others, however, people must be open to change and to seeing things from new points of view (Marsick & Watkins, 1990: 12). Such informal and incidental learning takes place along a continuum of conscious awareness (Marsick & Watkins, 1990: 13). Interactive learning opportunities view learning as a collaborative effort that

results in developing the whole person, externally and internally in relation to other persons and the whole context of the application of learning (Bellis & van Zyl, 1993: 28 and Panitz, 1996: 2).

Self-directed learning initiatives can consist of both intentional and unintentional learning experiences. The context of the application of learning is described in terms of meaning structures. Individuals appear to have a preference for interpreting the world in terms of their existing meaning structures (Dixon, 1994: 23). Meaning structures are created intentionally and unintentionally (Dixon, 1994: 15). Meaning structures are created intentionally when an individual purposefully tries to understand or learn something (comprehension activity) (Dixon, 1994: 15). The unintentional creation of meaning structures occurs outside of the individual's conscious awareness (tacit comprehension) (Dixon, 1994: 15). How do self-directed teams engage in unintentional self-directed team learning? Much human learning is accidental and unintended — it comes from chance happenings (Rogers, 2002: 119). There are, however, occasions when people engage in some more structured process of mastering a situation (Rogers, 2002: 119). These occasions may require formal methods of learning. However, most of them may be of a more informal nature, thus characterised by incidental and unintended learning (Rogers, 2002: 119 & 120). Some learning may be unintentional or intentional (Rogers, 2002: 119). This natural view of learning, as a learning matrix, is depicted in Figure 2.12.

Figure 2.12 Learning matrix



Rogers (2002: 120)

Learning may be undertaken voluntarily and often with some measure of enthusiasm and commitment, although some may be taken reluctantly, even perhaps with some anger (Rogers, 2002: 120). Learning that significantly influences behaviour is self-discovered, self-appropriated learning which has been personally appropriated and assimilated in experience (Rogers, 2002: 125).

Self-directed learners require skills that will enable them to define what to learn, the ability to plan and operationalise learning, time management skills, and the ability to seek out, use and evaluate resources (Blumberg, 2000: 201). Three major classes of self-directed learning processes have been identified by Zimmerman and Lebeau (2000: 300 - 303). The major classes of self-directed learning are described below.

- **Identifying learning objectives**. When identifying learning objectives the impact and role of team leaders and workplace experts on the generation of learning objectives is considerable. In this way, self-direction is expertly constrained and socially supported so that productive self-directed learning processes can follow (Zimmerman & Lebeau, 2000: 303-304). The identification of learning objectives may also be constrained or supported by the team who encounter the problems in the workplace (Zimmerman & Lebeau, 2000: 304). Learning objectives can also be derived from a person's own experience and perceptions, which, in turn, creates an individualised learning agenda for the learner (Zimmerman & Lebeau, 2000: 305 and Goleman, 1998: 28).

- **Pursuing learning issues**. Subprocesses associated with the pursuing of learning issues include planning, using resources, and employing learning strategies (Zimmerman & Lebeau, 2000: 305). Team leaders and workplace experts may also constrain or support the pursuing of learning issues. Expert-driven learning strategies and preferences can result in clashes between learners, and between learners and experts. Self-control by the learner of resources may, as a result, also be impacted (Zimmerman & Lebeau, 2000: 306). Interaction with other team members may influence resource allocation and team standards (Zimmerman & Lebeau, 2000: 307). At the self-directed level, the pursuit of learning issues are influenced by the social context, environmental, personal, and behavioural interplay of learners (Zimmerman & Lebeau, 2000: 308).

- **Self-evaluating learning**. Self-directed learning involves a continuing evaluation of learning goals, learning activities, personal demands and concerns, and perceptions (Zimmerman & Lebeau, 2000: 309). Feedback from experts contributes information that the learner uses to evaluate the relevance of learning and to measure success in learning (Zimmerman & Lebeau, 2000: 309). Team discussions and feedback provide ongoing sources of information for self-evaluation in order to allow the learner to keep up with the team's overall learning (Zimmerman & Lebeau, 2000: 309). Self-directed evaluation is integrated in both expert driven and team-driven experiences. However it is significant to note that the social milieu has a major impact on the way

that the individual self-evaluates his/her progress and performance (Zimmerman & Lebeau, 2000: 309).

A mental map of these major classes of self-directed learning processes is presented in Table 2.20.

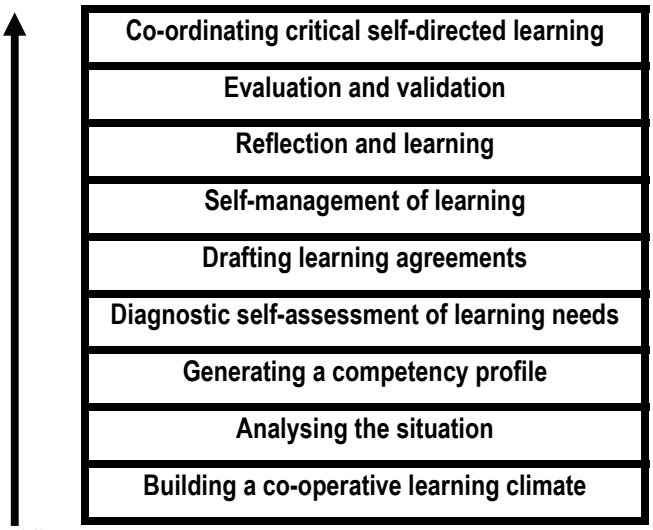
Table 2.20 Major classes of self-directed learning processes

	Expert-driven	Team-driven	Self-directed
Identifying learning objectives			
Pursuing learning issues			
Self-evaluating learning			

Adapted by the researcher from Zimmerman and Lebeau (2000: 303)

Learning design and development considerations, explained from both an intentional and unintentional self-directed learning perspective, should pay attention to personal, social, and technical skills and competencies (Gibbons, 2002: 47). These self-directed learning delivery strategies should combine learners' experiences, knowledge driven investigations and productivity elements (skills and outcomes that demonstrate competence) (Gibbons, 2002: 47-58). Hammond and Collins (1991: 15) make use of a critical self-directed learning process, applicable to individual and team learning, that integrates formal (intentional) and informal (unintentional) learning strategies. The critical self-directed learning process allows for empowerment of learners, ensures relevance of learning, meets demands about maintaining standards, prepares learners for continuing learning and promotes participation and coordination in the learning initiatives and solutions (Hammond & Collins, 1991: 15). Critical self-directed learning strategies may encounter opposition by learners who are accustomed to teacher-directed learning, and learners who do not favour an open or creative learning approach (Hammond & Collins, 1991: 15). Hammond and Collins (1991: 14) identify the following steps in the critical self-directed learning approach as depicted in Figure 2.13.

Figure 2.13 Steps in critical self-directed learning



Hammond and Collins (1991: 14)

A co-operative learning climate serves as the foundation element of critical self-directed learning. A co-operative learning climate will exist when an open, interdependent group atmosphere exists, which in turn, advances conducive, meaningful, challenging and deep learning, supported by critical reflection by individuals and teams (Hammond & Collins, 1991: 21). Such a climate will stimulate democratic, open, collaborative and non-threatening interactions in which learners take on new roles, reflect and also learn in a self-directed manner (Hammond & Collins, 1991: 23-25).

Within the scope of critical self-directed learning learners are encouraged to analyse their situations in order to generate relevant competency profiles and to keep learning focused (Hammond & Collins, 1991: 57). Situation analysis involves critical questioning of, reflection on, and consciousness-raising relating to a situation in order to deepen awareness (Hammond & Collins, 1991: 58-59). Situation analysis assists learners to focus learning for relevance, it motivates learners and it triggers action (Hammond & Collins, 1991: 63).

A competency profile provides a list of competencies that a competent person requires. These competencies can then be translated into learning and teaching objectives, outcomes and standards, which in turn, complement a self-directed learning approach (Hammond & Collins, 1991: 100). Competency profiles can be generated by means of literature reviews, verbal (oral and written) reports, observational techniques, personal reflection and discussions with learners (Hammond and Collins, 1991: 104-107).

Diagnostic self-assessment is crucial for self-directed continuing education, where practitioners periodically identify their learning needs and then work to meet them (Hammond & Collins, 1991: 121). A diagnostic self-assessment of learning needs allows learners to take full responsibility for self-designed learning programmes (Hammond & Collins, 1991: 114). Diagnostic self-assessment is a process in which learners assess their learning competencies at the start of a period of study, using a competency profile as the self-assessment instrument (Hammond & Collins, 1991: 116-117). The purpose is to enable learners to identify learning needs, so that rational plans can be made to address and meet those needs (Hammond & Collins, 1991: 16-117 and Goleman, 1998: 28 & 29).

Having diagnosed learning needs by using self-assessment, learners can make detailed plans to meet their needs by formulating learning agreements that include specific learning objectives (Hammond & Collins, 1991: 129 and Goleman, 1998: 28). Enabling learners to draft their own learning agreements is a major step in the direction of increasing learner and team autonomy, empowerment and control, which, in turn, allows learners to experience personal growth and increased self-esteem (Hammond & Collins, 1991: 137). The greatest motivator according to Ford (Gibbons, 2002: 96) is the active pursuit of personal interests in real circumstances. A learning agreement will contain details about what will be learned, how it will be learned, by when, and what assessment criteria will be used to determine competence/evidence of accomplishment (Hammond & Collins, 1991: 131). A learning agreement will typically have the same elements as a curriculum, except that a learning contract is focused on the learner rather than the teacher (Hammond & Collins, 1991: 131). Critical self-directed learning objectives will include (Hammond & Collins, 1991: 133):

- a statement of the content to be learned;
- the conditions under which learning should occur;
- the action or behaviour a successful learner will exhibit;
- the assessment criteria to be used; and
- a statement about what evidence of accomplishment a learner will provide.

Benefits associated with learning agreements include encouraged co-operative work between learners, a conducive learning climate and preparing learners for lifelong learning (Hammond & Collins, 1991: 138-139).

The learning contract or agreement outlines the basic elements of the self-directed learning process (Gibbons, 2002: 73). Gibbons (2002: 74-77) suggests a framework for a learning contract/agreement. The proposed framework is presented in Table 2.21.

Table 2.21 Learning contract agreement framework

1	**Biographical information**: learner and/or group information.
2	**Goal**: a concrete, specific, desired achievement.
3	**Importance**: explanation of the benefit and importance of the goal.
4	**The Plan**: a step-by-step plan of exactly what will be done to achieve the goal or:
4.1	a list of experiences;
4.2	an outline of what is to be known and how learners will learn it; and
4.3	activities to pursue and skills required.
5	**Challenges**: a description of the challenges.
6	**Problem-solving**: consists of two lists; the first focusing on anticipated difficulties and the second focusing on proposed solutions.
7	**Management**: organising efficiency and success by determining:
7.1	resources required; and
7.2	a timetable.
8	**Evaluation**: establish a framework to judge own progress and performance.
9	**Progress measure**: describe three observable levels of improvement/performance with reference to the:
9.1	smallest acceptable improvement/performance level (minimum progress);
9.2	basic competence, average improvement/performance (satisfactory progress); and
9.3	significant improvement, outstanding achievement (excellent progress).
10	**Demonstration**: how will learning and achievements be demonstrated?
11	**Celebration**: what is the most rewarding/appropriate way to celebrate achievement of the goal?

Adapted by the researcher from Gibbons (2002: 74-77)

To facilitate critical self-directed learning it is important to return control over the management of learning to the learners (Hammond & Collins, 1991: 151 and Goleman, 1998: 28). With self-management, learners take control of the content of their learning and the learning process — they decide how, when, where and

what to learn (Hammond & Collins, 1991: 153). Self-management takes account of individual differences (learning styles, paces, motivations) and it prepares learners to manage lifelong learning (Hammond & Collins, 1991: 154 and Goleman, 1998: 28).

Freire (1970: 13) states that the act of knowing involves a dialectical movement which proceeds from action to reflection and from reflection upon action to a new action. Reflection needs to be a purposeful activity that entails creating meaning from experience. Reflection also allows learners to become more aware of their feelings, motives, and of themselves in their social contexts — thus promoting personal growth (Hammond & Collins, 1991: 166). Habermas (Hammond & Collins, 1991: 167) points out that reflection in interaction with others who challenge, confront, and clarify issues is much easier than learners trying to reflect in isolation. According to Hammond and Collins (1991: 166-169) reflection promotes self-awareness and social awareness, supports adult education principles, improves learning, links theory to practice, and stimulates self- and peer-evaluation.

What are the objects of reflection? Taylor, Marienau, and Fiddler (2000: 318 & 322) propose the following as answers to the question:

- **Behaviour**. The most usual area of self-reflection (What actually happened? What did I actually do? What else might I have done?).
- **Capabilities**. People tend to engage in those behaviours for which they are best prepared. Reflection can, however, lead to a heightened awareness of one's existing capabilities and a plan to strengthen or develop new ones that would expand the repertoire.
- **Beliefs**. Focus is on influences and experiences as mediated by the social context.
- **Purpose**. Reflecting on what one tries to accomplish, thus reflecting on the purpose of effort.
- **Values**. Refers to those values that a person holds above all others.
- **Environment**. Reference to norms and expectations of the organisation, department, field, discipline, industry standard, or one's own standards. Contemplating these norms — how they are represented in espoused values and how their reality is experienced with colleagues — can be a rich arena for reflection.

One of the benefits associated with assessment is to ensure that learners are competent or safe in practice (Hammond & Collins, 1991: 185). This purpose of assessment is extremely important in a workplace that cannot compromise safety — such as the aviation industry. Evaluation within the scope of self-directed learning refers to assessment of performance. Evaluators may be the learner (self-assessment), a peer

(peer assessment), an educator (educator assessment), or a client (client assessment), or a combination of evaluators (Hammond & Collins, 1991: 182-184). Assessment criteria need to be aligned to information obtained and analysed from the situation analysis, competency profiling, diagnostic self-assessment of learning needs and the learning agreement. Validation refers to a process of confirmation or verification that learning has in fact occurred (Hammond & Collins, 1991: 187). In a self-directed team learning environment the team will need to validate learning by means of reference to the set standards of competence as described in the individual's learning agreement.

Co-ordination and maintenance of self-directed learning initiatives have been described by Hammond and Collins (1991: 202 & 208) as demanding and rewarding, especially where this exists in a conventional teacher dependent milieu. Boud and Brookfield (Hammond & Collins, 1991: 204) acknowledge that when people think differently about their work, the task of practicing progressively and consistently may become easier. In order to facilitate critical self-directed learning processes, learners need to review their learning and teaching roles, whilst also remaining critically aware of the demands of critical self-directed learning. Critical self-directed learning systems require support from higher authority in order to ensure system integrity and survival, and it requires a framework or structure within which it can be sustained (Hammond & Collins, 1991: 208). Mezirow (1985: 26) delineates a three-step self-diagnostic process for identifying self-directed learning needs, which is based on the andragogical process design model formulated by Knowles (1984: 14-18). The process consists of the following steps (Mezirow, 1985: 26):

- **Step 1**. Developing a model of desired behaviours/competencies required.
- **Step 2**. An assessment of the present level of performance in each behaviour/competence identified in step one. Self-report data can be used within the self-directed learning process to identify a person's direct perceptions of him/herself. Self-report data can also be used to triangulate data needed to draw inferences about the processes underlying the learner's work and performance. Self-report data are thus crucial to the understanding and evaluation of a self-directed learning process (Blumberg, 2000: 200-202).
- **Step 3**. An assessment of the gap between the ideal state and the present performances.

Such a framework or structure will place the learners in control of their own learning and make co-ordination a manageable task (Hammond & Collins, 1991: 212).

Self-directed learning outcomes generally focus on experiences, competencies and challenges (Gibbons, 2002: 32). Experiences are considered to be at the origin of self-directed learning. Experience is

multifaceted, multilayered and inextricably connected with other experiences (Boud, Cohen & Walker, 1993: 7). Learning experiences are not restricted to externally defined curricula and syllabi; they also include and encompass perceptions and experiences of our own and of others. An assumption that teaching leads to learning is questioned because it is the experiences that teachers help create that prompts learning (Boud, Cohen & Walker, 1993: 9). According to Criticos (Boud, Cohen & Walker, 1993: 9) experience has to be arrested, examined, analysed, considered and negated to shift it to knowledge. Learning involves much more than an interaction with a body of knowledge — it involves dealing with complex and intractable problems, interaction with others, personal commitment and understanding, whilst also engaging feelings and emotions (Boud, Cohen & Walker, 1993: 1). Boud, Cohen and Walker (1993: 9-16) identify the following five propositions about learning from experience:

- **Proposition one** describes experience as the foundation of, and the stimulus for learning. While experience may serve as the foundation for learning, it does not necessarily lead to it: there needs to be a concerted and reflective engagement with it. Reflection consists of those processes in which learners engage to recapture, notice and re-evaluate their experiences and then to work with their experiences and those experiences that others share to turn it into meaningful learning.
- **Proposition two** determines that learners actively construct their experience. In this regard it is noted that experience is the result of a transaction between the learner and the environment in which he/she functions. An event and experience can influence the learner; however the learner needs to be predisposed to being influenced.
- **Proposition three** explains that learning is a holistic process in a seamless whole — openness to the possibility of learning from any event facilitates learning.
- **Proposition four** signifies that learning is socially and culturally constructed. Learning cannot occur in isolation from cultural and social norms and values — it is through these norms and values that the learner interprets experience.
- **Proposition five** explains that learning is influenced by the socio-emotional context in which it occurs. Emotion and feelings are key influences for, and barriers to learning.

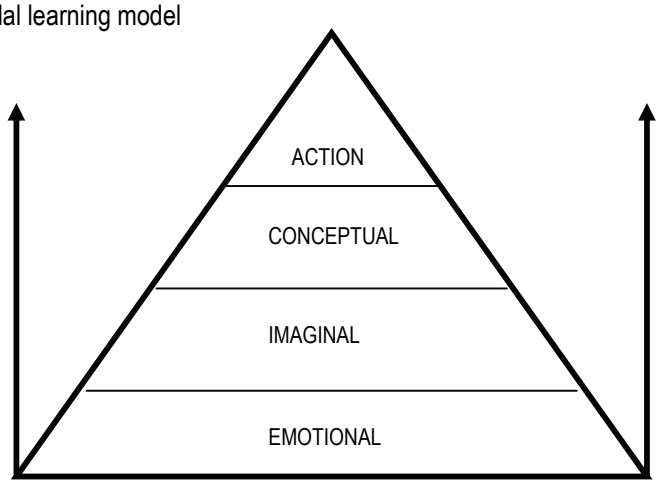
Heron (Postle, 1993: 33-35) identifies four modes of learning from experience, each dependent on the other and arranged as an “up-hierarchy”; known as multimodal learning. The four modes of learning from experience are described below and depicted in Figure 2.14.

- **Action mode**. The mode at the top of the pyramid — the practical mode of learning from experience — describes learning by doing by means of the competent practice of skills.

- **Conceptual mode**. The focus at this level is on communication and embraces analysis, logic, proof, argument and debate. Linked to this mode are reasoning skills, which facilitate the critical revision of personal constructs and theories (Mulligan, 1993: 56).
- **Imaginal mode**. The third mode, imaginal mode of learning, refers to learning through imagination and visioning. Mulligan (1993: 55) states that imaging allows for the creation of new perspectives and can help to generate possible solutions.
- **Emotional mode**. The fourth mode, the affective mode of learning, refers to learning by direct encounter/experience.

The message communicated by this multimodal learning model may be found in the manner in which practical learning has its roots in the conceptual mode, and these in turn are anchored and energised by the imaginal mode. All three mentioned modes rely on the affective mode for a sound foundation. The layers are thus interrelated and each layer depends on the other for its strength and survival. The value of the multimodal learning model is found in the manner in which it clarifies the sequencing of how people learn.

Figure 2.14 Heron's multimodal learning model



Postle (1993: 34)

A continuum of ways that one might use experience in the learning process is presented by Taylor, Marienau and Fiddler (2000: 314). The learner can enter into the process at any point, depending on his/her experience (Taylor, Marienau, & Fiddler, 2000: 315). If a learner is not used to working with his/her experiences as a source of learning, then he/she would probably start near the beginning. If a learner is more adept he/she may enter the continuum at a later point (Taylor, Marienau, & Fiddler, 2000: 315).

The continuum comprises of the following links (Taylor, Marienau, & Fiddler, 2000: 315 & 316):

- **Link one – understanding others' ideas through examining others' experiences**. The learner is compelled to rely on another person's experience. Analysis of the issue in question may be accomplished by consulting with other persons.
- **Link two – illuminating others' ideas by relating them to one's own experiences**. Learners are required to examine their own store of experiences, looking for those that help exemplify or illuminate the issue in question. As in the first link, the abstract idea is followed by and grounded in experience – this time, however, the learner's own experience.
- **Link three – interpreting one's own experiences by using others' ideas**. Here the learner's experience is the starting point, and the focus is less on a subject or topic and more on the learner as subject. The learner begins by examining his/her rich store of experiences, from different perspectives, then seeks ideas that provide a framework to explore and illuminate selected experiences.
- **Link four – deriving ideas from one's own experiences**. Learners begin with their own experiences, but rather than quickly moving away from their own experiences, learners are required to first stop and solidify their own understanding from an inductive perspective of such experiences.
- **Link five – interrelating experiences and ideas of self and others**. Learners illustrate that they are able to integrate experiences and move effortlessly back and forth between ideas as subjects and ideas as experienced. Learners no longer reproduce other's ideas, but are obtaining meaning through critical reflection on experience.

Experiential learning initiatives are influenced by different learning-related barriers. Barriers to learning from experience are categorised in terms of their origins in relation to the learner (Boud & Walker, 1993: 80). Some barriers are external such as other people, the environment, personal situation and context of the learner. Other barriers are internal and stem from personal experiences of the learner. These may include previous negative experiences, accepted presuppositions about own ability and own readiness to learn and the emotional state of the learner. Brew (1993: 96) also suggests that unlearning takes place when experiences necessitate a conceptual reordering of the whole or a part of one's world-view. When humans learn to unlearn they treat everything as if it were relevant. They reflect, and then they proceed with unbending intent. Paradoxically unlearning leads to effective new learning from experience.

When engaging in self-directed learning, viewed from an experiential learning perspective, the following principles need to apply (Gibbons, 2002: 43-45):

- Ensure learners possess the skills they need to take control over their learning activities.
- Shift the emphasis of the learning experience from content to productivity.
- Introduce new learning practices in gradual gradients of complexity.
- Make new ideas familiar by connecting them to the learners' lives and work.
- Learners must develop the attitudes necessary for success.
- Change from telling, to asking, from lecturing to interaction.
- Launch the learners on a journey of discovery.

Experience alone cannot suffice as the only self-directed learning influencing factor. Equal consideration must be given to the other important factor — reflection. Self-directed learning principles may be viewed as the psychological intent. However, the practical activities associated with both intentional and unintentional self-directed learning are based on the ability to reflect on performances and learning. Research findings support the notion that educational strategies in which learning is a passive process of transmitting information into memory, usually characterised by a high level of external regulation by instruction, merely encourages learners to memorise information (Dolmans & Schmidt, 2000: 252). Vermunt (1989) and Dolmans and Schmidt (2000: 252) support educational strategies in which learning is an active constructive process, characterised by a high level of internal regulation by learners that encourage learners to relate and structure information. Goleman (1998: 28), Bereiter and Scardamalia (1989: 361-392) and Dolmans and Schmidt (2000: 252) agree that learning should be developed in such a manner that will allow and encourage learners to become architects of their own knowledge and to take full responsibility for their own learning. For meaningful change to take place, individuals must be ready to take the risk of engaging in a process that could lead to discovering weaknesses in what they do (Silverman & Casazza, 2000: 237). Collaborative learning is based on consensus building through cooperation, sharing of authority and acceptance among team members for the team's learning actions (Panitz, 1996: 1). The process of critical reflection also needs to be a collaborative one that involves colleagues (Silverman & Casazza, 2000: 237). Collaboration also provides a wider range of perspectives and insights, which strengthen the whole process and contribute to the momentum that is necessary to implement and sustain meaningful change (Silverman & Casazza, 2000: 237).

Reflection in the context of learning is a generic term for those intellectual and affective activities in which individuals engage to explore their expectations in order to lead to new understanding and appreciation

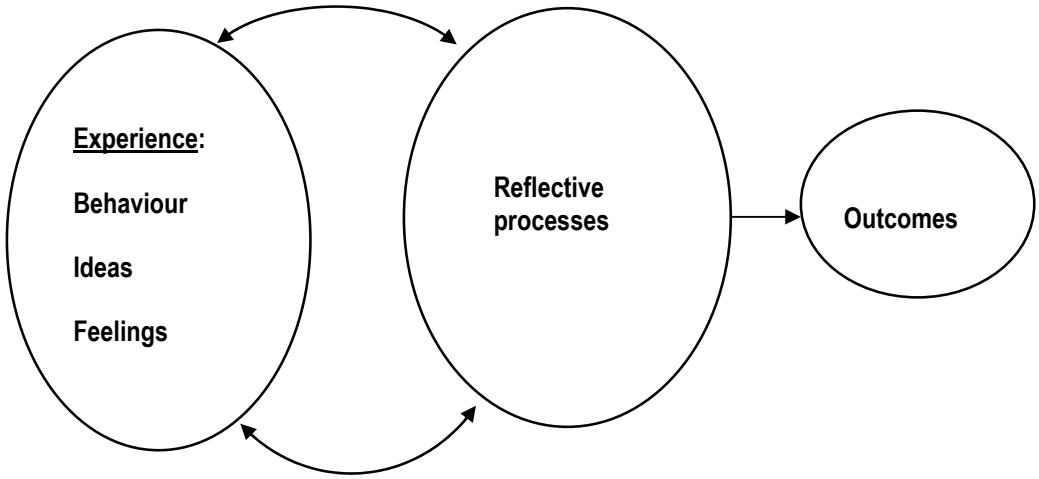
(Edwards, Hanson & Raggatt, 1995: 33). Reflection may take place in isolation or in association with others (Edwards, Hanson & Raggatt, 1995: 33). Reflection is an important activity in which people recapture their experience, think about it, mull over it and evaluate it (Edwards, Hanson & Raggatt, 1995: 33).

Boud, Keogh and Walker's (Edwards, Hanson & Raggatt, 1995: 34) model of reflection in the learning process points to the starting point and objects of reflection. These points and objects of reflection include (Edwards, Hanson & Raggatt, 1995: 34):

- The totality of experiences of the learners.
- The behaviour in which the learners have engaged.
- The ideas of which learners are aware.
- The feelings which the learners have experienced.

The model (presented in Figure 2.15) designates the outcomes of reflection, which may be a personal synthesis, integration and appropriation of knowledge, the validation of personal knowledge, a new affective state, or the decision to engage in some further activity (Edwards, Hanson & Raggatt, 1995: 34). These processes may be facilitated at an individual level, or in some cases, at a group level (Edwards, Hanson & Raggatt, 1995: 34).

Figure 2.15 Model of reflection in the learning process



Adapted by the researcher from Boud, Keogh and Walker (Edwards, Hanson and Raggatt , 1995: 34)

One of the most important ways to enhance learning is to strengthen the link between the learning experience and the reflective activity that follows it (Edwards, Hanson & Raggatt, 1995: 40). This link can be formed by incorporating a specific allocation of time that can be used for reflection (example a debriefing). This allows for a return to the experience by simply recollecting the salient events, and replaying them in the mind of the individual or recounting to others the features of the experience (Edwards, Hanson & Raggatt, 1995: 41). This may involve the conscious recollection of good experiences, attention to pleasant aspects of the immediate environment, or the anticipation of the possible benefits to be derived from the processing of events, and removing obstructing feelings (for example laughing about an embarrassing incident) (Edwards, Hanson & Raggatt, 1995: 41). Following from the learning experience itself is the re-evaluation of the experience, which, in turn, consists of four aspects (Edwards, Hanson & Raggatt, 1995: 45-49). These aspects are listed below (Edwards, Hanson & Raggatt, 1995: 45-49).

- **Association** that allows for the connection of the ideas and feelings which are part of the original experience and those which have occurred during reflection.
- **Integration** that permits the seeking of relationships among knowledge, skills and attitudes which are already known.
- **Validation** that encourages tests for internal consistency between new appreciations and existing knowledge, skills and attitudes — thus allowing one to determine the authenticity of the ideas and feelings which have resulted.
- **Appreciation** that allows one to integrate new information in a personal way if it is to become his/her own.

The outcomes of reflection may include a new way of doing something, the clarification of an issue, the development of a skill or the resolution of a problem (Edwards, Hanson & Raggatt, 1995: 50). A new cognitive map may emerge (Edwards, Hanson & Raggatt, 1995: 50).

Learning from experience and learning by means of reflection should be considered in a holistic sense. This consideration implies that experience and reflection can be combined and integrated into a reflective-in-action understanding. Much reflection-in-action hinges on the experience of surprise (Edwards, Hanson & Raggatt, 1995: 22). When intuitive, spontaneous performance yields nothing more than the results expected for it, then we tend not to think about it (Edwards, Hanson & Raggatt, 1995: 22). But when intuitive performance leads to surprises, pleasing and promising or unwanted, we may respond by reflection-in action (Edwards, Hanson & Raggatt, 1995: 22). In such processes, reflection tends to focus interactively on the outcomes of action, the action itself, and the intuitive knowing implicit in the action

(Edwards, Hanson & Raggatt, 1995: 22). Jarvis (1992: 72-78) expands on this idea and proposes that there are nine possible responses to an experience which can be grouped into three overarching categories (Taylor, Marienau, & Fiddler, 2000: 361). The typology of learning is illustrated in Table 2.22 (Taylor, Marienau, & Fiddler, 2000: 361 & 362). The typology also provides a theoretical underpinning of the integration of experience and reflection in order to create an understanding of intentional self-directed team learning and unintentional self-directed team learning.

Table 2.22 A typology of learning

Category of responses to experience	Types of learning/non-learning
Non-learning	
People do not learn from their experiences, because: People believe things will stay the same and there is thus no reason to learn. A potential learning experience does not capture a person's attention. People are not willing to change their opinions, attitudes or beliefs because they are convinced that they are right.	 Presumptions Non-considerations Rejection
Non-reflective learning	
Learning does not involve reflection, because: A learning opportunity passes into the mind of the person without his/her conscious awareness and usually not involving the communicative mode of experience.	 Preconscious learning

Learning of simple, short procedures occurring in the action mode of experience, rather than the communicative mode.	Skills learning
Experience and information is stored in memory and recalled for later use.	Memorisation
Reflective learning	
People are able to stand back, make decisions, and evaluate their learning, because:	
Persons think about an experience and reach a conclusion about it without necessarily referring to the wider social reality.	Contemplation
Learning does not only involve learning a new skill but also learning the concepts that support the practice.	Reflective skills learning
A theory is tried out in practice, resulting in a new form of knowledge that captures social reality.	Experimental learning

Adapted by the researcher from Jarvis (1992: 72-78) and Taylor, Marienau, and Fiddler (2000: 361 & 362)

The models presented in this section that address learning from experience and reflection identify three key factors in reflecting on experience (Boud & Walker, 1993: 75-77).

- **Factor 1** deals with the return to the experience or recall of the experience, whilst withholding judgement and evaluation.
- **Factor 2** deals with the feelings that arose out of the return to, or recall of the experience.
- **Factor 3** deals with the evaluation of the experience. During the evaluation stage the learner links the experience to a past experience (association), integrates this experience with an existing learning framework (integration), tests it in some manner (validation), and then makes it his/her own (appropriation).

When studying self-directed learning explored from an intentional and unintentional learning perspective it is necessary to understand:

- differences and contributions associated with intentional and unintentional learning within the self-directed team learning environment;
- how to use both intentional and unintentional learning to the benefit of self-directed team learning;
- the role of experience in self-directed team learning;
- the role of reflection in self-directed team learning; and
- the impact of learning barriers.

4.4.4 Role and relevance of self-directed learning

The detailed role and relevance of self-directed learning, as considered for this study, is presented in Table 2.23.

Table 2.23 Self-directed learning focus areas and associated relevance to the study

Focus areas	Relevance to the study
The individual's involvement in self-directed team learning.	An exploratory study of the individual's involvement in self-directed team learning requires an: • understanding of individual self-directed learning dynamics; • understanding of individual learning approaches; and • understanding the role and impact of individual self-directed learning contributions within the self-directed team learning effort.
The team's involvement in self-directed team learning.	An exploratory study of the team's involvement in self-directed team learning requires an: • understanding of team self-directed learning dynamics; • understanding of team learning approaches; and • understanding the role and impact of team self-directed learning contributions within the self-directed team learning effort.

Intentional self-directed team learning and unintentional self-directed team learning.	An exploratory study of the team's involvement in self-directed team learning requires an: • identification and understanding of intentional self-directed team learning dynamics; • identification and understanding of unintentional self-directed team learning dynamics; • identification and understanding of combined intentional and unintentional self-directed team learning dynamics; and • understanding the role and impact of intentional self-directed team learning and unintentional self-directed team learning contributions within self-directed team learning efforts.

Compiled by the researcher

4.5 Air traffic control operations

This section provides insight into the occupational specifics as applicable to air traffic control operations.

4.5.1 Air traffic control operations/workplace

Air traffic control operations, practices, rules, instructions and procedures are determined by the appropriate air traffic services authority. The authority will designate the area of responsibility for each air traffic control centre, and when applicable, for individual air traffic control services within an air traffic control centre (ICAO, 2001: 4.1). A defined airspace is thus allocated to a specific air traffic services unit, which in turn provides a control (or information) service to all aircraft operating in the airspace and on the ground, as well as people and vehicles operating within defined areas of the aerodrome. Duties and responsibilities of the air traffic controller providing an air traffic control service at an air traffic control centre will also be defined and stipulated in terms of standard operating procedures and station standard instructions.

Air traffic control procedures and instructions are considered to be filters, built into a system, to ensure the appropriate and adequate maintenance of aviation safety. The common purpose held by air traffic controllers is ultimately to ensure that the established level of safety applicable to the provision of air traffic control services within an aerodrome and airspace is met and that safety-related enhancements are

implemented whenever possible (ICAO, 2001: 2.1). Safety in air traffic control is the result of compliance with procedures and instructions in order to avoid a reduction of standard separation between aircraft in flight, aircraft on the ground, aircraft in flight and obstacles, and aircraft on the ground and obstacles. Non-compliance with standard operating procedures and station standard instructions may result in an aircraft proximity situation. An aircraft proximity situation is a situation, in which, in the opinion of the pilot or air traffic controller, the distance between aircraft as well as their relative positions and speed have been such that the safety of the aircraft involved may have been compromised (ICAO, 2001: 1.2). Air traffic control safety goals are achieved when air traffic controllers and air traffic control teams ensure compliance with stipulated rules, regulations, instructions and procedures.

4.5.2 Air traffic control

In order to comprehend the aspects influencing the role, responsibilities and task of the air traffic controller and air traffic control teams it is necessary to understand the typical air traffic control process. Air traffic control is a complex task (Laios & Giannacourou, 1995: 108). The aim of air traffic control is described as the safe, orderly and expeditious control of air traffic (Newman, Tattersall & Warren, 1995: 118). To achieve this objective numerous functions employing diverse facilities and aids are fulfilled cooperatively by air traffic controllers (Laios & Giannacourou, 1995: 108).

Air traffic control performance is categorised by MacLeod (2001: 70) in terms of:

- **product** — what is observable at the end of the activity (the result/results); and
- **process** — the method by which the product is achieved (includes internal interpretation and reasoning).

Associated cognitive behaviour processes are broken down into the three task types listed below (Newman, Tattersall & Warren, 1995: 120).

- Routine passive tasks describe baseline activity in which air traffic controllers perform monitoring tasks, but make no overt responses.
- Routine active tasks cover periods when overt behaviour is “controlled” such as radio communications. This category is also used for routine conflict searches, where a decision is rapidly reached and where heuristics seem to be in operation.

- Planning and problem-solving tasks describe processes with a highly demanding cognitive component, such as tasks of traffic conflict resolution.

The air traffic control process can be narrowly defined in order to explain the various control functions and associated tasks. Variations to the sequence of task events listed below do exist. However, the air traffic control process comprises inter alia, the following events:

- A flight plan is filed with an air traffic control centre by the pilot or a designated representative (ICAO, 2001: 1.6). The flight plan contains specific information provided to air traffic control, relative to an intended flight or portion of a flight for an aircraft (ICAO, 2001: 1.7).
- Once the pilot is ready to commence the flight, radio contact will be made from the aircraft with the air traffic control ground position (referred to as ground control). The air traffic controller (ground controller) will cross-check flight plan details and approve/disapprove the pilot's request to start the aircraft. The pilot will be provided with instructions to taxi to the runway favoured for departure. The ground controller will ensure that separation exist between all taxiing aircraft and vehicles and pedestrians operating on the aerodrome (referred to as the manoeuvring area). During this time the ground controller will coordinate with the approach controller in order to obtain instructions that the pilot will need to comply with once airborne. These instructions will be verified and then transmitted to the pilot, after which the ground controller will acknowledge the correct readback of the instructions by the pilot. The pilot will advise the ground controller when he/she is ready for take-off. At this stage the pilot will be instructed to contact the next responsible air traffic controller — the aerodrome controller.
- The aerodrome controller is responsible for providing a control service to all aircraft operating in the vicinity of the aerodrome within a defined airspace (ICAO, 2001: 1.1). The aerodrome controller is therefore also responsible to issue landing and take-off clearances to all aircraft making use of the runways and designated helicopter take-off areas. These clearances can only be issued when assurance exists that determined separation criteria will not be infringed. Once an aircraft has landed and vacated the landing area the pilot will be instructed to contact the ground controller for further taxi instructions. Once an aircraft has departed the pilot will be instructed to make radio contact with the next controller — the approach controller. The time of departure will be communicated to the approach controller by the aerodrome controller and the aerodrome controller will ensure that the departing aircraft's flight plan is activated.
- The approach controller provides an air traffic control service to all arriving, departing and over-flying aircraft within his/her area of responsibility (ICAO, 2001: 1.4). This service is provided with or

without the assistance of radar. Departing and overflying aircraft will be separated from all other traffic within the defined controlled airspace. Once a departing or over-flying aircraft leaves the controlled airspace the pilot will be instructed by the approach controller to contact the next approach controller, or flight information service provider (a non-control function), or area controller, or to transmit intentions on an unmanned frequency. Arriving flights will be issued with an air traffic control clearance by the approach controller that will ensure a safe passage to the aerodrome. The approach controller will be responsible for ensuring that the arriving aircraft is positioned in such a manner that a safe landing will be possible. Once an arriving aircraft approaches the area of responsibility of the aerodrome controller the pilot will be instructed by the approach controller to contact the aerodrome controller.

- Area controllers provide air traffic control services to flights in airways and other designated controlled airspaces (ICAO, 2001: 1.4). Aircraft climbing to their requested cruise levels, maintaining their cruise levels, and/or leaving their cruise levels are traditionally controlled by the area controller. Area controllers accept departing and overflying aircraft from approach controllers and hand over control of arriving and overflying aircraft to the approach controller. Similarly flight information service providers provide pilots operating within uncontrolled airspace with information regarding potential traffic situations. However no instructions are passed to pilots of such aircraft that infer air traffic control actions. Air traffic control clearances may, however, be relayed by flight information service providers.
- In poor weather conditions (low cloud and/or reduced flight visibility) arriving aircraft will be handed to the precision radar controller by the approach controller. Precision radar controllers (also known as ground controlled approach controllers) use radar equipment to determine the position of an aircraft during its final approach for landing, in terms of lateral and vertical deviations relative to a nominal approach path, and in range relative to the landing touchdown point (ICAO, 2001: 1.9). The pilot is issued with a series of radar-derived instructions that will ensure that visual contact with the runway becomes possible before the point of landing. Once the aircraft has landed safely the pilot will be instructed to contact the ground controller for taxi instructions.

4.5.3 Teamwork in air traffic control

Information provided above signifies the need for, and importance of sound communication and coordination strategies. The ability to effectively interact and communicate at an interpersonal level within the air traffic control work environment contributes to risk mitigation and aviation safety. Air traffic control centres do, to the extent that is possible, establish and apply standardised procedures for the coordination of air traffic

control information (ICAO, 2001: 10.1). Coordination must conform to the procedures stipulated by the air traffic control centre (ICAO, 2001: 10.5). Coordination must also be planned and executed in such a manner as to ensure that information shall be communicated in sufficient time to permit reception, understanding and analysis of data by the receiving party (ICAO, 2001: 10.2). Safe and effective service provision therefore relies on the availability of skilled and experienced air traffic controllers and air traffic control teams.

ICAO (2001: 2.4) states that the air traffic control services authority needs to as a matter of priority and as far as practicable, implement appropriate measures to eliminate the risk or reduce the safety risks to a level that is acceptable. Shift work and team work are viewed as risk management measures in this regard. Air traffic control operations demand high levels of concentration, attention and situational awareness from air traffic controllers. Shift work was introduced at air traffic control centres in order to ensure optimum performance from air traffic controllers. The duration of shifts is dependent on a wide array of aspects, including traffic type and/or intensity, meteorological conditions, services provided, number of personnel, organisation and legislative employment conditions, and complexity of the services provided. Shifts are manned by air traffic control teams.

4.5.4 Air traffic control teams

In air traffic control a team is defined as ”a group of two or more persons who interact dynamically and interdependently within assigned specific roles, functions and responsibilities — they have to adapt continuously to each other to ensure the establishment of a safe, orderly and expeditious flow of air traffic” (Barbarino & Isaac, 2000: 271). Research conducted by Smith-Jentsch, Zeisig, Cannon-Bowers and Salas (1997: 201-206) to determine the importance of teamwork in air traffic control, supports the notion that air traffic controllers demand and value effective teamwork. Furthermore, the data indicated that the more experienced a controller was, the more strongly he/she believed in the importance of teamwork (Smith-Jentsch, Zeisig, Cannon-Bowers & Salas, 1997: 201-206). Eight cognitive and behavioural skills that were identified as being important for air traffic control team performance are listed below (Smith-Jentsch, Zeisig, Cannon-Bowers & Salas, 1997: 201-206).

- **Self-regulation of stress**. The ability to monitor one’s own stress level, and to plan and employ effective strategies for dealing with stressful performance conditions. This includes awareness when one’s personal limits have been reached.

- **Team supporting behaviour**. Interaction with others in the air traffic control team which enhances their ability to perform the tasks required by their positions. This includes providing backup when needed as well as avoiding actions which hinder the efforts of controllers working other positions. Additionally, effective supporting behaviour involves requesting assistance when needed.
- **Boundary spanning**. Interaction with other entities in the air traffic control system which enhances the controllers' ability to perform the tasks required of their positions. This includes both taking actions which help and avoiding actions which hinder the efforts of these entities.
- **Information exchange**. The ability and willingness to seek and to pass on information which promotes a shared awareness or "mental model" of the team's internal and external environment. This includes using concise, standard phraseology, offering information before having to be asked, active listening and inquiry.
- **Team feedback skill**. The ability to provide, seek, and receive feedback from other team members in a direct and specific manner, while not becoming hostile or defensive.
- **Flexibility**. The ability and willingness to adapt one's behaviour quickly and appropriately in accordance with environmental demands.
- **Team self-correction skill**. The ability to diagnose team coordination problems, resolve conflicts, develop solutions, and to energise or motivate team members towards achieving performance goals.
- **Problem-solving skill**. This includes the ability to quickly determine optimal task redistribution in order to preserve safety and efficiency in response to high workload, time-pressured, or emergency situations.

Three team member generic attitudes (listed below) were also defined by Smith-Jentsch, Zeisig, Cannon-Bowers and Salas (1997: 201-206).

- **Belief in the importance of teamwork**. The belief that teamwork is a critical component of an air traffic controller's job.
- **Collective orientation**. The tendency to view oneself as an interdependent part of the air traffic control system, and to take other team members' behaviour into account when working in the team.
- **Team vision**. Beliefs regarding the purpose, goals and functions served by an air traffic control team.

Furthermore, six team member generic knowledge competencies were also defined by Smith-Jentsch, Zeisig, Cannon-Bowers and Salas (1997: 201-206). These competencies are listed below.

- **Interpositional knowledge**. Knowledge of the duties, responsibilities, limitations, and capabilities of positions within the air traffic control system that are outside of those of the team.
- **Knowledge of the team's performance-related signs of stress**. The ability to recognise the specific signs of stress in the team. These include physiological (e.g., pallor), cognitive (e.g., narrowing of attention), social (e.g., irritability), and communication-related signs (e.g., talking faster) as well as body language (e.g. arm gesturing, fidgeting).
- **Knowledge of the components of air traffic control teamwork**. An understanding of the teamwork-related attitudes, knowledge, and skills that are related to effective performance.
- **Cue-strategy associations**. The recognition of task and environmental cues that trigger specific problem-solving strategies in the team.
- **Mental model of air traffic control team role-interaction patterns**. An accurate mental representation of the interdependencies among positions within the team including position-specific goals which may be in conflict.
- **Mental model of boundary-spanning roles and responsibilities**. An accurate mental representation of the interdependencies between positions within the team and other entities within the air traffic control system including position-specific goals which may be in conflict.

In addition, four team member specific attitudes were identified by Smith-Jentsch, Zeisig, Cannon-Bowers and Salas (1997: 201-206). The team member specific attitudes are listed below.

- **Team cohesion**. An attraction or desire to be a part of a specific air traffic control team. This includes loyalty and a feeling of "teamness" within a group of controllers.
- **Collective efficacy**. A sense of confidence in a specific team's collective ability to perform the tasks required of an air traffic control team.
- **Mutual trust**. A sense that team members respect and trust one another, give one another the benefit of the doubt (assume positive intent), and are open to resolving conflicts honestly.
- **Shared vision**. A sense of common purpose regarding the goals and functions served by a team and shared by members of a team.

Finally, three team member specific knowledge competencies were identified by Smith-Jentsch, Zeisig, Cannon-Bowers and Salas (1997: 201-206). The team member specific knowledge competencies are listed below.

- **Knowledge of performance-related team member characteristics**. Knowledge of the task-related preferences, habits, strengths, and weaknesses of specific team members.
- **Knowledge of team task expectations**. Knowledge of the task strategies typically employed by a particular team for handling common air traffic control situations.
- **Knowledge of team norms**. An understanding of the particular norms that exist among a specific team of controllers. This knowledge involves an awareness of a team's climate or personality. For example, whether the environment is forgiving, competitive, formal versus informal, etc.

Air traffic control team members should have shared concepts/mental models of the processes and sub-tasks required in reaching goals. The higher the level of shared understanding (shared mental models) between team members, the more efficient and successful the goal completion (Cannon-Bowers, Salas & Converse, 1993: 221-246). The more team members can understand, predict, and act upon each other's and the team's needs in carrying out their responsibilities, the more effectively the team will operate in pursuit of the air traffic control operational goals.

4.5.5 Air traffic control operational output

Individual and team competence, effective teamwork, use of shift work and compliance with operational rules, regulations, instructions and procedures contribute to desired air traffic control operational outcome. The desired air traffic control operational outcome is defined as providing a safe, orderly and efficient air traffic control service. Air traffic control services are therefore provided for the purpose of preventing collisions between aircraft, and on the manoeuvring area between aircraft and obstructions; and expediting and maintaining an orderly flow of air traffic (ICAO, 2001: 1.3). Indicators that the desired air traffic control operational and organisational outcome has been met are:

- no collisions occurred;
- no aircraft proximity situations/risk of a collision occurred;
- safety-related enhancements were employed whenever necessary;
- air traffic control actions did not result in flight delays;
- no excessive use of airspace that resulted in low levels of productivity;

- traffic occurrences were handled in an orderly manner and sequenced;
- control of traffic was in compliance with specific operational practices, rules, instructions and procedures; and
- air traffic controllers worked effectively as a team whilst on shift.

Indicators that the desired air traffic control personal outcomes have been met are (Seamster, Redding, Cannon, Ryder and Purcell, 1993: 261):

- no violation of minimum separation standards occurred;
- no deviations from standard operating procedures took place;
- no disorders were experienced which may have resulted in cognitive work overload; and
- no unnecessary requests were made to pilots.

The air traffic control organisational operational outputs and the air traffic controller's personal outputs demonstrate the presence of a primary common goal — aviation safety.

4.5.6 Role and relevance of air traffic control operations

The detailed role and relevance of air traffic control operations, as considered for this study, are presented in Table 2.24.

Table 2.24 Air traffic control operational focus areas and associated relevance to the study

Focus areas	Relevance to the study
Air traffic control teams consist of skilled members that are responsible for specific controlling duties.	Discovering the learning value links that exist between team members (with reference to, amongst others, the role and impact of skills and experience differences).
Compliance is essential in safe, orderly and effective air traffic control operations.	Trace the learning value associated with acts of compliance and non-compliance.
Teamwork requirements as dictated by air traffic control operational teams (reference: research results).	• Explore behavioural skills identified as being important for air traffic control team performance.

	• Explore team member generic attitudes. • Explore team member attitudes, especially learning attitudes. • Explore team member generic knowledge competencies. • Explore team member specific attitudes. • Explore team member specific knowledge competencies.
The impact of shift work on air traffic control team performance.	Determine the impact of shift work and changing teams on the service delivery outputs and the learning that takes place/does not take place.
To what extent do air traffic control teams meet the air traffic control operational and personal outcomes?	Determine whether and how teamwork supports overall air traffic control operational outputs.

Compiled by the researcher

4.6 Air traffic control training

This section provides insight into the specifics as applicable to air traffic control training within the operational milieu.

4.6.1 The air traffic control operational training need

Air traffic control operational training refers to all the post-formal training that takes place within the air traffic control work environment. Air traffic control operational training has thus as its ultimate aim to teach people how to solve problems, while being able to keep the air traffic control system functioning at levels of acceptable safety, effectiveness and expedition (MacLeod, 2001: 37). Operational training includes on-the-job training presented to student air traffic controllers within the work environment (aimed at ensuring competence) as well as any formal or informal continuation training and learning initiatives that take place within the air traffic control operational environment. Operational training needs are necessitated by the increasing complexity of air traffic control tasks that require a structured approach to ensure air traffic controllers have the opportunity to develop the appropriate attitudes, knowledge and skills for safe and efficient teamwork (Barbarino & Isaac, 2000: 270).

Air traffic control workplace learning and training focuses on ensuring the currency of the air traffic controller's competence in order to deliver a safe service. Controller competence in this regard is categorised in terms of (MacLeod, 2001: 42 & 43):

- **Action**. The physical skills and procedural tasks conducted by an air traffic controller in order to get the job done.
- **Control-of-action**. Describes all the mental processes involved in identifying what the problem is, seeking information, formulating plans, prioritising actions and monitoring progress. Control-of-action is the least considered aspect of training design (MacLeod, 2001: 56).

Air traffic control relies on the application of acquired knowledge and skills in the workplace. These key cognitive processes involved in air traffic control and shared by air traffic controllers consist of (Hannan, Moore, Telfer, Marrison & Ross, 2000: 289):

- The identification of actions required by the recognition of incoming information or by scanning existing information.
- Task recognition as a process that results from the synthesis of information and the requirements of air traffic control procedures and objectives.
- Planning and prioritising as processes arising from task recognition in which the air traffic controller coordinates information from various sources and determines a course of action from known strategies.
- Decision-making and actions that arise from the above in that the controller, having recognised tasks, planned actions (and perhaps prioritised them), then commits him/herself to carrying out those actions.

Competence indicators/criteria are understood in terms of the controller's tasks, responsibilities and duties. The findings of a job analysis carried out to identify key elements of an air traffic controller's job are presented below (Neal, Griffin, Paterson & Bordia, 2000: 307).

- **Elements of situational awareness**. Including scanning of the traffic, interpreting and evaluating traffic events, and prioritising, projecting, and planning.
- **Behavioural elements of task performance**. Including executing control actions, communicating, and operating facilities.

- **Elements of contextual performance**. Including teamwork, professionalism, and support for organisational objectives.
- **Situational factors**. Including traffic volume, traffic complexity, weather, abnormal situations, and pilot actions.
- **Elements of effectiveness**. Including orderliness and efficiency of traffic flow.

When describing air traffic control operational training needs one needs to consider key cognitive processes and key elements identified by means of a job analysis. These considerations constitute the basis of air traffic control operational training activities (for both on-the-job training and continuation training).

4.6.2 Design and development of air traffic control operational training

Teams and the individual members of the team are characterised by the level of competencies that they have, relative to what would be required to provide safe, orderly and effective air traffic control services.

The design and development of air traffic control operational training and learning needs to focus on specific deficiencies in existing and/or identified individual and/or team performances. Learning in this regard is evident in the performance of air traffic controllers with reference to their ability to anticipate events, solve problems fast and maintain a level of skilled performance/expertise with less effort (MacLeod, 2001: 37). Effective air traffic control team performance is therefore characterised by the identifiable and traceable knowledge, skills and attitudes (Smith-Jentsch, Kraiger, Salas & Cannon-Bowers, 1999: 1). Knowledge includes the theories, principles and concepts needed for effective team performance. Skills refer to the required behaviours and actions needed for thorough and successful completion of a task. Attitudes describe the team member's affective views, both individually and collectively, on their abilities and motivation to accomplish these goals (Cannon-Bowers, Tannenbaum, Salas & Volpe, 1995: 333-380). Air traffic control team knowledge, skills and attitudes are presented in Table 2.25. Adaptability and shared mental models are thus key requirements for the members of an air traffic control team to work together in an effective manner.

Table 2.25 Air traffic control team knowledge, skills and attitudes

Air traffic control team knowledge
Inter-positional knowledge Knowledge about the components of ATC teamwork

Knowledge about the signs of performance-related stress Knowledge about teammates' task expectations Knowledge of teammate characteristics
Air traffic control team skills
Flexibility Information exchange Supporting behaviour Team feedback skill
Air traffic control team attitudes
Belief in the importance of teamwork Collective orientation Collective efficacy Mutual trust Team cohesion

Smith-Jentsch, Kraiger, Salas and Cannon-Bowers (1999: 1)

Air traffic control knowledge, skills and attitudes presented above are taught and learned during on-the-job training and continuation training interventions. Air traffic control on-the-job training requires a formal design and development process, whereas continuation training is of an ad hoc nature. Continued learning is designed and developed (consciously or unconsciously) as a result of proactive or reactive training and learning needs.

4.6.3 Air traffic control on-the-job training

Air traffic control on-the-job training is mentioned in the literature review to allow for completeness of the air traffic control operational training process.

On-the-job training commences once a student has completed the formal academic phase of air traffic control training at a training institution. During on-the-job training the student will be guided towards a level of competence. On-the-job training is also used to assist an experienced air traffic controller who needs to illustrate competence in a new work environment (for example being transferred from one air traffic control centre to another). The on-the-job training phase ends when the air traffic control student has reached a

standard regarded as being proficient and has satisfied requirements that he/she can work without supervision (IFATCA, 2001(b): 1). At this stage he/she is granted a licence permitting him/her to carry out the duties of an air traffic controller for a specific task at a particular centre.

Air traffic control on-the-job training consists of a formal one-to-one training approach that is synonymous with a learning-by-objectives programme. Each on-the-job training session is a structured learning event that consists of a pre-briefing phase, a demonstration phase, a talk-through phase, a performance monitoring phase, and a de-briefing phase (ATNS, 2002: 12). The people who carry out on-the-job training in the air traffic control environment are, usually, not full-time instructors. They are experienced air traffic controllers who are competent in their own jobs and have been selected to carry out one-to-one training as an addition to their primary task (ATNS, 2002: 4). Good training relies upon a good working relationship between the student and the on-the-job trainer. If that relationship fails, then the student's ability, willingness and motivation to learn may also be jeopardised (ATNS, 2002: 59). No student can be given unlimited on-the-job training (IFATCA, 2001(a): 1). National legislation stipulates the maximum training times that are allowed for the various air traffic control disciplines. These are the points beyond which a student should not be permitted to continue if he/she has not illustrated competence to perform a specific air traffic control task unassisted. On-the-job training results are assessed by means of criterion referencing – air traffic control performance is thus assessed against a set of fixed standards or criteria (ATNS, 2002: 41).

On-the-job training is essentially an important continuation of formal academic air traffic control training, whereas operational continuation training is synonymous with workplace self-directed team operations and learning (the latter being included in the focus of this study).

4.6.4 Air traffic control continuation training

Air traffic control continuation training provides a platform for self-directed team learning. Within a systems perspective individual and/or collective learning needs can be addressed by a team's concerted effort to ensure the competence of all team members. Desired competence is achieved by a concerted effort to continuously identify, design, develop, deliver and evaluate learning solutions. Competence in this regard is thus viewed as a valid predictor of performance.

Continuation training cannot be described in a narrow context because it is used for a wide array of purposes. Controllers should participate in refresher and continuation training, as a means of maintaining a world-wide air traffic control service of the highest standard (IFATCA, 2001(a): 1). IFATCA (2001(a): 1)

describes continuation training as a generic term that indicates a training phase following licensing and rating training and can include refresher training, additional training and development training. It is therefore expected that air traffic control continuation training will include or address the following (Smith-Jentsch, Kraiger, Salas & Cannon-Bowers, 1999: 1-3 and Salas, Bowers & Edens, 2001: 36-42 & 243):

- **Information exchange**. Involves passing relevant data to team members who need it, before they need it, and ensuring that the messages sent are understood as intended.
- **Supporting behaviour**. Involves offering assistance and means to request assistance in an effective manner both within and across teams in the air traffic control system. Supporting behaviour has two primary components: (1) requesting and accepting assistance and (2) providing assistance. Providing assistance refers to the need to identify the need to assist others and the resulting actions that will take place. Requesting assistance involves monitoring oneself for signs of performance deficiency and then to request help from other team members before it is too late.
- **Team feedback skills**. Refers to an environment that supports and encourages team members to communicate their observations, concerns, suggestions, and requests in a clear and direct manner without becoming hostile or defensive.
- **Flexibility**. Involves the ability to learn and adapt performance strategies quickly and appropriately to changing task demands.
- **Teammate generic knowledge competencies**. Smith-Jentsch, Kraiger, Salas and Cannon-Bowers (1999: 1-3) identified the following three teammate-generic knowledge competencies:

    - Inter-positional knowledge. Involves understanding the tasks performed by the other teams and team members with whom an air traffic controller must coordinate.
    - Knowledge about teamwork. Knowledge that will help air traffic controllers to diagnose and correct coordination breakdowns.
    - Knowledge about the performance-related signs of stress. This knowledge is critical for members of air traffic control teams that operate in environments characterised by time pressure, rapidly unfolding events, high information processing demands, and severe consequences of error. This knowledge is necessary in order to determine when to offer or request assistance.

- **Teammate specific knowledge competencies**. Smith-Jentsch, Kraiger, Salas and Cannon-Bowers (1999: 1-3) identified the following two categories of teammate-specific knowledge as being important for air traffic control teamwork:

    - Knowledge about teammate characteristics. Knowledge helps air traffic controllers to be aware of situations in which individual teammates may require assistance and to anticipate what type of assistance those teammates prefer. The role of a social and favourable learning environment is highlighted in this regard.
    - Knowledge about team-task expectations. Knowledge includes information regarding a specific team's preferred strategies or procedures for handling different types of situations.

- **Teammate-generic attitudes**. Smith-Jentsch, Kraiger, Salas and Cannon-Bowers (1999: 1-3) identified the following two teammate-generic attitudes:

    - Belief in the importance of air traffic control teamwork. Refers to the individual and collective opinion that teamwork skills are necessary to achieve the most effective and efficient performance as an air traffic controller.
    - Collective orientation. Refers to the tendency to view oneself as part of a larger system and to accept specific and general system responsibilities. Collectively oriented air traffic controllers are expected to be better able to provide effective supporting behaviour because they are more likely to consider the impact of their actions on the workload of other team members.

- **Teammate-specific attitudes**. Smith-Jentsch, Kraiger, Salas and Cannon-Bowers (1999: 1-3) identified the following three teammate-specific attitudes that are important for effective air traffic control teamwork:

    - Collective efficacy. Refers to an air traffic controller's confidence in the technical abilities of his/her individual teammates as well as the team's ability to coordinate and adapt to rapidly changing situations. Collective efficacy is a product of effective continuous learning by a team.

- Mutual trust. Involves a belief that one's teammates can be counted on to be honest and to act with good intentions towards one another. This level of trust is achieved when teammates communicate, control, coordinate and learn in an effective manner.
- Team cohesion. Refers to the desire to become or remain a member of a specific team of individuals. Cohesive teams are characterised by a functional group status and a fine reputation.

- **Team situational awareness**. The concept of team situational awareness relates to maintaining a collective awareness of important job related conditions. Team situational awareness relies on shared mental models, verbalisation of decisions, better team meetings, teamwork and feedback, and individual situational awareness. Team situational awareness can be taught and learned — it requires, as stated before, a concerted team effort.

Effective continuation training relies upon a concerted effort by all team members. A team may find itself in one of the three phases associated with continuation training — awareness, practice and feedback, and reinforcement (Smith-Jentsch, Kraiger, Salas & Cannon-Bowers, 1999: 42). Creating a continuation training awareness within the air traffic control team environment can assist self-directed teams with their advancement towards self-directed team learning. During the awareness phase teams will need to challenge their dysfunctional teamwork attitudes and create sensitivity towards effective self-directed teamwork concepts (Smith-Jentsch, Kraiger, Salas & Cannon-Bowers, 1999: 42-44). Awareness will serve as the foundation for the next level of continuation training, namely assuming responsibility for interactive learning practice and feedback opportunities. During the practice and feedback phase the team needs to develop and implement skills necessary to apply the concepts introduced in the awareness stage (Smith-Jentsch, Kraiger, Salas & Cannon-Bowers, 1999: 45). Finally the quality of continuation training will rely on continuous effort and reinforcement activities. During this phase repeated exposure to team concepts as well as performance feedback efforts will facilitate a climate that supports effective teamwork and which will ensure the sustainability of the continuation training strategy (Smith-Jentsch, Kraiger, Salas & Cannon-Bowers, 1999: 49).

When reflecting upon the value of air traffic control continuation training it is observed that continuation training is an effective means to ensure the sustainability and survival of effective self-directed team learning and performance. Continuation training provides performance stability in an environment that is characterised by uncertainty, rapid change and the continuous pursuit of safety and excellence (Meyer, 1999: 87). Continued learning is a valuable team trait in organisations that view themselves at the forefront

of institutionalising what they are learning (Meyer, 1999: 87). Effective continuation training therefore also contributes towards learning organisation eminence.

4.6.5 Role and relevance of air traffic control training

The detailed role and relevance of air traffic control training, as considered for this study, are presented in Table 2.26.

Table 2.26 Air traffic control training focus areas and associated relevance to the study

Focus areas	Relevance to the study
Air traffic control operational training considers key cognitive processes and key elements identified by means of a job analysis.	Determine: • cognitive processes and key elements identified by means of a job analysis that are considered to be present during air traffic control operational training; and • air traffic control team knowledge, skills and attitudes that are considered to be present during air traffic control operational training.
Continuation training is an effective means to ensure the sustainability and survival of effective self-directed team learning and performance.	• Explore the manner in which self-directed teams manage their own continuation training. • Identify the team's continuation training phase. • Determine the focus areas and impact of air traffic control continuation training.

Compiled by the researcher

4.7 Human factors

This section explores human factors principles as applicable to air traffic control operations. The purpose of this exploration is to identify the nature of human factors and the link between self-directed learning and human factors principles. The human factors focus will therefore allow for a better understanding of shared mental models, shared motives, accepted team learning strategies, and other behaviour-related variables.

4.7.1 Human factors in air traffic control

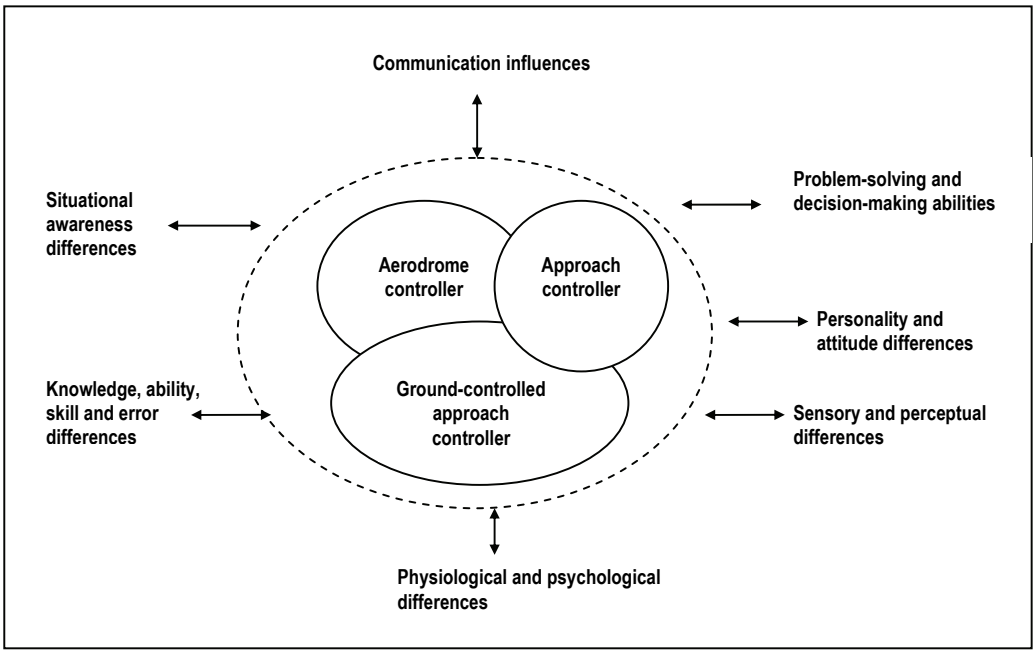
A study of human factors allows for the assessment (Thomas, 2004: 213, Amundson, 1995: 83-86 and Hamman, Seamster & Edens, 1995: 89-92) of the following:

- **Individual mental factors**. Individual mental factors include:
  - technical proficiency;
  - situational awareness;
  - workload management;
  - planning; and
  - decision-making.
- **Interpersonal factors**. Interpersonal factors include:
  - team building;
  - group climate;
  - leadership/followership;
  - communications; and
  - coordination.

To ensure an understanding of human factor principles present within the air traffic control workplace, consideration also needs to be given to an explanation of human performance. Human performance refers to the human capabilities and limitations which have an impact on the safety and efficiency of aeronautical operations (ICAO, 2001: 1.8). Human use of complex and integrated systems is limited by the functional capacity of the human (Isaac, 1995: 107). Human factors principles, in turn, are those principles which apply to aeronautical design, certification, training, operations and maintenance and which seek safe interface between the human and other system components by proper consideration to human performance (ICAO, 2001: 1.7). The basic human factors issues include judgement and decision-making, communication, leadership and teamwork, and stress management (Maschke, Goeters, Hormann & Schiewe, 1995: 25). Human factors are recognised to be at the heart of future developments in the maintenance and improvement of aviation safety (Fuller, Johnston & McDonald, 1995: 1). According to the Consequences of Future Air Traffic Management Systems for Air Traffic Controller Selection and Training Report (CAST) the air traffic controller of the future will need more human factors knowledge in order to

cope with workplace challenges and requirements (CAST, 1999: 23). Human performance, primarily defined as the team's results, within an air traffic control environment, is dependent upon human interactions, influences, dynamics, perceptions, competence and complexities. Figure 2.16 presents human factors forces, explained from a team resource management perspective, that impact on the nature of teamwork in air traffic control.

Figure 2.16 Illustrating human factors forces, explained from a team resource management perspective, that impact on the nature of teamwork in air traffic control



Adapted by the researcher from ATNS (2003: 1-5) and ICAO Circular 217-AN/132 (1989)

An air traffic control team's collective worth may be described in terms of the SHELL model. Hawkins (Hawkins & Orlady, 1993: 22-26) designed the SHELL model in order to describe the complex interactions associated with human factors (Isaac & Ruitenberg, 1999: 13). The SHELL model (as depicted in Figure 2.17) denotes four kinds of interactive resources and relationships, namely (Isaac & Ruitenberg, 1999: 13-17):

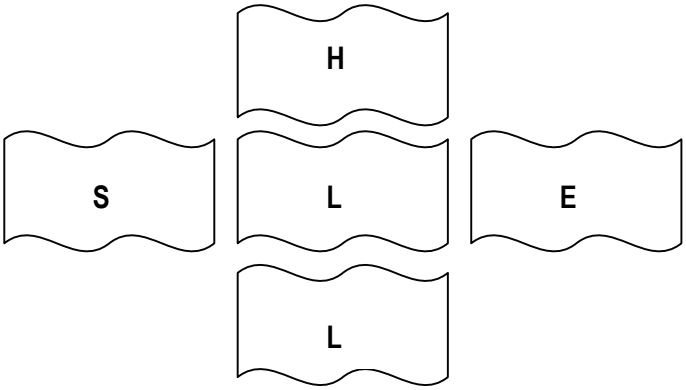
- **S** — Software. The rules, procedures, spoken words, which are part and parcel of the standard operating procedures.
- **H** — Hardware. The air traffic control suites, their configuration, controls and surfaces, displays and functional systems.

- **E** — Environment. The social and economic climate in which the air traffic controller operates as well as the natural environment.
- **L** — Liveware. The human beings, other controllers, flight crews, maintenance personnel, management and administration personnel within the system.
- **L** — Liveware (in the middle). The controller and his relationship with all the mentioned elements.

The SHELL model (Hawkins & Orlady, 1993: 22-26) emphasises that air traffic control performance is influenced by liveware-liveware interfaces. Team resource management training and evaluation have been aimed at the enhancement of the liveware-liveware interfaces (prerequisites for effective team performance) through the development of five sets of competencies (Isaac & Ruitenberg, 1999: 15). The competencies are (Isaac & Ruitenberg, 1999: 15):

- enhancing decision-making skills;
- developing effective interpersonal communication styles of behaviour;
- developing leadership/followership abilities;
- engendering a "team" concept for enhanced operational performance; and
- dealing with stress.

Figure 2.17 SHELL model



Hawkins and Orlady (1993: 22-26) and Isaac and Ruitenberg (1999: 13-17)

From the SHELL model's (Hawkins & Orlady, 1993: 22-26) perspective it is evident that the liveware-liveware value link deserves attention when self-directed learning is studied, because decision-making, interpersonal communication, leadership/followership occurrences, team spirit and stress are essentially human traits.

A narrow liveware-liveware focus will not consider environmental issues and its role and impact on self-directed learning. In this regard Koenig (1995: 5) states that four primary issues in air traffic control human factors need to be considered when studying air traffic controller behaviour:

- **Operating environment**. The air traffic control work environment promotes the individual rather than teams. It is marred by poor communication, attitude problems and negative reinforcements.
- **Attitudes**. A reluctance to request assistance at individual level.
- **Communication**. Communication problems exist at many levels in the air traffic control community.
- **Trust**. Greater levels of trust among controller team members, controllers and pilots, and controllers and their supervisors need to be promoted.

Air traffic controller learning behaviours are influenced by the individual, the team and the environment within which the work/learning input is presented. However, Koenig (1995: 5) identifies typical behaviour characteristics associated with air traffic control operations as a result of specific work environmental influences. The influence of these behaviours on self-directed learning thus requires further investigation.

Air traffic control requires specific human behaviour — the application of a skill, being able to control air traffic. Behaviour requirements include flexibility of the human operator (controller), capability to deal with unexpected situations, creativity and a safety consciousness (Leroux, 1995: 89). This behaviour is described and explained by means of Rasmussen's (Isaac & Ruitenberg, 1999: 20-23) classification of human behaviour according to the control exercised along with the situation at hand (summarised in Table 2.27).

Table 2.27 Rasmussen's three levels of behaviour

Situation	**Control**		
	Mainly conscious	Conscious and automatic	Mainly automatic
Routine/expected			*Skill-based behaviour*
Familiar or trained-for problems		*Rule-based behaviour*	
Novel, difficult or dangerous problems	*Knowledge-based behaviour*		

Isaac and Ruitenberg (1999: 20)

The different work-related air traffic control situations signify the need for different individual and group mental processes, which in turn stimulate relevant behaviour, in order to achieve desired outcomes in terms of safety and effectiveness. Skill-based behaviours are routine and automated activities that rely on existing experience, judgement and skills. These behaviours are evident when controllers perform monitoring tasks, referred to as routine passive tasks (Newman, Tattersall & Warren, 1995: 120). Rule-based behaviours are directed by standard operating procedures and require an integration of rule-based knowledge with control procedures/skills. These overt behaviours are observed when routine active controlling tasks are performed (Newman, Tattersall & Warren, 1995: 120). Knowledge-based behaviours rely on overall skill, ability, observation, training and experience in order to understand and solve problems. These planning and problem-solving behaviours refer to the highly cognitive component of the task, for example conflict resolution and non-routine flight data management (Newman, Tattersall & Warren, 1995: 120). Workplace required behaviours (focusing on knowledge, skills and attitudes) are taught by means of air traffic control training provided by training institutions and reinforced in the workplace. Attention should also be afforded to teamwork behaviours and how these are acquired and practised.

To ensure a safe, orderly and effective flow of traffic the air traffic controllers need to operate within a team, which, in turn, calls for an additional skill — the skill to work with others. The main objectives of human factors are to enhance the effectiveness and efficiency with which work and other activities, including social interactions, are carried out by people and also to maintain and enhance certain desirable values (Isaac & Ruitenberg, 1999: 2). Social influences that can possibly exist in air traffic control teams (Isaac & Ruitenberg, 1999: 162-186) are:

- **Conformity**. In this regard conformity is considered to be a change in behaviour or belief as a result of real or imagined group pressure.
- **Compliance**. Refers to both compliance and refusal to comply with requests in a team situation.
- **Team decision-making**. It is rare in the air traffic control environment to deliberately work in a team decision-making situation. As such, collective decision-making is not as much a factor in this environment as the problems of communication within a monitoring and/or assisting role. Misunderstandings arise because of differences in decision-making strategies, and differences in communication styles amongst team members. Often the decision-making process in air traffic control teams is made more complex by a lack of common understanding. This may be exaggerated by the problems of individual responsibility, which can arise from actual disagreement or from the failure to question assumptions.

- **Team polarisation**. Arises when individuals are faced with a choice or dilemma in which the desirable outcome must be weighed against the risk of a possible undesirable one. Team members are thus concerned with how their opinions compare with those of others in the team.
- **Groupthink**. One of the main problems to be found, in some controlling situations is the lack of a group or collective mental model. In a rapidly developing and dynamic situation the mental model needs to be updated as new information is added. Ineffective groupthink stifles criticism and dissent and leads to irrational and dehumanising actions.
- **Team roles**. Desired responses in an air traffic control team role context are giving/sharing information, suggestion or criticism. The problem of different roles in an air traffic control team often creates paradoxical situations. This refers to the fact that some roles are not well defined and therefore have different meanings for different individuals.
- **Team atmosphere**. Often within the air traffic control environment, controllers are critical of their team members and/or members from other teams, which is usually damaging to the working situation.

Performance differences associated with teamwork effectiveness can be explained and understood from a human factors perspective by paying attention to individual and team dynamics (ATNS, 2003: 1-5). These dynamics are the result of (ATNS, 2003: 1-5):

- Communication influences that include non-verbal communication, language fluency, listening skills, verbal reasoning, interpretation abilities and understanding.
- Problem-solving and decision-making abilities that include identifying problems, defining problems, constructing solutions, implementing and evaluating problem-solving, attention span, proactive actions and vigilance.
- Situational awareness differences, with reference to the ability to extract relevant and useful environmental cues and information in order to continuously construct reality. Isaac (1995: 108) also emphasises techniques such as imagery (ability to create a clear stable picture) and visualisation (three-dimensional spatial aptitudes) in this regard.
- Personality and attitude differences, with reference to the role of individual personalities, leadership/followership preferences and individual and shared work-related attitudes viewed within a certain corporate culture.
- Knowledge, ability, skill and error differences that include differences in work experience, training received, traffic management skills, traffic scanning, dual tasking, error detection, remedial actions,

control preferences, risk management, task allocation and prioritisation, and attention management.

- Sensory and perceptual differences, with reference to observation skills, coping and emotional control, individual and shared perceptions, and mental processing.
- Physiological and psychological differences that include adaptation abilities, sleep patterns, relaxation preferences, the effect of shift work, stress and fatigue, levels of boredom and complacency, and overall ability to handle the workload.

Although technical competence in air traffic control systems is of vital importance, the application of technical knowledge in complex settings requires skilful interpersonal interaction (Jones, 1997: 1-3). Controller development should encourage and support interpersonal behaviours (Jones, 1997: 1-3). There are certain patterns of air traffic control behaviour that can be accurately linked to mishap behaviour; presented as (Jones, 1997: 1-3):

- lack of information sharing (not utilising and sharing data); and
- poor task management (not making and implementing a plan).

Conversely, interpersonal aspects such as flexibility and receptivity were linked to exemplary performance (Jones, 1997: 1-3).

Several human factors focus areas have been identified above, which, in turn, identify the team-learning need to design, develop, implement and evaluate the appropriate attitudes, knowledge and skills associated with effective teamwork. Information that probes social, variables, technical competence and team behaviours needs to be interwoven in an attempt to study and understand the role of human factors upon self-directed team learning. It is therefore proposed that the effectiveness of air traffic control workplace learning (self-directed team learning) be studied from both a functional vocational perspective and a human factors perspective.

4.7.2 Role and relevance of air traffic control human factors

The detailed role and relevance of air traffic control human factors, as considered for this study, are presented in Table 2.28.

Table 2.28 Air traffic control human factors focus areas and associated relevance to the study

Focus areas	Relevance to the study
Shared mental models, shared motives and accepted team learning strategies that exist within a team.	Determine how learning within the team is influenced by: • judgement, problem-solving and decision-making; • situational awareness; • sensory and perceptual differences; • personality and attitude differences; • communication; • knowledge, skill and ability differences; • leadership and teamwork dynamics; and • physiological and psychological differences (example - stress management).
The SHELL model denotes four kinds of interactive resources and relationships that exist within teams.	Explore how individual and team learning is influenced by the following interfaces: • **S** - Software • **H** - Hardware • **E** – Environment • **L** – Liveware • **L** – Liveware (in the middle)
Four primary issues in air traffic control human factors need to be considered when studying air traffic controller behaviour.	Determine how team learning is influenced by: • operating environment; • attitudes; • communication; and • trust.
The different work-related air traffic control situations signify the need for different individual and group mental processes, which in turn stimulate relevant behaviour.	Determine how situational influences and team learning initiatives are influenced by: • routine/expected (skill-based) behaviour; • familiar or trained-for problems (rule-based behaviour); and • novel, difficult or dangerous problems (knowledge-based behaviour).

Human factors and air traffic control operations are influenced by social interactions.	Determine which of the following social aspects exist within the team and how these influence learning: • conformity; • compliance; • team decision-making; • team polarisation; • groupthink; • team roles; and • team atmosphere.
Certain patterns of air traffic control behaviour can accurately be linked to mishap behaviour.	Determine whether the following behaviours exist and trace the impact thereof on team learning: • Lack of information sharing (not utilising and sharing data). • Poor task management (not making and implementing a plan).

Compiled by the researcher

5 Reflection

Section 4	Reflection

This literature review provided me with an opportunity to disseminate the research question and sub-questions in order to identify all the review areas. This review identified the following essential focus areas that were explored:

- adult learning;
- self-directed learning;
- self-directed teams;
- self-directed team learning;
- air traffic control;
- the air traffic control operational/work environment;
- the air traffic control team;
- air traffic control training; and

- indicators of effectiveness in the air traffic control operational environment.

The exploration of the focus areas equipped me with the necessary knowledge, understanding and awareness in order to identify and summarise specific areas of relevance to the study.

The air traffic control operational environment is characterised and influenced by a common purpose, strict rules and high standards. The success of the entire air traffic control effort is synonymous with a collective mental model that signifies a movement towards group work or a team mental model that favours self-directed team performance. Proper and safe conduct is the result of a team mental model fostered by a learning self-directed team. The collective/mental model and associated behaviour are influenced, shaped and directed by both the individual's and the team's technical air traffic control competences and human factors capacities. The collective/team mental model (albeit functional or dysfunctional) needed to be explored by means of accumulated information presented by individuals and teams regarding his/her/their workplace learning performance and preference-directed behaviours. The researcher therefore had to identify and understand the nature of the air traffic control team's prevailing collective/team mental model

The impact study is dependent upon enablers and impact assessment criteria, inferred relationships, perceptions and observed practices. The self-directed team learning impact study required sufficient and valid workplace information consisting of reflective reports from both team members and teams. These reports were uncovered, understood and described by me within the self-directed team learning theoretical framework that emphasised human factors competence, air traffic control knowledge, skills and abilities, teamwork occurrences and performances, and related learning strategies and initiatives.

A thorough understanding of adult learning and adult learners is required by the researcher in order to identify, understand and present the self-directed team learning discourse. This discourse relies upon an understanding of learning practices and strategies utilised by both team members and teams and the subsequent reported and perceived impact/outcome/effectiveness results. These practices, strategies and results are anchored within the world of air traffic control, which also sets the scene for this self-directed team learning study.

A critical review of the accumulated wealth of knowledge presented, contributed significantly to my understanding of the impact of self-directed team learning upon individual, team and organisational performance. An emerging theory I proposed as a result of the literature review is **that a self-directed**

team learning approach may contribute to aviation safety within the air traffic control community of practice.

On a flight from Cape Town to Johannesburg on 15 April 2005, I reflected upon the outcome of this literature review and the feasibility of the presented emerging theory. I realised that I had to identify the theoretical concepts and had to understand the relationships between these concepts. Conceptualisation in this regard would provide me with more clarity in terms of data collection and interpretation.

I decided to summarise and present the essential aspects of the literature review with the aim of motivating and directing further research activities. The outcome of this step is presented below.

- The air traffic control operational environment is characterised and influenced by a common purpose, strict rules and high standards. The success of the entire air traffic control effort is synonymous with a collective mental model that signifies a movement towards group work or a team mental model that favours self-directed team performance within a community of practice. Proper and safe conduct is the result of a team mental model fostered by a learning self-directed team. The collective/mental model and associated behaviour are influenced, shaped and directed by both the individual's and the team's technical air traffic control competences and human factors capacities. **I had to identify and understand the nature of the air traffic control team's collective/team mental model and trace the associated success/impact thereof upon air traffic control operations.**

- The impact study is dependent upon enablers and impact assessment criteria, inferred relationships, perceptions and observed practices. The self-directed team learning impact study required sufficient and valid workplace information consisting of reflective reports from both team members and teams. **I had to uncover, understand and describe these reports from both an individual self-directed learning and a team self-directed learning perspective.**

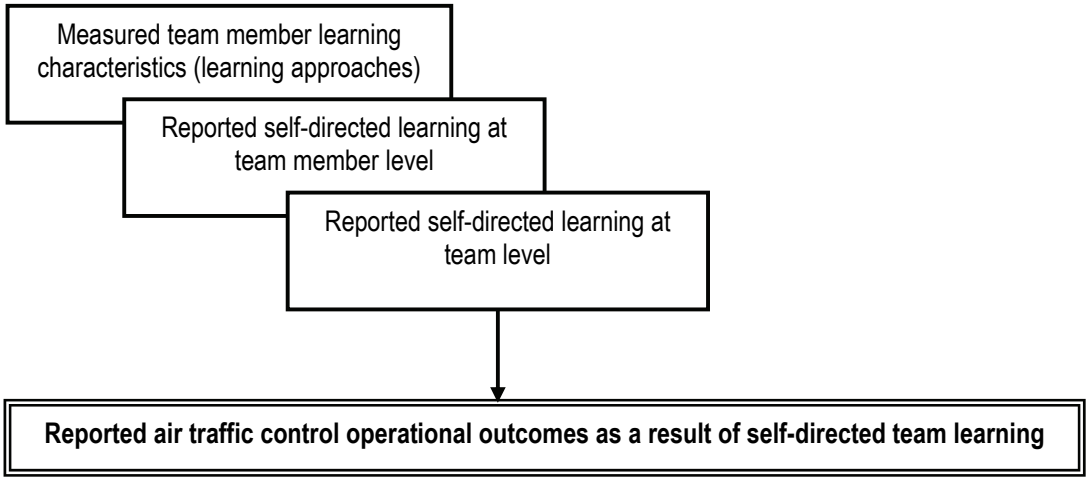
- I required a thorough understanding of learning practices and strategies utilised by both team members and teams and reported and perceived impact/outcome/effectiveness results. These learning practices, strategies and results are reliant upon individual learning approaches. **I had to understand, describe and link individual learning approaches with self-directed learning strategies, as found within air traffic control teams and team members.**

I also decided to compile a research mission statement for the study, which would assist and guide me during the research activities — **link identified individual and team self-directed learning initiatives, and then link self-directed team learning findings with air traffic control operational outcomes**. This mission statement makes provision for the following objectives:

- understand how self-directed learning manifests itself at individual and team level; and
- understand how self-directed team learning influences air traffic control operational outcomes.

I then decided to describe and present the result of my reflection in a visual format (Figure 2.18).

Figure 2.18 Reflection outcome



Compiled by the researcher

CHAPTER 3

CONCEPTUAL ORIENTATION

Figure 3.1 Chapter 3 conceptual orientation

Section 1	Introduction	
Section 2	Philosophical departure	**Humanist paradigm**
		Progressive paradigm
		Technicist-behaviourist paradigm
		Broad philosophical assumptions • Ontological assumptions • Epistemological assumptions • Anthropological assumptions • Methodological assumptions
		Paradigmatic perspective
Section 3	Conceptualising learning	• Learning motives • Learning orientations • Learning approaches • Why do individuals and teams participate in learning?
Section 4	Reflection	

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1 Introduction

Section 1	Introduction

Self-directed air traffic control teams are viewed as self-organising, social systems. These teams need to cope with increasing complexity and the dynamics of a continuously changing environment in order to ensure that aviation safety needs are satisfied. Self-directed air traffic control teams act as learning agents for the air traffic control community, responding to changes in the internal and external environment of the community, by detecting and correcting errors in the team's theory-in-use, and embedding the results of their inquiry in private images and shared maps (Argyris & Schön, 1978: 29). How do they do it?

Greater understanding relies upon a process of inquiry that involves thinking about questions, making interpretations and reflecting upon data, while stretching the limits of my own understanding and ability to respond. My challenge is to explore, interpret and present my own understanding in response to the research questions, thus creating a whole system of thought.

2 Philosophical departure

Section 2	Philosophical departure	Humanist paradigm
		Progressive paradigm
		Technicist-behaviourist paradigm
		Broad philosophical assumptions • Ontological assumptions • Epistemological assumptions • Anthropological assumptions • Methodological assumptions
		Paradigmatic perspective

In order to explain the foundation and basic structures that will act as lenses through which I will attempt to understand phenomena, events and realities in this research study, it is essential to explain my points of "philosophical" departure:

- I accept that personal development is an aim of adult education, thus the individual is central in the learning experience. However, practice towards this end emphasises *process* over *content* (Darkenwald & Merriam, 1982: 49). It is the responsibility of the individual to learn what he/she

wants to learn in the manner desired (Darkenwald & Merriam, 1982: 48-49). Rogers (Darkenwald & Merriam, 1982: 49), supports group activities as an instructional technique in bringing about individual growth. Lindeman (Darkenwald & Merriam, 1982: 50), states that *if adult learners want their "intellectual alertness" to count for something, they will be as eager to improve their collective enterprises, their groups, as they are to improve themselves*.

- I acknowledge that adult learning depends on the readiness and responsibility to grow and develop that exists in individuals and effective teams. McKenzie (Darkenwald & Merriam, 1982: 49) and Brookfield (1985: 14 & 15), state that once the individual accepts the responsibility for individual growth (interpreted from both an individual and group learning perspective), a readiness for self-directed learning, which addresses cognitive and affective domains, is signalled. McKenzie (Darkenwald & Merriam, 1982: 49) cautions those who value individual growth and development of constraints involved in transforming this ideal into effective practice, with reference to the application of these ideas in a complex real world.

- It is not possible to ignore environmental and societal influences when analysing the role of the adult learner. Dewey, Lindeman and Bergevin (Darkenwald & Merriam, 1982: 57) agree that education stimulates interaction with the environment, whilst society simultaneously influences the individual's needs, desires and motivation to learn. Apps (Darkenwald & Merriam, 1982: 51) views these influences as instrumental in helping people to acquire the tools for psychological, physical and social survival, and helping people to learn how to learn.

- Organisational/workplace effectiveness is closely linked to environment and society influences, and the development of human resources has thus become one of the aims of adult education. The tension between individual and organisational needs is described by Argyris (Darkenwald & Merriam, 1982: 68) as *the foundation for increasing the degree of effectiveness of both*. I take cognisance of the need to triangulate individual, team and organisational dynamics in order to fully comprehend phenomena.

My challenge is to determine what theories of knowledge air traffic controllers hold regarding self-directed team learning and the impact thereof. Theories of knowledge are not static reflections of the environment, but dynamic constructions achieved by human relationships and interactions. I assume that knowledge is constructed by the subject or group of subjects in order to adapt to their environment and that construction of knowledge is an ongoing process at different levels; psychological and social. These ongoing processes

are the result of individual and collective changes of consciousness due to constructive efforts by the subject/subjects. I expect to discover factors internal to the subject's point of view and factors external, which in turn, will allow me to understand how knowledge structures were/are formed, nurtured and maintained within a defined learning situation and learning environment.

I decided that the experiences, perceptions, views and feelings of air traffic controllers will need to be studied in a holistic and integrated manner in order to address the research questions formulated for this study. This decision poses the question to the researcher which paradigm or which group of paradigms should be followed. I realised that when adopting a paradigm or group of paradigms for my research that my decision would literally permeate every act even tangentially associated with the research inquiry (Lincoln, 1990: 81). Realising that research results no longer have to only claim absolute truths or absolute insights allowed me to consider a multiparadigmatic approach.

2.1 Humanist paradigm

Hiemstra (Brockett, 1988: 184) states that the **humanist paradigm** subscribes to reality that is found in the acknowledgement of human potential, which, in turn, depends on educational methods comprising self-directiveness and teamwork — as research focus areas. The humanistic paradigm facilitates a deeper learning approach that places emphasis on self-directed learning, reflection as a learning stage and the overall development of the learner.

2.2 Progressive paradigm

According to Hiemstra (Brockett, 1988: 183) the **progressive paradigm** enables the researcher to discover "truths" by studying people's needs, experiences and perceived realities by taking cognisance of interrelationships and collaborative extensions as a result of these relationships — also research focus areas. The progressive paradigm encourages performance-based learning approaches.

2.3 Technicist-behaviourist paradigm

Darkenwald and Merriam (1982), and the University of the Witwatersrand (2000) agree that the **technicist-behaviourist paradigm** will allow the researcher to view reality from an occupational skills perspective, where such skills are governed by external forces (including social forces) that lead to workplace conditioning and associated behaviour changes — thus supporting the notion that learning is a reasonably

permanent change in behaviour brought about by experience(s). Occupational skills in the air traffic control environment are described in terms of desired and correct outcomes. Learning, viewed within the technicist-behaviourist paradigm, may be directed by superficial learning approaches.

I accept that individual and team-actualisation objectives **(humanist)** will facilitate personal and social improvement **(progressive)** that contributes to organisational effectiveness **(technicist-behaviourist)**, as described by Darkenwald and Merriam (1982), and the University of the Witwatersrand (2000). The humanist, progressive and technicist-behaviourist paradigms were utilised to trace the impact of self-directed team learning in the air traffic control environment.

This personal view of philosophy will allowed me to investigate phenomena within its real life contexts in order to explore views, meanings, experiences, accounts, actions and events that occur in self-directed team learning.

2.4 Broad philosophical assumptions

I accept that research is concerned with understanding the world and that such understanding is informed by how I view the world, what I take understanding to be, and what I see as the purpose of understanding (Cohen, Manion & Morrison, 2000: 3). I have attempted to link ontology, epistemology, anthropology and methodology in order to provide shared assumptions about the nature of the phenomena I wish to study, a vocabulary for presenting such phenomena, and a criterion for evaluating my research (Orlikowski & Gash, 1994: 176).

2.4.1 Ontological assumptions

Guiding my thoughts and assumptions regarding the nature of "reality" within an individual and team context I had to make provision for individual and shared consciousness as well as individual and shared cognition.

Humans create reality by learning from others, teaching others, and by reflecting on their own understanding. This individualistic and humanist view supports the notion of nominalism by acknowledging that individuals do construe their own realities. Realities are also developed by shared language and common practices within a community of practice, thus providing a realist glimpse of reality. Social reality can thus be understood from both an external point of view and within levels of individual consciousness (Cohen, Manion & Morrison, 2000: 5). To allow for a rich understanding of social reality within the scope of

my research study, I needed to include individual, team and environmental forces/influences, and debate their roles and contributions.

2.4.2 Epistemological assumptions

My epistemological assumptions are challenged by the grounds and nature of knowledge and the view held regarding truth. These assumptions are listed below.

- Knowledge is acquired by transactional means, which implies that it can be acquired by interacting with the source in a bi-directional manner. This implies a readiness to learn from one party and a readiness to teach from the other party. This transactional view indicates that knowledge can be viewed as hard, objective and tangible, which, in turn, posed a challenge to me to consider the use of quantitative methods in my research study (Cohen, Manion & Morrison, 2000: 6).

- Knowledge can also be created by personal experiences that result in individual cognition. These experiences require a deeper qualitative approach in order to discover the personal, subjective and unique nature of translated interactions and intra-actions.

- Collective knowledge can be the product of collaborative cognitive interactions. These interactions allow for a qualitative approach in order to discover interdependent, interactive and holistic forms of cognition.

Epistemological assumptions stated above favour an investigation that considers both quantitative and qualitative inquiry. However, a predominant qualitative approach allowed me to acquire a deeper understanding of the phenomena.

2.4.3 Anthropological assumptions

All facets of the environment influence human behaviour. However, the environment is by and large a product of human effort and influences. I do agree that human beings and their experiences are also a product of the environment. However, I propose a shift in focus. In this research study I am curious to learn how learning takes place and how learning impacts upon a community of practice. Ultimately humans are initiators of their own actions, which, in turn, impact on the status of the environment. This line of thought

allows me to focus more on issues synonymous with a softer, personal and more humanly created view of the social world.

2.4.4 Methodological assumptions

Abovementioned assumptions impacted on my methodological choices and, in turn, demanded consideration of different research methods (Cohen, Manion & Morrison, 2000: 6). I found that my principal concern is understanding the way in which the individual and team create, modify and interpret the world in which he/she/they function. According to Cohen, Manion and Morrison (2000: 7) such a research approach will take on a qualitative as well as quantitative aspect. The cited assumptions made it clear to me that my proposed study will need to make use of both quantitative (positivist context) and qualitative (phenomenological context) methods (resulting in a mixed-method approach) and associated techniques in order to discover reality and then to understand such reality.

2.5 Paradigmatic perspective

The basic paradigmatic point of departure in this research study is that a self-directed team learning approach may contribute to aviation safety within the air traffic control community of practice. This implies that in an effort to understand and to contribute to aviation safety I must be seen to subscribe to a meta-theoretical approach that supports self-directed team learning. In other words, self-directed team learning is understood in terms of the activities of people within a particular community of practice. My meta-theoretical assumptions are based on the significance of collective and collaborative learning. I realise that learning is more than a change in performance of a single individual; learning is the result of the performance of a team of individuals sharing a common purpose or intent or engaged in a common practice (Driscoll, 2002: 59). Collaborative learning essentially integrates knowing with doing.

Considering my epistemological and ontological assumptions stated above, I realise that learning initiatives and associated performances are characterised not just by the processes within an individual but also by the processes shared by and affecting air traffic controllers within a defined team.

My challenge is to understand links between learning and performance — including learning methods, approaches, motives and practices.

3 Conceptualising learning

Section 3	**Conceptualising learning**	• **Learning motives** • **Learning orientations** • **Learning approaches** • **Why do individuals and teams participate in learning?**

A conceptual orientation allows for a framework within which I could consider and understand the issues and principles that structure, guide and shed light upon the focus area of this research study — learning and performance relations.

A conceptual orientation supports the paradigms of inquiry by paying attention to the development of individual and collective learning motives that are supported by dynamic learning approaches and orientations that contribute to organisational learning and performance. The result is the creation of an understanding of the rationale for learning at individual and team level.

3.1 Learning motives

Organisational learning is a term often used to describe workplace learning. Organisations cannot really learn; organisational learning is the result of individual and team learning motives, initiatives and experiences that are not inhibited by specific frameworks or contexts (Thompson, 1995: 85-100). Organisational learning transcends boundaries and such learning is controlled by individuals (Thompson, 1995: 85-100). Meaningful and effective learning are characterised by individuals and teams that continuously aspire to become more effective and efficient in those areas that are regarded as important/critical (Senge, 1994: 18 & 19). Individuals and teams that embark on this route of continuous learning make extensive use of conceptualisation and reflective strategies (Senge, 1994: 18 & 19).

Any major changes in knowledge and increases in demand for knowledge-based workers are bound to have an effect on the education system; and since these workers are adults, these changes will have an effect on adult education (Jarvis, 2001: 5). Significant changes in education are illustrated by Jarvis (2001: 6 & 9) in his overview of the various axes along which education is travelling, as indicated in Table 3.1.

Table 3.1 Overview of the axes along which education is travelling

From initial to adult to recurrent and continuing education.	A statement from the 1960s that refers to post-school education. The term recurrent education was replaced by continuing education, which, in turn, signifies the notion of lifelong education.
From teacher-centred to student-centred education.	A statement from the 1960s that signifies the movement in adult education from pedagogy towards andragogy. The value of student-centred learning became widely incorporated into the educational system, both schooling and adult.
The changing status of knowledge.	Emerging in the 1980s; the premise being that the rapid technology changes convert knowledge into a relative and ever changing phenomenon. Knowledge taught has to be understood critically, thus introducing critical theory to the educational vocabulary.
From curriculum to programme.	Previously curriculum theory was restricted to the classical and the romantic formulation. Pluralism necessitates that curricula be broken down into smaller clusters (modules or short courses).
From liberal to vocational.	Previously a great deal of adult education was liberal. However this state has changed and adult education is placing the emphasis on a vocational orientation.
From face to face to distance.	Traditionally education was conducted in a face-to-face mode. However, the advent of new information technology gave rise to distance education. In effect time and space have been

	transformed in education as a result of the technological interfaces.
From education and training to learning.	Traditional education and training made way for multilevel workplace practical competence. It no longer matters how knowledge was learnt, as long as it was learnt.
From rote learning to learning as reflection.	In the past learners were expected to grasp the truth of scientific discovery and remember it (rote learning). However knowledge has become a narrative and even a discourse; it has to be considered, criticised and reflected upon to ascertain the extent to which it contains any truth.
From welfare needs to market demands (wants/desires).	The idea that education is part of the welfare provision of society is being replaced by a realisation that educational needs have turned into a matter of supply and demand — a market.

Jarvis (2001: 6 & 9)

The workplace relies on the individual, team and organisation's ability to identify and meet workplace demands by means of continuous learning. Adult workplace learning is viewed as a delicate process that relies on active, motivated and interdependent inputs that are presented, debated and reflected upon continuously by learners in order to discover new insights, views and meanings.

Learners consciously and subconsciously select learning priorities and learning approaches considered to be appropriate. The workplace (consisting of technology and team members) provides the dynamics that stimulate and energise the learning process and also serve as the support mechanism for learning to take place. Effective learning transpires as a result of a cyclical reflective and creative process that is characterised by observation, reflection, conceptualising and experimentation (Rogers, 2002: 107-110 and Kolb, 1984: 31).

The most complete form of self-directed learning is present (Brookfield, 1985: 15):

- when self-directed learning intentions and initiatives are allied with the adult's quest for critical reflection; and
- in the creation of personal meaning after due consideration of a full range of alternative value frameworks and action possibilities.

Such a complete form of self-directed learning is synonymous with critical reflection efforts aimed at the contextual and contingent aspects of reality, the exploration of alternative perspectives and meaning systems, and the alteration of personal and social circumstances (Brookfield, 1985: 15).

When adults come together in search of a common objective and they find that they posses the ability to fuse the external workplace dimensions with their individual and collective internal and reflective dimensions then they can effectively reinterpret and recreate their personal and social worlds (Brookfield, 1985: 15). Within the team context, team members integrate diverse individual awareness, insights and understanding into a new collective perspective of autonomous, self-directed learning.

3.2 Learning orientations

Individuals form certain perceptions towards individual and collective learning intentions, learning responsibilities and associated activities (Levey & Levey, 1995: 257-274). These individual perceptions are interpreted as the individual's learning design and development strategies.

Learning orientations at the individual level constitute (Levey & Levey, 1995: 257-274):

- superficial learning approaches (characterised by memorising and reproducing existing knowledge in a familiar format);
- deeper learning approaches (involving construction of new insights and ideas); and
- performance-based learning approaches (emphasising the optimisation of the organising strategies of the learning task).

Learning orientations at the collective level are made up of (Levey & Levey, 1995: 257-274 and Chawla, 1995: 501-508):

- dependent learning approaches that support shared purpose, vision, values and strategies;
- independent learning approaches that allow for wisdom, insight, inspiration and joy of discovery;
- competitive learning approaches that support the emergence of greater business effectiveness; and
- collaborative learning approaches that reflect the quality of systems thinking, performance, efficiency and the depth of wisdom and compassion of a learning community.

Self-directed learning is thus also understood as a continuum that exists to some degree in each person and learning situation. This statement implies that differences and similarities can be expected between individuals and between teams in terms of learner self-direction.

3.3 Learning approaches

A learning approach describes an individual's learning orientation, which, in turn, explains the individual's perception of workplace learning demands (Biggs & Moore, 1993: 315). Individual learning approaches signify a certain predisposition towards learning, held by an individual that is co-determined by personality, personal objectives and workplace strategies found in a specific environment (Biggs & Moore, 1993: 315).

Effective team learning relies on collective collaborative learning approaches that are anchored in deeper and performance-based individual learning approaches (Thompson, 1995: 85-100). The relationship between learning and performance is thus highlighted. Knowledge of individual learning approaches will allow the individual and the team to appreciate and understand individual and collective performance differences and similarities in the workplace. It is also expected that collective collaborative learning approaches support creative conceptualisation of complex issues, reflective behaviours/habits, while also stimulating higher level thought processes (Biggs & Moore, 1993: 309-315).

3.4 Why do individuals and teams participate in learning?

Learning processes and experiences are directed and influenced by (Biggs & Moore, 1993: 309-316):

- learning motives;

- learning strategies; and
- social influences.

Extrinsic motives are linked to superficial, dependent and competitive learning approaches. **Intrinsic** motives are linked to deeper, independent and collaborative learning approaches (Biggs & Moore, 1993: 316).

When learners learn simply to ensure a certain task outcome, rather than focus on the task itself, they are externally motivated and a superficial learning approach is evident (Biggs & Moore, 1993: 316). A learner that is inspired by the opportunity to develop his/her skills in order to perform more effectively/efficiently will be intrinsically motivated and he/she will make use of a deeper learning approach (Biggs & Moore, 1993: 316). If the learner's learning goal is a combination of self-development, self-satisfaction and esteem, he/she may opt for a performance-based learning approach (Biggs & Moore, 1993: 316).

Learning strategies indicate the purposeful planning and implementation of procedures and actions that are essentially of a cognitive nature. In this regard a superficial learning strategy will encompass known actions and the deployment of existing and accepted procedures in the workplace by the learner (Biggs & Moore, 1993: 316). When new information and experiences are combined with existing knowledge structures in order to discover new meanings, more options and to develop theories, a deeper learning strategy is present (Biggs & Moore, 1993: 316). Performance-based learning strategies prevail when the learner becomes involved in all aspects related to successful learning, rather than narrowly paying attention to learning tasks or activities (Biggs & Moore, 1993: 316). Self-directed learning strategies are understood within the context of independent, collaborative and deeper learning approaches.

Social influences impact upon the learners' predispositions towards learning goals and learning initiatives within a specific environment. Social support and cooperation, which, in turn, stimulate and encourage collective learning activities, are synonymous with collaborative learning (Biggs & Moore, 1993: 316). A competitive learning environment supports a negative interdependence (a win-lose situation) that prevails between learners in the workplace (Biggs & Moore, 1993: 316). Competitive learning thus has as its intention to merely learn in order to gain an advantage above others at all costs. When a team member or a team becomes dependent upon someone to assume a position of authority (thus one person supervises/manages learning) before learning can take place, a dependent learning environment is identified (Biggs & Moore, 1993: 316). An independent learning environment supports and empowers team members and teams to utilise own initiative and creativity as part of the learning process (Biggs & Moore,

1993: 316). Critical debates and collective interpretations are characteristics of independent learning in this regard.

4 Reflection

Section 4	Reflection

In this chapter I provided an extensive philosophical argument and orientation in support of the research paradigms of inquiry presented above. These paradigms facilitate my journey of exploration and understanding. I also accept that these paradigms are not fixed, and that they will be refined and extended through use — these paradigms therefore become an object for further articulation and specification during my research efforts (Kuhn, 1972: 23).

CHAPTER 4

RESEARCH DESIGN AND METHODOLOGY

Figure 4.1 Chapter 4 orientation

Introduction	Aims and purpose of the research
	Orienting decisions
Research constraints	
Research possibilities	
Mode of inquiry	
Research setting	Sites
	Sampling
Data collection plan	
Mixed-method data collection techniques	Individual interviews
	Focus group interviews
	Self-directed Team Learning Questionnaire (SDTLQ)
	Learning Approach Questionnaire (LAQ)
Role of the researcher	
Data analysis	
Data validation	Validity
	Reliability
	Trustworthiness
Conclusion	

Compiled by the researcher

1 Introduction

Introduction	Aim and purpose of the research
	Orienting decisions

This research project constitutes an impact study of self-directed team learning practices found at three South African Air Force Air Traffic Control Centres. The level of discourse/generalisability of this research project is therefore restricted to the self-directed team learning practices at these sites.

This research design and methodology chapter describes the mixed-method design utilised in this study with specific reference to the following highlighted focal points:

- **Research constraints** and considered actions viewed from both a qualitative and a quantitative perspective.
- **Research possibilities** associated with this self-directed team learning study.
- A **mode of inquiry** depicted and described in terms of employed qualitative and quantitative methods.
- Information relating to the three **research settings** where data collection took place.
- A **data collection plan** describing data collection phases and identified activities.
- Four **mixed-method data collection techniques.**
- A description of the **role of the researcher** from a functional and an ethical perspective**.**
- **Data analysis** that allowed for data triangulation.
- **Data validation** that considered validity, reliability and trustworthiness criteria.

An introduction to the research project planning is encapsulated in the aim, purpose and orientation statements and decisions presented below.

1.1 Aim and purpose of the research

The aim of this research is to discover multiple realities that are assumed to be present in the air traffic control self-directed team learning environment. Accordingly I believe that human actions and performances are strongly influenced by the setting in which they occur. The study of human performance in real-world situations is the most complex topic of all in science (Dismukes, 1994: 321). According to Dismukes (1994: 321) many important operational problems cannot be answered decisively because we do

not yet have sufficiently penetrating research methods for evaluating human behaviour. Wilson (1977: 249) provides guidance in this respect by affirming that a study of human behaviour relies on an understanding of the framework within which the subjects interpret their thoughts, feelings and actions.

The purpose of this research project is to understand a team learning situation from the participant's perspective, the team's perspective and the resulting performance influences. According to Brookfield (1985: 13) research designs on self-directed learning tend to treat all learning projects as having equal significance for the learner. Individuals and teams differ in terms of internal characteristics, personal meanings and their significance for the society at large. Therefore it is undesirable to assume such a generalised research approach (Brookfield, 1985: 13). Studies of self-directed learning have also generally relied on structured interview schedules and precoded categories of responses that subject's perceptions of their learning are made to fit (Brookfield, 1985: 13). When the researcher uses only standardised instruments in a self-directed learning study with groups of working-class adults he/she may (Brookfield, 1985: 13):

- overlook the quality of learning that takes place; and
- cause the individuals to regard the researcher with suspicion.

Brookfield (1985: 13) agrees that a crucial area for further self-directed learning research is the congruence or disjunction between adult's own judgements regarding the quality and effectiveness of their learning. Research in this regard primarily necessitates a detailed description of phenomena that facilitates the researcher's recording, interpretation and expression of a deeper/extended understanding (McMillan & Schumacher, 2001: 11).

The aim and purpose of this research signifies the need to assess the merit and worth of self-directed team learning within a defined air traffic control environment.

1.2 Orienting decisions

Orienting decisions are strategic as they set the general nature of the research and establish key parameters of the research (Cohen, Manion, & Morrison, 2000: 75).

Self-directed learning within air traffic control operations was central to this research. This statement implies that data collection was restricted to the South African Air Force's air traffic control workplace environments

and activities. The scope of this research was limited to three air traffic control centres identified and approved within the South African Air Force. Individual and team self-directed learning initiatives/practices, as well as workplace performance impact descriptors were emphasised in this research. Self-directed learning activities were not influenced by the researcher and are thus viewed as usual learning occurrences that took place within a self-directed team. This population constituted all air traffic controllers that functioned within self-directed teams at the three research sites during the data-gathering exercises. Participation in this research was regarded as voluntary. Participant confidentiality was ensured in order to protect the rights of participating air traffic controllers. The benefit of this research may be found in its perceived value to adult educators that rely on self-directed team learning in order to achieve levels of effective workplace performance and to researchers and practitioners that are charged with ensuring aviation safety goals.

The initial feasibility (Cohen, Manion, & Morrison, 2000: 83 & 84) of this research is summarised by acknowledging that:

- the research is regarded as useful in terms of its contribution to adult learning and aviation safety;
- participant contribution was voluntary and shared information is confidential;
- adequate resources existed to carry out this research;
- the purpose and aim of the research was known to the organisation and approved by the organisation; and
- ethical compliance was upheld by the researcher.

Orienting decisions applicable to this research served as the first step in the research planning process that facilitated an authoritative investigation of self-directed team learning within a defined air traffic control environment.

2 Research constraints

I identified qualitatively derived constraints by using the framework provided by Patton (1990, 40-41), supported by Swanson, Watkins and Marsick (1997: 95). These constraints are presented in Table 4.1.

Table 4.1 Qualitative derived constraints of this study

Theme	Constraints
Naturalistic inquiry	The existence of self-managed work teams was restricted to certain air traffic control centres only.
Inductive analysis	Only one person would perform data collection and interpretation.
Holistic perspective	The Hawthorne[1] effect could influence team dynamics, environmental influences and learning dynamics.
Qualitative data	Detail descriptions would be made possible by means of qualitative and quantitative data collection methods. However an individual performed this task.
Personal contact and insight	Findings could be criticised in terms of the Hawthorne effect and personal bias.
Dynamic systems	Continuous changes in the teams being investigated may be due to shift and staff-rostering requirements.
Unique case orientation and Context sensitivity	The context would focus only on self-directed team learning. Environmental influences and differences (intra-centre and inter-centre) that could affect behaviour may not have been known.
Empathetic neutrality	The role of observer and not participant may have been strange to individuals and/or teams and thus influenced behaviour.
Design flexibility	Structural research requirements may have influenced the nature of flexibility associated with this study.

Patton (1990, 40-41) and Swanson, Watkins and Marsick (1997: 95)

In addition I identified the following quantitative-derived constraints by using the framework provided by Swanson, Watkins and Marsick (1997: 90) and Borg and Gall (1979: 162-166). These constraints are indicated in Table 4.2.

[1] Hawthorne effect: the tendency of people to act differently because they realise that they are subjects in a study (McMillan & Schumacher, 2001: 591).

Table 4.2 Quantitatively derived constraints of this study

Theme	Constraints
Neutral and objective inquiry	Quantitative researchers attempt to remain neutral, objective and apart from the reality that they study. Respondents may perceive this approach as cold and threatening, which may have influenced responses.
Hawthorne effect	Research involving human subjects can distort results because of the perceived special attention given to the subjects. The Hawthorne effect may have influenced feedback from respondents.
Demand characteristics	Respondents may be over-sensitive to all aspects of the research environment. In such a case respondents may form conclusions/assumptions as to what the researcher may prefer, what is expected of them (respondent perception), and what the researcher hopes to find (in the respondents' view). Respondents may have directed their responses accordingly.
Selected sample	All air traffic controllers did not have an equal chance of being included in the sample because a non-probability convenient sample was used. This implied that results may not be generalised.

Swanson, Watkins and Marsick (1997: 95) and Borg and Gall (1979: 162-166)

These constraints served as a constant checklist and reminder of potential shortcomings and possible weaknesses in my study. This list was used as an additional measurement of validity, thereby ensuring that proposed delimiters would be monitored throughout my study.

I formulated a checklist (Table 4.3) to remind me of appropriate actions in order to address the above mentioned constraints.

Table 4.3 My checklist

Constraint	My actions
Inquiry	Do not allow own neutrality to influence the data collection. Do not appear distant, show interest in the activities of the centre and do not voice inter-centre comparisons/observations to the respondents during data collection.

Perspective and effect	Do not hint towards sought after or expected data during conversation with respondents. Encourage respondents to be honest and fair when providing data/sharing information. Also encourage respondents to provide examples in order to support responses and awareness.
Data collection task	Realise and be aware that data presented is data presented; do not attempt to manipulate data (only ensure understanding and clarification).
Dynamic sample	View each team from a centre perspective, thus an air traffic control centre was considered to be a virtual team (although team members may change during the data collection). The intention was, however, not to only compare teams but rather to consolidate findings in order to encourage understanding.
Focus/attention	Ensure respondents were aware that observations would not be used to collect data and refrain from providing comments pertaining to air traffic control practices.
Empathy	Ensure that respondents understood what was expected from them in terms of data collection focus areas before commencing with data collection.
Results	I may not generalise the research results.

Compiled by the researcher

The above checklist was also used to obtain feedback from respondents in order to present evidence that the researcher complied with this self-imposed data collection framework.

3 Research possibilities

Research possibilities ←

One of the outcomes of this research was directed at adding to research-based knowledge about a specific practice — self-directed team learning. Acquiring supportive, new or different perspectives about the self-directed team learning phenomenon may also contribute towards the generation of ideas on how to approach workplace team learning practical challenges (McMillan & Schumacher, 2001: 25). Furthermore I am of the opinion that the outcome of this research will contribute to research-based knowledge in a given field —aviation safety.

Studying self-directed team learning as practised by members of a self-directed team, charged with the responsibility to safeguard human life, within a technologically sophisticated environment, and with no margin for error is considered to be challenging from both a research and researcher perspective. During this study vocational-centred self-directed learning activities were analysed in a systematic rather than an intuitive manner. Essentially the contribution of this research would be more than a mere extension of understanding of self-directed learning practices; it would also examine associated outcomes of these learning practices. Such outcomes may possibly influence work performance aspects; such as aviation safety.

Aviation safety has as its ultimate goal to manage industry risks at a level as low as reasonably practicable. This management task requires that conditions and circumstances that can endanger human life be identified preferably in a proactive manner. Only once these hazards are identified can the severity and likelihood of incidents and/or accidents be determined. Thereafter reasonable mitigation measures can be designed, implemented and evaluated. There is a need to ensure awareness amongst all role players in the aviation industry in terms of safety management advances. Effective communication, workplace training and learning are regarded as important characteristics within a safety management system.

I realised that this research project corresponds with views held by Janesick (2003: 57) and thus:

- allowed me to concentrate on the larger/holistic picture in order to search for understanding of the whole;
- allowed me to look at relationships within air traffic control teams;
- provided an opportunity to deal face-to-face with air traffic control team members and teams;
- created an opportunity to gain understanding of workplace settings and interpersonal relations;
- permitted me to gather data first-hand;
- allowed me to analyse data; and
- presented an opportunity to question and reflect upon my own biases and ideological preferences.

This narrow focused education-based research project made it possible to gain insight into self-directed learning practices and to determine how these practices influenced and continued to influence aviation safety and aviation performance outcomes.

4 Mode of inquiry

The decision regarding the mode of inquiry was directed by my desire to understand occurrences and effects that take place within the air traffic control work environment. I realised that I needed to study team learning within its natural setting in order to make sense of it. I also accepted that this study within the air traffic control workplace would allow air traffic controllers to present, describe and interpret phenomena in terms of their individual and collective meaning structures. Upon consideration of these factors I initially decided to primarily make use of an interactive qualitative inquiry to collect data from air traffic controllers within their workplace. I acknowledge that data gathering relied upon respondent feedback describing individual learning approaches, descriptions of meaning (focused on learning strategies and performance outcomes) provided by individuals and teams, and reflections associated with known behaviours, preferences and occurrences (also focused on learning strategies and performance outcomes). In this regard Denzin and Lincoln (2003: 5) urge qualitative researchers to deploy a wide range of interconnected interpretive practices in order to gain a better understanding of the subject matter at hand.

Multiple realities are viewed as so complex that one cannot decide *a priori* on a single methodology (McMillan & Schumacher, 2001: 396). I thus realised that a stringent qualitative approach may be restrictive in terms of creating valuable understanding of the self-directed learning phenomena studied. In response to this perceived shortcoming a mode of inquiry was desired that extended the breadth and the range of results. A mixed-method strategy was opted that combined quantitative and qualitative techniques and data analysis in order to add depth and detail to findings (Swanson & Holton, 1997: 93; Tashakkori & Teddlie, 1998: 46 and McMillan & Schumacher, 2001: 542). Such a mixed-method approach allowed for the elaboration, enhancement, illustration and clarification of the results of one method with that of another (Tashakkori & Teddlie, 1998: 46). This mixed-method strategy is illustrated by the typology quan + QUAL. These abbreviations indicate that quantitative (quan) and qualitative (QUAL) methods were used. The upper case denotes the priority given to the orientation (Teddlie & Tashakkori, 2003: 3-8). This mixed-method strategy:

- allowed for the collection and corroboration of data collected and may have enhanced the credibility of the study (McMillan & Schumacher, 2001: 428 & 429);

- from a quantitative perspective (non-experimental) was descriptive and comparative because it allowed me to assess the nature of existing conditions in order to categorise and compare individual and team learning strategies, contributions and outcomes (McMillan & Schumacher, 2001: 33); and
- from a qualitative perspective (interactive) was phenomenological because it allowed me to study and understand the meanings associated with lived experiences and perspectives in order to make sense of the workplace impact and associated learning experiences at individual and team levels (McMillan & Schumacher, 2001: 36).

Quantitative data collection would make use of a psychometric instrument (LAQ) and a questionnaire (SDTLQ), whilst qualitative data collection instruments consisted of individual interviews and focus group interviews. Confirmation and corroboration of data required me to triangulate[2] data (McMillan & Schumacher, 2001: 408).

5 Research setting

Research setting	Sites
	Sampling

Data collection took place at three South African Air Force air traffic control centres that provide Aerodrome, Approach and Ground-Controlled Approach Control services, and where air traffic controllers function within self-managed work teams.

5.1 Sites

Approval was obtained from the South African Air Force to perform data collection at the following sites (these were the only sites that met this study's requirements):

- Langebaanweg Air Traffic Control Centre
- Hoedspruit Air Traffic Control Centre
- Makhado Air Traffic Control Centre

[2] Triangulation is discussed in paragraph 9

5.2 Sampling

The population for this study was defined as all air traffic controllers employed by the South African Air Force that function as a full team (consisting of available Aerodrome, Approach and Ground Controlled Approach Control services at a specific site). This population as reported by the South African Air Force on 18 March 2005 numbered 33 persons.

The purpose of this study was to better understand self-directed team learning. In terms of determining the type and size of the sample, I considered that the aim of this study was to collect exploratory data and not to generalise findings. A subgroup of the accessible population was investigated (25 selected team members within the identified air traffic control centres) by me, which in turn influenced the type of sample drawn – being a non-probability convenient sample. Respondent selection criteria were explained to the three Air Traffic Control Managers at each site. These criteria are presented below.

- Respondents had to be qualified air traffic controllers. Air traffic service assistants were not included as they do not fulfil a controlling role.
- Respondents had to have air traffic control teamwork experience at the specific site.
- Respondent participation was voluntary.
- Respondents had to complete the LAQ, SDTLQ and participate in the individual interviews. From these respondents volunteers were requested to participate in focus group interviews.
- Respondents had to be available over a three-day period in order to allow for data collection.

All available air traffic controllers were subsequently requested by their respective Air Traffic Control Managers to voluntarily participate in this study. No instance of non-participation was noted.

This sampling method allowed for comparison of intra-team, inter-team and the consolidation of results from both a qualitative and quantitative perspective. I acknowledged that limitations did exist in terms of generalising from this sample to any type of population, which implied that findings would be limited to the characteristics of the respondents.

According to Stoker (1981: 13) a sample size of 26 was considered to be adequate for this study. A sample of 25 respondents was drawn/available. Selection of these respondents was deferred to the Air Traffic Control Manager at each site.

6 Data collection plan

Data collection plan

I collected data during deliberately created opportunities at each of the research sites. Each respondent was required to complete the SDTLQ, the LAQ and participate in the individual interview. Focus group attendance was dependent on the availability of these respondents and such allocation was determined by the Air Traffic Control Manager at each site.

I collected qualitative data during one-to-one interviews that allowed me to construct mundane reality in the interview, whilst focus group interviews created opportunities for transactions between members themselves – one-to-one interviewers *constructed* data, whilst participants (focus group interviews) allowed one to *find* data (Miller & Dingwall, 1997: 60-61). Quantitative data collected assisted me in determining relationships between predefined variables as stated in the SDTLQ and measured variables in the LAQ.

Planned data collection activities were influenced by the following three distinct stages that typically represent the dynamics associated with the air traffic control work environment, namely:

- The pre-work shift, when controllers get together and arrange/allocate tasks and review the work schedule. Data collection was possible once this stage had been completed.
- The work shift, when controllers function both individually and within the team context. During this stage I could not collect data, due to safety and work condition limitations, however, controllers were able to assess, evaluate and reflect on their own performance and that of the team during this stage and reported on these after the shift.
- The post-work shift, when controllers disengage from the control positions and complete post-shift duties. Data collection was possible during this stage.

This planned data collection period was subdivided into an introductory phase, a data collection phase and a disengagement phase as presented in Table 4.4. The introductory phase comprised:

- introducing myself to the entire air traffic control team; and
- completing the researcher-respondent agreement (attached as Appendix A)

During the data collection phase attention was drawn to the respondent instructions required for completion of the SDTLQ and the LAQ. These instructions were displayed on the first page of each questionnaire. Qualitative data collection was guided by a researcher task/activity guide for the individual interviews (attached as Appendix B) and the focus group interviews (attached as Appendix C).

Activities conducted during the disengagement phase included an explanation to respondents regarding member-checking requirements and duties. The means of feedback communication in this regard was verbally explained by me. This feedback required from respondents to review typed transcripts that would be forwarded to them and communicate any required changes to me by a specific agreed-upon date. Covering letters explaining this process are included as Appendix D. This phase was concluded by thanking everyone concerned and leaving the research site.

Sequence of data collection, data collection activities, and techniques are summarised in Table 4.4.

Table 4.4 Mixed-method data collection plan

Data collection sequence	Data collection phase	Data collection activity and technique to be used
1st	1	Introduction to this study
2nd	2	Administer SDTLQ
3rd	2	Administer LAQ
4th	2	Conduct one-to-one interviews
5th	2	Conduct focus group interviews
6th	3	Agree on member-checking activities
7th	3	Disengagement conversation

Compiled by the researcher

7 Mixed-method data collection techniques

Mixed-method data collection techniques	Individual interviews
	Focus group interviews
	Self-directed Team Learning Questionnaire (SDTLQ)
	Learning Approach Questionnaire (LAQ)

This pragmatic study posed several questions about learning practices, training strategies, workplace performance results and the relationship between learning and performance. These different levels of inquiry called for data collection techniques that were primarily of an exploratory nature (qualitative), supported by measures of frequency and relationship data (quantitative). Such a study that combines qualitative and quantitative techniques and/or data analysis within different phases of the research process favours a mixed method (McMillan & Schumacher, 2001: 594). In this study these mixed-method techniques complemented each other, although their focus areas (dealing with self-directed team learning, self-directed team performance and learning approaches) may appear to be diverse. This assumed diversity was merged by utilising a mixed method approach to elaborate, illustrate and clarify defined aspects of results of one method with those of another method.

I accepted that multiple realities may have prevailed and for this reason I searched for an understanding of an emerging reality by means of qualitative techniques. Swanson and Holton (1997: 90) confirm that social scientists turn to qualitative research methods and techniques because they are well suited to exploration and discovery in an era of rapid and fundamental change. Patton (1990, 40-41), supported by Swanson and Holton (1997: 95), identifies ten themes that are part of every qualitative design. In Table 4.5, these ten themes are listed against my actions, thus motivating the use of qualitative techniques. Qualitative techniques included in this study consisted of individual interviews and focus group interviews (described in paragraphs 7.1 and 7.2).

Table 4.5 Ten themes that are part of a qualitative inquiry and linked to my actions

Theme	My actions
Naturalistic inquiry with reference to real world situations.	Inquiry took place in the air traffic control work environment.
Inductive analysis that begins with collection of details that lead to generalisations.	Data collection was performed by means of various methods (described above) to establish links between findings in order to gain new insights. Perceived self-directed team learning and

	performance generalisations were reanalysed for context and consistency in order to enhance understanding.
Holistic perspectives where phenomena are understood as complex systems.	Self-directed team learning, as a complex system, was studied from both an individual and team perspective; focusing on team dynamics, environmental influences and learning dynamics.
Qualitative data that imply that detailed description is collected.	Detailed descriptions were made possible by means of qualitative and quantitative data collection methods – the aim and focus was to gain deeper understanding of the impact of self-directed team learning.
Personal contact and insight that requires that the researcher ensure personal contact with participants.	Data collection took place in the air traffic control workplace – this allowed for data collection on site.
Dynamic systems that view the object of study as dynamic and changing during a study.	Change of team members was a reality, members changing roles is a workplace practice, and different teams from different sites were used in this study.
Unique case orientation; resulting in each research case being regarded as unique and special.	Each team and each site was considered to be unique, whilst learning in each team may also have been different.
Context sensitivity that allows for the placement of findings in a social, historical, and temporal context.	The context was focused on self-directed team learning viewed from a results point-of-view.
Empathetic neutrality; although the researcher cannot be completely objective, neither should the researcher use the process to advance personal agendas.	The researcher was not part of any workplace air traffic control team, site or sample and showed no intention to participate in any self-directed team learning activities.
Design flexibility that ensures that the inquiry process is adaptive, potentially changing as the research process is conducted.	This qualitative approach allowed for flexibility in terms of qualitative data gathering.

Patton (1990: 40-41) and Swanson & Holton (1997: 95)

The supportive and descriptive role and aim of the quantitative design were limited to describing and comparing characteristics of the domain being studied (described in Table 4.6) in order to assist in the

discovery of relationships amongst teams and characteristics of individuals and teams being studied (Swanson & Holton, 1997: 70 & 79). Quantitative techniques included in this study consisted of the LAQ psychometric instrument and the SDTLQ.

Table 4.6 Two core questions (quantitative inquiry) and the proposed researcher action

Question	Category	Quantitative techniques
What were the learning and performance characteristics of the three self-directed teams?	Description	SDTLQ LAQ
Were the three teams similar or different on pre-determined characteristics?	Comparison of teams	SDTLQ LAQ

Swanson & Holton (1997: 79)

As supported by paragraph 4 (mode of inquiry) I did not emphasise a need to standardise findings, to seek precision or objectivity, or to ensure replicability and generalisation of findings. The term *trace the impact* communicates a need for more than a quantified debate – it signified the need to facilitate and produce new knowledge, obtained through an orderly mixed-method investigative process (illustrated by the typology quan + QUAL) that resulted in a deeper understanding of the research topic.

7.1 Individual interviews

I emphasised in Chapter 3 that this study challenged me to explore, interpret and present my own understanding in response to the research questions, thus creating a whole system of thought. Furthermore I acknowledged that knowledge is acquired by transactional means and created by personal experiences that result in individual cognition. Kvale (1996: 11) expands on this notion by affirming that knowledge is often generated between humans through conversation. I used individual interviews to allow respondents to discuss their interpretations of the world in which they work, and to express how they regard situations from their own point of view (Cohen, Manion, & Morrison, 2000: 267).

In-depth, face-to-face interviews enabled me to gather self-directed team information from air traffic controllers in the workplace. I designed and utilised these individual interviews as a means of exploring to what extent team members and teams observe or do not observe self-directed team performance and team learning practices identified in the literature review (Chapter 2). Extensive use was made of open-ended questions to impose no limitations on the interviewee's responses. Open-ended questions allowed for

opportunities to elicit underlying information and feelings/opinions. Free-narration questions (Du Plooy, 1995: 143) were used in order to allow the respondent to formulate feedback in terms of a story/structured recollection.

These individual interviews specifically attempted to gain a deeper understanding of the role of the individual in the team learning initiative, levels of intentional and unintentional learning, contributions from other team members with reference to learning, and the impact/value of self-directed team learning.

Appendix B and D provide insight into the interview protocol used while Table 4.7 presents formulated questions, focus areas and the value of these individual interview questions.

Table 4.7 Formulated interview questions, interview focus areas and the value of these interview questions

Question	Question 1	**Focus**	The impact/influence of teamwork on workplace performance outcomes[3]
Question			**Value and relevance to this study**
Explain with the aid of examples how teamwork influences the outcome of the air traffic control service provided by your centre?			Allowed the teams to explain to me how self-directed teams plan learning, use resources to learn, and what learning strategies were employed. Allowed me to identify whether a self-directed work team approach had resulted in: • improved quality, productivity and service; • greater flexibility; • reduced operating costs; and • faster response to technological change. Allowed me to identify benefits associated with effective self-directed teamwork that included: • Presence of a growing awareness of the importance of resource management skills related to decision-making, team coordination, and planning, especially in organisations where

[3] Refer to Chapter 2 pages 32, 55, 62, 74, 86, 91, 92, 112, 119, 121, 128 & 131 and Table 2.16.

	work teams perform complex, time-constrained, and critical tasks. • Open lines of communication, cooperation, listening, and speaking one's own mind. The single most important factor in maximising the excellence of a group's product is the degree to which the members are able to create a state of internal harmony, which lets them take advantage of the full talent of their members. Many things people do at work depend on their ability to call on a loose network of fellow workers; different tasks can mean calling on different members of the network. This creates an opportunity for ad hoc groups, each with a membership tailored to offer an optimal array of talents, expertise, and placement. • Positive, supportive interpersonal communication amongst team members. Solution-focused teams accept the important role of continuous learning and development, therefore learning includes imparting of information, interpersonal learning, developing socialising techniques and imitative behaviour. • Effective informal networks that typically consist of at least three varieties: communication webs - who talks to whom; expertise networks, based on which people are turned to for advice; and trust networks. These networks rely on effective coordination of efforts in teamwork, being leaders in building consensus, being able to see things from the perspective of others, persuasiveness, and promoting cooperation while avoiding conflicts. Allowed me insight into other performance skills displayed by team members that may have included: • taking initiative; • being self-motivated enough to take on responsibilities above and beyond their stated job; and • self-management in the sense of regulating their time and work commitments. I was able to explore team dynamics found in air traffic control teams

			and identified benefits and disadvantages reported by teams and determined the impact of these on team efforts.
Question	Question 2	**Focus**	The impact/influence of teamwork on the individual's performance[4]
Question			**Value and relevance to this study**
Explain with the aid of examples how learning from air traffic control teamwork experiences influences your own performance?			Presented me with an opportunity to determine individual practices and consequences achieved, as a result of continued evaluation of learning goals, learning activities, personal demands and concerns, and perceptions. Provided me with an opportunity to explore each individual's involvement in self-directed team learning, including: • individual self-directed learning dynamics; • individual learning approaches; and • the role and impact of individual self-directed learning contributions within the self-directed team learning effort. Provided me with an opportunity to explore influences of the following aspects on learning that took place in the work environment, being: • authority structures internal and external to the team; • learning support structures; • workplace experiences (viewed as an input and output of learning); • informal learning opportunities; • intentional and unintentional learning occurrences; and • environmental characteristics. Provided me with an opportunity to trace and explore: • expectations and agendas which adult learners brought to their learning experience; • how knowledge was constructed by individuals as a result of

[4] Refer to Chapter 2 Tables 2.10, 2.11 & 2.23.

			learning; • the role of interaction with others as a means that directed own learning and assumed responsibility for own learning; • the individual's level of willingness to accept responsibility for his/her own learning; and • reported learning locus of control. Allowed me to understand how analysis of experiences (based in problem-solving and decision-making), reflection as an evaluation technique, and experimenting by recalling knowledge from memory contributed towards self-directed adult learning results. Presented me with an opportunity to record and analyse occurrences reported that provided insight into different individual information processes, as initiated by non-routine occurrences. Allowed respondents to explain to me their use of self-esteem techniques, self-efficacy beliefs and self-concept statuses. Provided me with an opportunity to consider the role and influence of: • the work, learning and social environments; • the work climate; and • the complementary extended social settings.
Question	Question 3	**Focus**	The impact/influence of learning from experience on teamwork[5]
Question			**Value and relevance to this study**
Explain with the aid of examples how learning from experience influences air traffic control teamwork?			Allowed me to assess dynamics, associated with self-managed work team activities and workplace learning, in the air traffic control environment. Allowed me to describe air traffic control teams' shared decision-making tasks, their need for effective communication, respect for individuality, and their mutual striving towards safety, orderliness and

[5] Refer to Chapter 2 page 36 and Tables 2.2, 2.6, 2.10 & 2.23.

	efficiency in terms of quality service delivery. Provided me with an opportunity to explore each individual's involvement in self-directed team learning; thus allowing me to understand: • individual self-directed learning dynamics; • individual learning approaches; and • the role and impact of individual self-directed learning contributions within the self-directed team learning effort. Presented me with an opportunity to explore team dynamics found in air traffic control teams and identify benefits and disadvantages reported by teams and determine the impact of these on team efforts. Allowed me to understand how self-directed team learning incorporated the team member's description of his/her critical analysis processes and outcomes, reflection habits and practices, and how he/she responded creatively to situations (learning opportunities). Allowing me insight into individualised learning agendas.

Compiled by the researcher

7.2 Focus group interviews

I stated in Chapter 3 that collective knowledge can be the product of collaborative cognitive interactions. In order to elaborate on this statement in a pragmatic manner I decided to generate and evaluate data from different subgroups of this population. My challenge was to ensure that respondents interacted with each other rather than with me, the moderator, thus allowing the views of respondents to emerge (Cohen, Manion, & Morrison, 2000: 288).

Focus groups are suggested as a means to create a social environment in which individual members are stimulated by the perceptions, opinions and ideas of each other, which in turn, increases the richness of data (McMillan & Schumacher, 1989: 410). A focus-group technique was introduced to gather qualitative

data and to gain deeper understanding of learner behaviour, to test preliminary information, and to test ideas (Du Plooy, 1995: 118). Lewis (1992: 413-421) adds that focus group interviews can generate a wider range of responses than in individual interviews. Focus groups thus enabled me to capitalise on the group interaction around a topic (Swanson & Holton, 1997: 98).

Focus groups offered me exposure to the typical learning processes, experiences and perspectives of the air traffic controllers within their workplace. I designed, introduced and facilitated the three focus group interviews as a means of exploring to what extent team members and teams observe or do not observe self-directed team performance and team learning practices identified in the literature review (Chapter 2). Focus groups provided access to: shared individual and team learning experiences; techniques used to learn; comments relating to the role of the team in terms of intentional and unintentional learning; value and contributions from different team members and team roles; and the perceived value of the learning focus.

These focus group interviews relied on the following steps and my listed actions, as suggested by Vaughn, Schumm and Sinagub (1996: 120-125):

- Delineate the general purpose – The research aim was communicated by means of a purpose statement to the group (refer to Appendix C).
- Designate a facilitator – I assumed the role of facilitator, in order to maintain a supportive and non-evaluative environment.
- Refine the research goal – The general scope of discussion was presented as described in Appendix C.
- Select the participants – This activity was dealt with by means of the sampling technique described in paragraph 5.2.
- Determine the number of focus group interviews – Three focus groups were used.
- Arrange for the focus group facility – Air Traffic Control manager's office at each site was used.
- Develop an interview guide – Appendix C served as the interview guide, thus providing an outline for the focus group interview procedures and a general idea of the questions that were asked.
- Conduct the focus group interview.
- Analyse the focus group data – Transcribed and coded data were utilised as stated in paragraph 9.

Appendix C and D provide insight into the focus group interview protocol used while Table 4.8 presents formulated questions, focus areas and the value of these focus group interview questions.

Table 4.8 Formulated focus group interview questions, interview focus areas and the value of these focus group interview questions

Question	Question 1	**Focus**	Reflecting on team characteristics[6]
Question			**Value and relevance to this study**
What can a team member, joining the air traffic control team, expect from the team?			Allowed me to assess teamwork skills, the team's ability to share knowledge and the team members' attitudes. Provided me with an opportunity to explore whether self-directed teams possessed the following characteristics: • An open and supportive social environment, with a focus on learning, without authority-directed problem-solving. An underlying commitment to team performance rather than individual performance. • A variety of people with different experiences and areas of expertise. Strong interpersonal relationships that allowed the team to function more openly, sharing knowledge and experience. • Effective communication between team members and those outside the team. • Participative practices and evidence that all ideas were listened to without domination by a strong team member, thereby keeping the team open to creativity and thinking everything through thoroughly. • Clearly defined goals to which all team members were committed and to which they aspired. • Leadership was viewed as a shared group responsibility, not a delegated position. Because team members have different skills and abilities, the leadership role would probably change as the goals and dynamics of the team changed. Presented me with an opportunity to explore team dynamics found in air traffic control teams.

[6] Refer to Chapter 2 pages 36, 45, 55, 59, 60, 62 & 130 and Tables 2.4, 2.6 & 2.16.

			Assisted me to identify and explore benefits and disadvantages reported by teams and determine the impact of these on team efforts.
Question	Question 2	**Focus**	Individual and collective learning strategies[7]
Question			**Value and relevance to this study**
How are individual and collective learning planned and executed at your air traffic control centre?			Providing me with an opportunity to determine whether collective mental models were also explained by investigating outcomes associated with self-directed team learning (including the cognitive, affective and connotative outcomes and associated communication forms). Reminded me to check for use of learning contracts. Allowed me to investigate learning agreements that contained details about what was learned, how it was learned, by when, and what assessment criteria were used to determine competence/evidence of accomplishment. Allowed me to check for learning contract/agreement framework elements.
Question	Question 3	**Focus**	Reflecting on team learning opportunities[8]
Question			**Value and relevance to this study**
How can air traffic control team learning at your centre be improved?			Allowed me to explore the: • manner in which self-directed teams managed their own continuation training; • the team's continuation training phase; • the focus areas and impact of air traffic control continuation training; • occurrence and aim of continuation training from both an individual and team perspective; • the manner in which self-directed learning influenced continuation training; and • cases of incremental learning and unlearning.

Compiled by the researcher

[7] Refer to Chapter 2 pages 86, 94, 95, 114, 118, 123 & 124 and Tables 2.10, 2.25 & 2.28.
[8] Refer to Chapter 2 pages 44, 51, 52, 116, 118-121 & 123 and Tables 2.11 & 2.26.

7.3 Self-directed Team Learning Questionnaire (SDTLQ)

I designed the SDTLQ as a means to explore to what extent team members and teams observe or do not observe self-directed team performance and team learning practices identified in the literature review (Chapter 2). The SDTLQ allowed me to progress from a generalised point-of-departure to specific data focus areas. The primary objective of the SDTLQ was to allow me to accumulate qualitative data such as descriptions of experiences from controllers and quantitative data that allowed for measurement of self-directed team performance data and self-directed team learning data. Self-directed team performance and self-directed team learning were thus identified and documented as subsidiary topics that related to the primary objective of this questionnaire. I clustered all relating information requirements as questions under these two subsidiary topics during the planning of the SDTLQ. Specific subquestions/indicators were finally formulated for each question. This process allowed for sequencing of questions in a logical and coherent manner. From a quantitative perspective it was necessary for this questionnaire to describe and compare phenomena. Table 4.9 lists performance and learning aspects of the various teams that were questioned by means of the SDTLQ which, in turn, allowed for categorical data and continuous data (Swanson & Holton, 1997: 79). Data collected also allowed for intra-team and inter-team comparisons (Swanson & Holton, 1997: 80).

Table 4.9 SDTLQ performance and learning aspects

Self-directed Team Performance	Self-directed Team Learning
Team work characteristics	Individual learning preferences
Self-efficacy	Learning participation
Team performance activities	Individual workplace learning orientation
Individual reflection	Workplace training design
Teamwork performance measures	Workplace training implementation
Team performance dynamics	Workplace training evaluation
	Operational training characteristics
	Continuation training characteristics
	Workplace learning environment
	Team learning facilitation
Opportunity for individual feedback	

Compiled by the researcher

Use was made of open-ended questions (assisting with, amongst other things, perception and opinion gathering) and structured questions (assisting to determine categories, characteristics, preferences and timelines associated with occurrences). Responses were primarily managed by means of Likert scales, thus providing for a range of responses to each subquestion/indicator.

The SDTLQ is presented as Appendix E. Table 4.10 presents SDTLQ focus areas and their value and relevance to this study. This presentation excludes SDTLQ questions 1 to 6, as these addressed biographical data.

Table 4.10 SDTLQ focus areas and their value and relevance to this study

Questionnaire	Question 7	**Focus**	Team work characteristics[9]
Value and relevance to this study			
Allowed me to explore the disadvantages of teamwork for learning that included: • pressures to conform; • the status offered by the team – this may become restrictive (an individual may become typecast by other teams into a set role and may thus find it hard to break out and adopt another role); • the closeness of the team, as each member who engages in the activities, may become a threat to some of the more individualistic learners (the group may be strong enough to deter experimentation by those who are less confident); • coping strategies – some members may thus find it difficult to cope with the wide range of experiences and views that others see as the richness of the adult learning group; and • the pace set by the team – such a pace may not meet or satisfy the needs of an individual member (teams may be intolerant of those members who are felt to move too fast or too slow). Allowed me to explore the following problems or mega-traps that may have contributed to ineffective team performance and team learning within a self-directed team context. • Strategic blunders imply that no organisation structure is immune to the strains and pressures of changing conditions, threats and management. Teams could thus not cover up for organisational strategic blunders. • Collision of work cultures means that changes to a team's charter and membership will likely lead to a regression			

[9] Refer to Chapter 2 pages 39, 40, 46, 60, 63, 66, 78-82, 85, 99, 101, 102, 111, 118, 122 & 129 and Tables 2.10 & 2.28.

in its overall operating and learning effectiveness.

- Inability to transfer learning refers to the tendency to dismiss what is often significant achievement that hampers both the credibility and assumed relevance of team member involvement.

Presented me with an opportunity to explore model 1 and 2 theories held by team members. (Model 1 tells the individuals to craft their positions, evaluations, and attributions in ways that inhibit inquiries into them and tests of them with other's logic. The consequences of Model 1 strategies are likely to be defensiveness, misunderstanding, and self-fulfilling and self-sealing processes. Model 2 theories are, at the outset, espoused theories. The challenge for individuals is to transform their espoused theories into theories-in-use by learning a new set of skills and a new set of governing values.)

Allowed me to gain insight into learning objectives and learning outcomes. (Learning objectives provide the focus and means in order to realise learning outcomes. Types of outcomes from effective team-directed learning can be categorised as (1) informational, (2) affective and (3) behavioural. Essential to the learning process is the ability to communicate; therefore a greater understanding of the way knowledge is coded will increase the power to communicate.)

Provided me with an opportunity to describe learning environments found during this study. This was considered to be significant because adults become increasingly more self-directed when given appropriate learning resources, experiences and encouragement. A conducive self-directed learning environment is characterised by the presence of these characteristics.

Allowed me to determine whether organisational dialogue:

- provided team members with accurate and complete information;
- confirmed other's personal competence;
- made reasoning explicit;
- allowed the members to voice their perspectives;
- allowed for reconsideration of one's own position when confronted with convincing data;
- regarded own assertions and those of others as hypotheses to be tested; and
- challenged errors in others' reasoning or data.

Presented me with an opportunity to understand self-regulated learners as those who are metacognitively, motivationally and behaviourally active participants in their own learning. These three universal aspects of the process are summarised below.

- Metacognition as the component that directs planning, organising, self-monitoring, and self-evaluating.

- Motivation that relates to high efficacy and attribution, as well as to an intrinsic interest in the learning task.
- Behaviour that supports the process for selecting, structuring, and creating an environment that is considered to be optimal for learning.

Questionnaire	Question 8	**Focus**	Self-efficacy beliefs and associated impact upon performance[10]

Value and relevance to this study

Allowed me to determine self-efficacy viewpoints because the team's social state and joint competence influences individual and team self-efficacy beliefs. It can thus be expected that high levels of espoused and/or observed competence and social synergy will support greater levels of self-efficacy.

Questionnaire	Question 9	**Focus**	Team performance activities[11]

Value and relevance to this study

Allowed me to determine whether learning opportunities were found in the following team activities:

- advising — gathering and reporting information;
- innovating — creating and experimenting with ideas;
- promoting — exploring and presenting opportunities;
- developing — assessing and testing the applicability of new approaches;
- organising — establishing and implementing ways of making things work;
- producing — concluding and delivering outputs;
- inspecting — controlling and auditing the working of systems;
- maintaining — upholding and safeguarding standards and processes; and
- linking — coordinating and integrating the work of others.

Allowed me to gain insight into accessible meaning structures and learning cycles. In this regard I paid attention to the four steps listed below.

- Step 1. Encouraging the generation of information. This is the responsibility of all team members.
- Step 2. Integrating the generated information into the team context.
- Step 3. Collectively interpreting the information.
- Step 4. Authority to take responsible action based on the interpreted meaning.

Questionnaire	Question 10	**Focus**	Individual reflection upon performances[12]

Value and relevance to this study

Presented me with an opportunity to investigate individual's reflective practices. I considered it to be important because reflection promotes self-awareness and social awareness, supports adult education principles, improves

[10] Refer to Chapter 2 pages 49, 50 & 71 and Table 2.11.
[11] Refer to Chapter 2 pages 68, 69, 84 & 89 and Table 2.16.
[12] Refer to Chapter 2 pages 30, 45, 48, 50, 58, 67, 90, 93, 96, 98 & 100-106 and Tables 2.4, 2.11 & 2.23.

learning, links theory to practice, and stimulates self- and peer-evaluation. This investigation was directed by the objects of reflection, as listed below.

- Behaviour. The most usual area of self-reflection (What actually happened? What did I actually do? What else might I have done?).
- Capabilities. People tend to engage in those behaviours for which they are best prepared. Reflection can, however, lead to a heightened awareness of one's existing capabilities and a plan to strengthen or develop new ones that would expand the repertoire.
- Beliefs. Focus is on influences and experiences as mediated by the social context.
- Purpose. Reflecting on what one tries to accomplish, thus reflecting on the purpose of effort.
- Values. Refers to those values that a person holds above all others.
- Environment. Reference to norms and expectations of the organisation, department, field, discipline, industry standard, or one's own standards. Contemplating these norms — how they are represented in espoused values and how their reality is experienced with colleagues.

I realised that experience alone could not suffice as the only self-directed learning influencing factor. I had to consider reflection. This decision allowed me to study self-directed learning principles and practical activities associated with both intentional and unintentional self-directed learning (emphasising the ability to reflect on performances and learning). Also allowed me to investigate levels of internal regulation held by individuals that encouraged them to relate and structure information.

Questionnaire	Question 11	**Focus**	Teamwork performance measures[13]

Value and relevance to this study

Allowed me to identify indicators that the desired air traffic control operational and organisational outcome had been met. Indicators considered by me were:

- no collisions occurred;
- no aircraft proximity situations/risk of a collision occurred;
- safety-related enhancements were employed whenever necessary;
- air traffic control actions did not unnecessary delay flights;
- no excessive use of airspace that resulted in low levels of productivity;
- traffic occurrences were handled in an orderly manner and sequenced;
- control of traffic was in compliance with specific operational practices, rules, instructions and procedures; and
- air traffic controllers worked effectively as a team whilst on shift.

Allowed me to recognise indicators that the desired air traffic control personal outcomes had been met. In this regard I

[13] Refer to Chapter 2 pages 52, 107, 108, 112, 114, 115, 119, 121 & 134 and Tables 2.3, 2.11 & 2.24.

considered whether:

- no violation of minimum separation standards had occurred;
- no deviations from standard operating procedures had taken place;
- no disorders were experienced which may have resulted in cognitive work overload; and
- no unnecessary requests were made to pilots.

Allowed me to investigate cognitive and behavioural skills associated with teamwork performance. The following eight cognitive and behavioural skills that were identified as being important for air traffic control team performance were considered in this regard.

- Self-regulation of stress. The ability to monitor one's own stress level, and to plan and employ effective strategies for dealing with stressful performance conditions. This includes awareness when one's personal limits have been reached.
- Team-supporting behaviour. Interaction with others in the air traffic control team which enhance their ability to perform the tasks required of their positions. This includes providing backup when needed as well as avoiding actions which hinder the efforts of controllers working other positions. Additionally, effective supporting behaviour involves requesting assistance when needed.
- Boundary spanning. Interaction with other entities in the air traffic control system which enhance the controllers' ability to perform the tasks required of their positions. This includes both taking actions which help, and avoiding actions which hinder the efforts of these entities.
- Information exchange. The ability and willingness to seek and to pass information which promotes a shared awareness or "mental model" of the team's internal and external environment. This includes using concise, standard phraseology, offering information before having to be asked, active listening and inquiry.
- Team feedback skill. The ability to provide, seek, and receive feedback from other team members in a direct and specific manner, while not becoming hostile or defensive.
- Flexibility. The ability and willingness to adapt one's behaviour quickly and appropriately in accordance with environmental demands.
- Team self-correction skill. The ability to diagnose team coordination problems, resolve conflicts, develop solutions, and to energise or motivate team members toward achieving performance goals.
- Problem-solving skill. This includes the ability to quickly determine optimal task redistribution in order to preserve safety and efficiency in response to high-workload, time-pressured, or emergency situations.

Questionnaire	Question 12	**Focus**	Team performance dynamics[14]
Value and relevance to this study			
Allowed me to determine how learning within the team was influenced by: • judgement, problem-solving and decision-making; • situational awareness; • sensory and perceptual differences; • personality and attitude differences; • communication; • knowledge, skill and ability differences; • leadership and teamwork dynamics; and • physiological and psychological differences (example – stress management).			
Questionnaire	Question 13	**Focus**	Individual learning preferences[15]
Value and relevance to this study			
Allowed me to determine how situational influences and team learning initiatives were influenced by: • routine/expected (skill-based) behaviour; • familiar or trained-for problems (rule-based behaviour); and • novel, difficult or dangerous problems (knowledge-based behaviour).			
Questionnaire	Question 14	**Focus**	Learning participation[16]
Value and relevance to this study			
Afforded me the opportunity to identify initiative(s) that provided work performance information/feedback for personal self-evaluation. These initiatives included, but were not limited to: • individual self-directed learning; • team self-directed learning; • learning approaches; • learning environment; • learning agreements (including encouraged co-operative work between team members); and • lifelong learning preparation.			

[14] Refer to Chapter 2 page 33 and Table 2.5.
[15] Refer to Chapter 2 pages 128 & 129 and Table 2.28.
[16] Refer to Chapter 2 pages 37, 68, 91, 93 & 94 and Tables 2.10, 2.11 & 2.23.

Questionnaire	Question 15	**Focus**	Individual workplace learning orientation[17]
Value and relevance to this study			
Allowed me to determine to what extent effective self-directed adult learning was linked to an external locus of control that favoured dependency.			
Questionnaire	Question 16	**Focus**	Workplace training design[18]
Value and relevance to this study			
Allowed me to determine who assumed responsibility for workplace training design. I understood that when identifying learning objectives the impact and role of team leaders and workplace experts on the generation of learning objectives was considerable.			
Questionnaire	Question 17	**Focus**	Workplace training implementation[19]
Value and relevance to this study			
Allowed me to determine who assumed responsibility for workplace training implementation. I understood that team leaders and workplace experts may also have constrained or supported the pursuit of learning issues. Expert-driven learning strategies and preferences could also have resulted in clashes between team members, and between team members and experts.			
Questionnaire	Question 18	**Focus**	Workplace training evaluation[20]
Value and relevance to this study			
Allowed me to determine who assumed responsibility for workplace training evaluation. I understood that feedback from experts may have contributed information that the team member(s) used to evaluate the relevance learning and to measure success in learning. Team discussions and feedback could have provided ongoing sources of information for self-evaluation in order to allow the team members to keep up with the team's overall learning. Self-directed evaluation could have been integrated in both expert driven and team-driven experiences. However it is significant to note that the social milieu had a major impact on the way that the individual self-evaluated his/her progress and performance.			
Questionnaire	Question 19	**Focus**	Operational training characteristics[21]
Value and relevance to this study			
Adaptability and shared mental models were considered by me to be key requirements for the members of an air traffic control team. This question allowed me to investigate air traffic control team knowledge, skills and attitudes. • Air traffic control team knowledge			

[17] Refer to Chapter 2 page 47 and Table 2.11.
[18] Refer to Chapter 2 pages 30, 33, 37-39, 47, 77, 78, 83, 86-88, 91, 92, 94, 118-120 & 131 and Tables 2.10 & 2.23.
[19] Refer to Chapter 2 pages 39, 72 & 91 and Tables 2.10 & 2.23.
[20] Refer to Chapter 2 pages 30, 37, 47, 48, 73, 79, 82, 87, 91, 93, 95-97, 103 & 105 and Tables 2.10, 2.11.
[21] Refer to Chapter 2 pages 30, 32, 59, 111-116, 119, 122 & 134 and Tables 2.6 & 2.24.

- Inter-positional knowledge
- Knowledge about the components of ATC teamwork
- Knowledge about the signs of performance-related stress
- Knowledge about team-mates' task expectations
- Knowledge of team-mate characteristics

- Air traffic control team skills

  - Flexibility
  - Information exchange
  - Supporting behaviour
  - Team feedback skill

- Air traffic control team attitudes

  - Belief in the importance of teamwork
  - Collective orientation
  - Collective efficacy
  - Mutual trust
  - Team cohesion

Questionnaire	Question 20	**Focus**	Continuation training characteristics[22]

Value and relevance to this study

Information regarding air traffic control continuation training provided me with a different view relating to self-directed team learning. I realised that within a systems perspective individual and/or collective learning needs can be addressed by a team's concerted effort to ensure competence of all team members. Continuation training characteristics investigated by me are listed below.

- Information exchange. Involves passing relevant data to team members who need it, before they need it, and ensuring that the messages sent are understood as intended.
- Supporting behaviour. Involves offering assistance and means to request assistance in an effective manner both within and across teams in the air traffic control system. Supporting behaviour has two primary components: (1) requesting and accepting assistance and (2) providing assistance. Providing assistance refers to the need to identify the need to assist others and the resulting actions that will take place. Requesting assistance involves monitoring oneself for signs of performance deficiency and then requesting help from other team members before it is too late.

[22] Refer to Chapter 2 pages 31, 51, 52, 116 & 118-123 and Tables 2.11 & 2.26.

- Team feedback skills. Refers to an environment that supports and encourages team members to communicate their observations, concerns, suggestions, and requests in a clear and direct manner without becoming hostile or defensive.
- Flexibility. Involves the ability to learn and adapt performance strategies quickly and appropriately to changing task demands.
- Team-mate generic knowledge competencies.
- Team-mate specific knowledge competencies.
- Team-mate-generic attitudes.
- Team-mate-specific attitudes.
- Team situational awareness.

Questionnaire	Question 21	**Focus**	Workplace learning environment[23]

Value and relevance to this study

I realised that a functional self-directed adult learning environment needed to support:

- a supportive learning environment;
- an enabling learning climate; and
- a complementary extended social setting.

I had to investigate whether functional self-directed adult learning environments were dependent upon intentional/formal and/or unintentional/informal learning interventions.

Questionnaire	Question 22	**Focus**	Team learning facilitation[24]

Value and relevance to this study

Allowed me to explore how individual and team learning was influenced by the following interfaces:

- S – Software
- H – Hardware
- E – Environment
- L – Liveware
- L – Liveware (in the middle)

Allowed me to determine how team learning was influenced by:

- operating environment;
- attitudes;

[23] Refer to Chapter 2 pages 44, 46, 50, 51, 97, 106 & 122 and Tables 2.11 & 2.23.
[24] Refer to Chapter 2 pages 126-128 and Tables 2.5 & 2.28.

• communication; and • trust.			
Questionnaire	Question 23	**Focus**	Individual feedback[25]
Value and relevance to this study			
Provided me with insight into voluntary feedback invited from respondents regarding: • individual's impact upon performance; • team's impact upon performance; • individual self-directedness; and/or • team self-directedness			

Compiled by the researcher

7.4 Learning Approach Questionnaire (LAQ)

I stated (in Chapter 3) my assumption that knowledge is constructed by the subjects in order to adapt to their environment and that construction of knowledge is an ongoing process at different levels; psychological and social. My challenge was to discover and categorise dynamic learning approaches and orientations associated with individual knowledge construction in order to support my own understanding of factors internal to the subject's point of view and external factors. The purpose of such an investigation was to discover how knowledge structures were formed, nurtured and maintained within a defined learning situation and learning environment.

I could not overlook the value and importance of learning approaches as applicable to this study. This point of view is shared by Schaap (2000) who acknowledged that the way an individual views the process of learning influences the individual's approach to a learning opportunity and the effectiveness of the learning process concerned. This statement warranted further investigation because it allowed me to consider the use of a valid and reliable measure to determine learning approaches of air traffic controllers.

The Self-directed Learning Readiness Scale (SDLRS) was considered in this regard. However, Brockett (1984: 1) pointed out that the SDLRS may be suited to measure the readiness for self-directed learning of adults who have an average or above-average level of formal education and who rely on books and periodicals for information. Brookfield (1985: 13) concluded that the SDLRS is a questionable measure of

[25] Refer to Chapter 2 Tables 2.3-2.6, 2.10, 2.11, 2.16, 2.23, 2.24, 2.26 & 2.28. In this regard adult learning, learning within teams, self-directed learning, air traffic control operations, air traffic control training and human factors responses were contemplated.

self-directed learning readiness for adults who use fellow learners as the primary source of information in their explorations of knowledge and skills areas. I decided to make use of the Learning Approaches Questionnaire (LAQ) (Schaap, 2000).

The LAQ consists of two sections; learning approaches in terms of learning content (LAQc) and learning approaches in terms of social orientation (LAQs). These two dimensions dealing with relations between learning approaches and the situational nature of learning had been identified as variables/impact elements to consider during this study. The LAQ allows for measurement of learning approaches in terms of learning content, consisting of deep approaches, achievement approaches, surface approaches and self-efficacy. The LAQ also integrates dependent, independent, cooperative and competitive learning approaches in terms of social orientations. These dimensions were also aligned to the focus areas of this study, being team-directed learning and self-directed learning.

The LAQ was subjected to the following questions in order to motivate use, value and applicability of the instrument in this study (Borg and Gall, 1979: 157):

- *Question: What reliability data are available?*
  Response (Schaap, 2000): *Alpha*-reliability coefficients calculated for the LAQ illustrated acceptable reliability (varying between 0,744 and 0,928). Reliability statistics confirm acceptable reliability coefficients for all LAQ dimensions. Research results also support the reliability of the LAQ.

- *Question: What validity evidence is available?*
  Response (Schaap, 2000): LAQ factor validity was determined by means of factor analytical methods, intra-dimensional correlation coefficients, reliability coefficients, congruency coefficients of factor structures of different data sets and factor comparisons between culture groups. Factor analytical results support factorial validity of the LAQ. Factor validity of the various LAQ dimensions for different context groups was also confirmed. Content validity of the LAQ was evaluated by means of item correlation values and Cattell and Tsujioka's statistic used for factor validity. Research results also support the factor and construct validity of the LAQ.

- *Question: Is the measure appropriate for the sample?*
  Response (Schaap, 2000): The LAQ is aimed at adults who have at least completed Grade 12. The LAQ specifically focuses on informal and formal learning situations found in organisations.

The LAQ examines learning approach constructs in terms of learning content and social orientations. Research results support the stability (for a business learning context) of the LAQ. Constructs measured by the LAQ are reported as being suitable for use in an organisational context. The LAQ thus allows for the measurement of learning approaches in a specific situation (such as the air traffic control work environment).

- *Question: Are test norms appropriate?*
  Response (Schaap, 2000: 556): A generic set of norms was developed for the LAQ. Ipsative interpretation was also possible. Ipsative and normative interpretation guidelines were provided by Schaap (2000: 556).

I used the LAQ (attached as Appendix F) results in conjunction with the traditional qualitative data collection techniques and the SDTLQ in order to describe measured characteristics. Further discussion in this regard is presented in paragraph 9.

8 Role of the researcher

Role of the researcher ←

My role as researcher was purposefully chosen to empower me to enter into a collaborative partnership with the respondents in order to collect and analyse data, with the aim of creating understanding. I fulfilled the role of a sensitive observer and recorded phenomena as faithfully as possible. This role allowed me to raise additional questions, check out hunches, and move deeper into analysis of the phenomena (McMillan & Schumacher, 1989: 393).

My functional researcher role, ethical considerations and future post-research actions were presented in the Researcher-respondent agreement (Appendix A).

My functional role as a researcher included:

- obtaining permission from the South African Air Force to conduct this research;
- compiling the SDTLQ;
- administering the SDTLQ;

- administering the LAQ;
- preparing and structuring interviews;
- conducting interviews;
- preparing focus group interviews;
- facilitating focus-group interviews;
- analysing data;
- triangulating data.

I complied with ethical issues (Du Plooy, 1995: 45-46, 65, 85, 169) by:

- protecting the rights of human subjects including not causing emotional harm, not infringing on their rights to maintain self-respect and human dignity;
- providing all information without distortion or misrepresentation;
- avoiding being biased in the interpretation and presentation of data;
- using measurements that were suited to the research problem;
- not knowingly ascribing greater confidence than the measurements warranted;
- reporting conflicting evidence; and
- reporting any flaws or limitations in the research.

No reasons could be cited as necessary for disclosing the identity of participants, therefore:

- I ensured confidentiality by not disclosing the identity of respondents; and
- I made use of numbers in order to protect sites and individuals.

I visited the air traffic control sites after obtaining consent from corporate and centre management. The importance of air traffic control safety needs and requirements were fully realised by me – these were respected at all times. No unprofessional behaviour was required from participants.

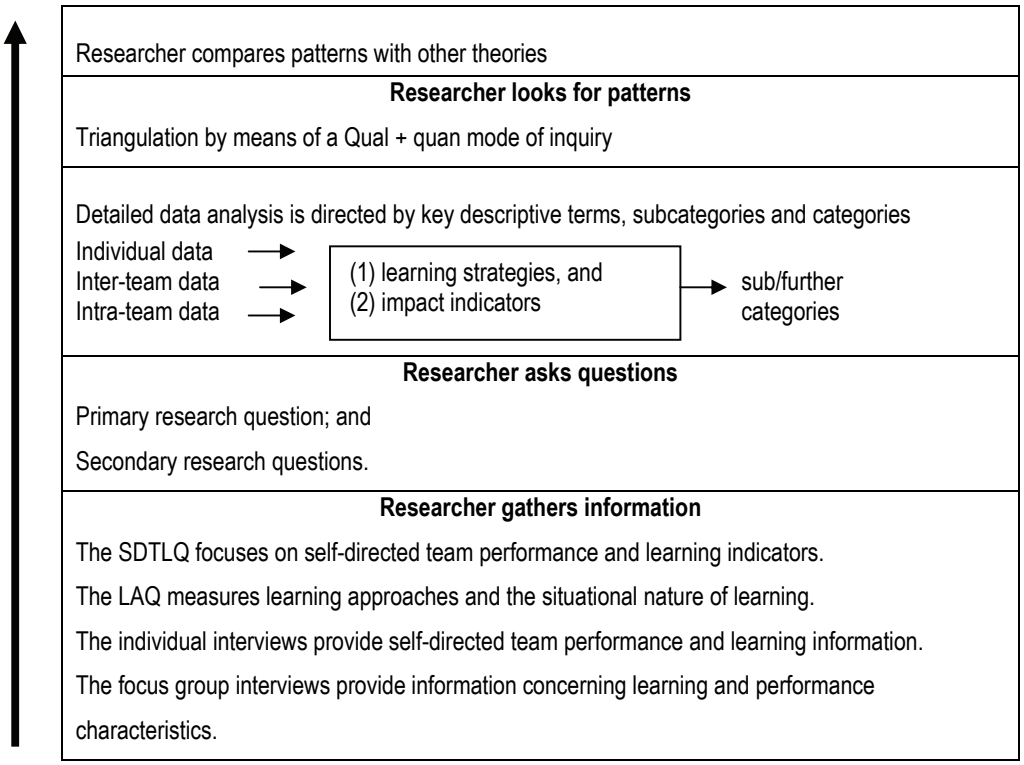
I agreed to provide the participants with an opportunity to learn from their participation, therefore the outcome of this study will be made available to participants and will be communicated by means of arranged internal organisational means.

9 Data analysis

Data analysis ←

Data analysis from a dominantly qualitative approach was viewed as an ongoing process that integrated all phases of qualitative and quantitative data. This qualitative data analysis observed a relatively systematic process that was guided by the primary and secondary research questions. This necessitated a continuous awareness and orientation by me to pay attention to evidence that illustrated the impact of self-directed team learning on the air traffic control work environment and the nature of such impact. I also considered my data analysis challenge to be guided by a search to identify individual and team self-directed learning initiatives and relationships, and then link self-directed team learning findings with air traffic control operational outcomes. Data were analysed from an integrative perspective (using information obtained to result into something new) as presented below in Figure 4.2 as a logic diagram; a basic visual representation of relationships among concepts (Cresswell, 1994: 96).

Figure 4.2 Overview of the analysis plan



Adapted from Creswell (1994: 96)

An intensive data analysis effort enabled me to trace present team performance – thus exploring team performance from an individual, collective and organisational perspective. This approach also allowed me to trace present team learning – thus presenting team learning from an individual, collective and organisational perspective. Finally, I was able to trace future team learning possibilities – proposed strategies from an individual, collective and organisational perspective.

I implemented an analytical approach suggested by Lederman (1990: 117-127) that consisted of data coding into prescribed categories. These categories coincided with the focus areas of the various data collection techniques listed above. The categories are summarised in Table 4.11.

Table 4.11 Data analysis categories

Individual interviews	Focus groups
• Impact/influence of teamwork on workplace performance outcomes. • Impact/influence of teamwork on the individual's performance. • Impact/influence of learning from experience on teamwork.	• Reflecting on team characteristics (team performance and learning environment) • Individual and collective learning strategies reported. • Reflecting on team learning opportunities reported.
SDTLQ	**LAQ**
• Self-directed Team Performance responses. • Self-directed Team Learning responses.	• Learning approaches in terms of learning content (LAQc) responses. • Learning approaches in terms of social orientation (LAQs) responses.

Compiled by the researcher

This form of data analysis allows for patterning of responses (Cohen, Manion & Morrison, 2000: 82) and relationships between categories of data (Cohen, Manion & Morrison, 2000: 342). Data analysis took place upon completion of data collection. Qualitative data analysis followed an inductive reasoning mode and quantitative data analysis followed a supporting deductive reasoning mode. An abstract descriptive synthesis of the data emerged as a result of the inductive analysis approach utilised. A technique of comparing and contrasting, as suggested by McMillan & Schumacher (2001: 464) was used to identify

segments that emanated from individual interviews and focus group interview data. These segments were presented as key descriptive terms, subcategories and categories that addressed:

- team performance;
- team learning; and
- continued learning.

I realised that objectivity can never really be captured. However, I decided to add to the richness of understanding by making use of triangulation. The use of triangulation reflects an attempt to facilitate an in-depth understanding of the phenomena in question. Triangulation is thus not a tool or strategy for validation, but an alternative to validation (Flick, 1998: 230). The success of this data analysis depended on the thoroughness of this triangulation process.

This data analysis strategy is aligned to Marshall and Rossman's approach (1989: 112-120) and allows for the following stages (Vaughn, Schumm & Sinagub, 1996: 105-113; Marshall & Rossman, 1989: 112-120 and de Vos, 1998: 342-343):

- Organising data. An initial framework for participant responses assisted to identify trends and patterns that appear and reappear. This initial framework consisted of a breakdown of the primary and secondary research questions.

- Generating key descriptive terms, subcategories and categories. In the framework, I made provision for the linking of units of information presented by individuals and teams. This approach allowed me to identify descriptions, characteristics and comparisons as inferred by data collected. Provision was thus made for accumulated data to be analysed from:

    - both an overall sample perspective (considering data from all respondents) as well as a team perspective;
    - an intra-team perspective; and
    - an inter-team perspective.

- Evaluating and categorising data for informational adequacy, credibility, and usefulness. Units of information were directed into identifiable categories. During this stage statistical supportive information was used in order to provide further meaning to the various categories.

- Looking for, and recording, plausible explanations and interpretations. Triangulation was used to facilitate this entire stage. This decision is motivated below.

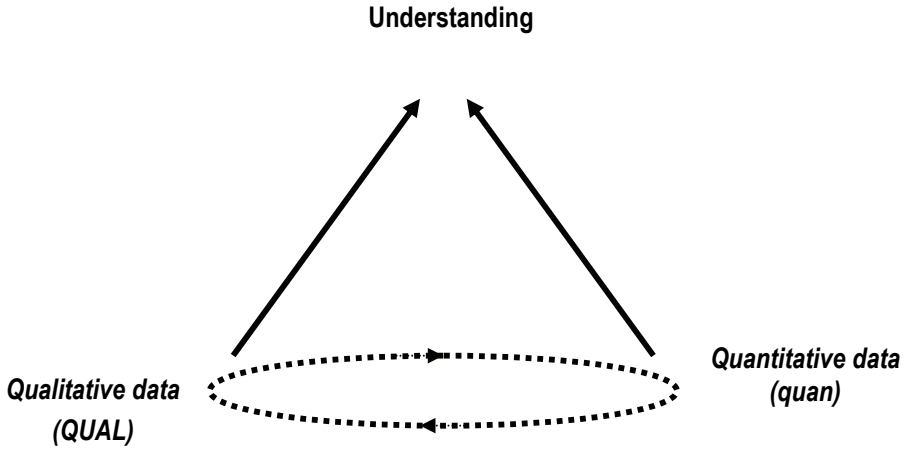
    - Maxwell (1996: 95) states that many of the conclusions of qualitative studies have an implicit quantitative component. Lather (1986: 270) follows on this line of thought when she states that the researcher must consciously utilise designs that allow counterpatterns as well as convergence if data is to be credible.

    - Triangulation is critical in establishing data trustworthiness (Lather, 1986: 270 and McMillan & Schumacher, 1989: 418). Validity and reliability are enhanced by including triangulation in qualitative research (Maxwell, 1996: 94). Triangulation reduces the risk of chance associations and systematic biases.

Triangulation thus relied on information collected from a diverse range of individuals, teams and settings, using a variety of methods (Maxwell, 1996: 93) as illustrated above. Independent measures of the same phenomena should agree (Swanson & Holton, 1997: 105). This implies that data collected relating to, for example learning preferences, by means of a one-to-one interview and the LAQ should result in statistical similarities. A deeper qualitative analysis (unbound by predefined variables) was introduced in order to gain deeper understanding in cases of differences.

Triangulation as a technique was used to determine whether multiple sources of data agreed and to obtain better, cross-checked insights (Burgess, 1985: 306). This proposed data analysis strategy explained above facilitated such an approach, the reason being that various data types were linked and tested to determine areas of congruence and incongruence. Triangulation furthermore allowed me to test and support claims that are inherently quantitative by qualitative means. Figure 4.3 and 4.4 captures the essence of triangulation as utilised in this study.

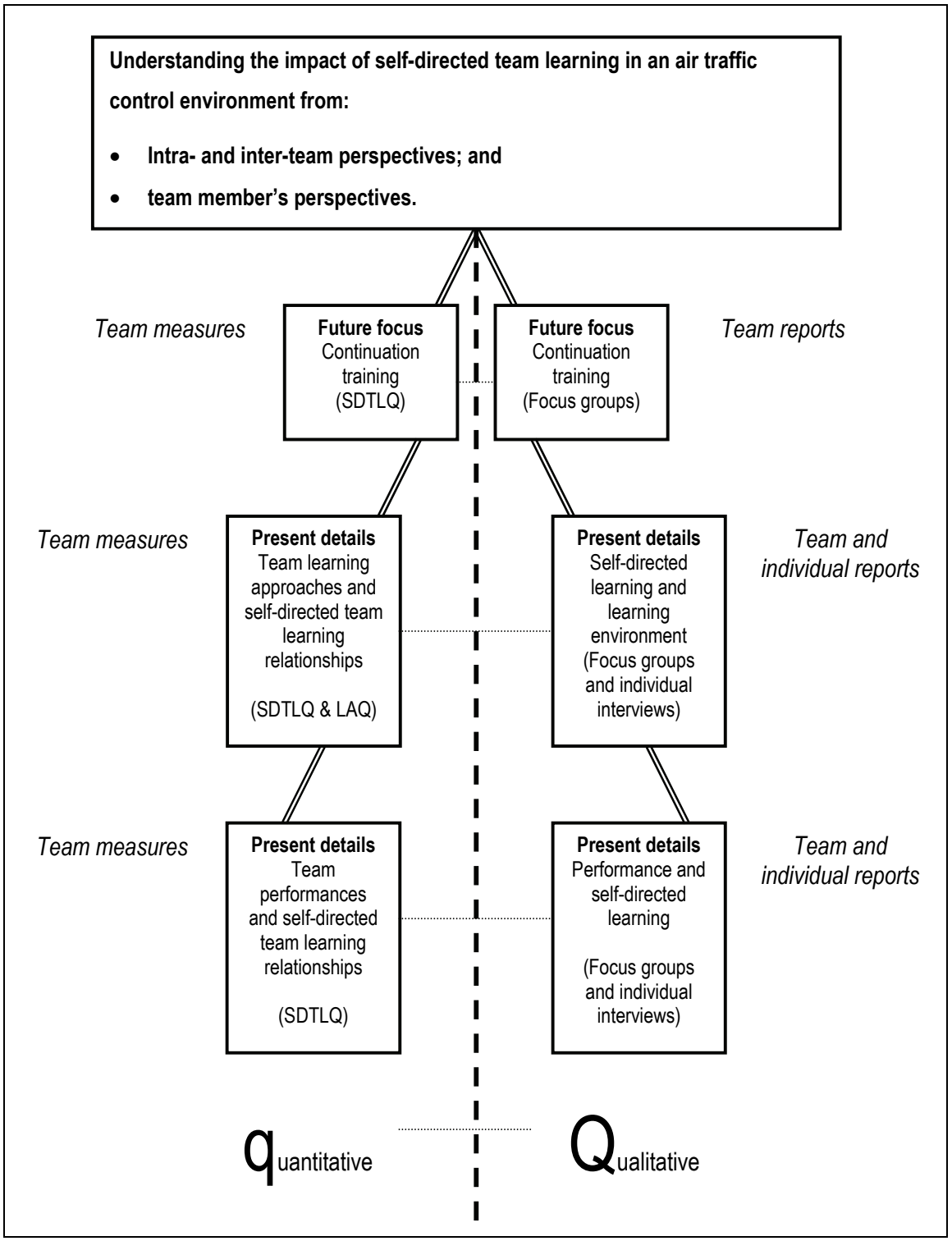
Figure 4.3 Triangulation



Compiled by the researcher

In an attempt to understand and appreciate possible individual and team learning, team performance and continued learning similarities and/or differences, an addition to this triangulation technique was incorporated. This extension favoured a crystallisation technique that supported the process of inductive data analysis by means of intensive reflective dialogues (McMillan and Schumacher, 2001: 463). This orientation guided a multifaceted segmentation, categorisation and pattern-seeking (McMillan and Schumacher, 2001: 463) data analysis approach that, in turn relied on individual, intra- and inter-team perspectives. Figure 4.4 illustrates this approach.

Figure 4.4 Data triangulation and crystallisation



Compiled by the researcher

10 Data validation

Data validation	Validity
	Reliability
	Trustworthiness

Compiled by the researcher

10.1 Validity

Actions supporting validity of the **quantitative research design element** of this study are presented below. Paragraph 7.4 acknowledges the factor and construct validity of the LAQ. I therefore did not embark on further validity procedures with regard to the LAQ.

The SDTLQ was presented to four senior South African Air Force Officers on 22 July 2005 in order to assist with a pilot validity phase. These four officers were selected on account of their:

- experience as air traffic controllers;
- knowledge of human resource development practices; and
- awareness of the aim and objectives of this research project.

Feedback was received on 01 August 2005 via email. The reported process followed by the four officers was divided into two phases: an individual critical review of the SDTLQ followed by a group critical feedback session. The feedback provided and associated corrective actions are presented in Table 4.12.

Table 4.12 Feedback received from the South African Air Force and corrective actions

Feedback received from the South African Air Force	Corrective actions
Reference to the rank of "First Lieutenant" should read "Second Lieutenant".	Question 3 was changed accordingly.
The term "Air Traffic Control Assistant" should be changed to read "Command and Control Assistant".	Question 6 was changed accordingly.
Post levels depicted in question 6 may differ from military ranks in question 3.	No corrective action was required.

The term "traffic sequencing" used in question 11 should be rephrased to read "traffic sequencing abilities of the controllers".	Question 11 was changed accordingly.
Question 12 leading sentence used the word "directed". However, it was proposed to replace the word with "directed/facilitated/guided" in order to ensure clarity.	Question 12 was changed accordingly.
Question 16 refers to decision-making in terms of training objectives. Respondents may simply select the "Yes" or "No" as a result of perceived corporate directives. More response options may need to be considered.	This comment was noted and a four-scale response option was included (similar to the scale used throughout the questionnaire with similar question types).
Question 21 refers to the use of learning contracts. Learning contracts are generally not considered to be a training option that is widely used in the South African Air Force.	This comment was noted and feedback from respondents in this regard will be of interest. Analyses will be performed in accordance with this forewarning.
Outlay of this questionnaire is considered to be user-friendly.	Outlay remained unchanged.
Contents of the questions correspond to expectations. This is described as a result of existing understanding and/or awareness of the aim and objectives of this research project.	Contents remained unchanged.

Compiled by the researcher

Validity of individual interviews and focus group interviews was dealt with by complying with McMillan and Schumacher's (2001: 408) proposed strategies to enhance design validity. I used this framework (Table 4.13) to provide a description of my actions in response to each strategy.

Table 4.13 Enhancing design validity

Strategy	Description of my action
Prolonged and persistent field work	Data collection took place during four phases, whilst data analysis and triangulation ensured a match between findings and participant reality.
Mixed-method strategies	This study allowed for triangulation with respect to data collection and analysis.

Participant language; verbatim accounts	Interviews were recorded and transcribed in a verbatim manner. One language (English) was used.
Low-inference descriptors	Detailed description of explanations and situations were recorded and transcribed.
Multiple researchers	My testing for understanding of data collected and reviewed was facilitated by my supervisor.
Mechanically recorded data	Use was made of voice tape recording.
Participant researcher	My recorded perceptions and assumptions (noted during interviews) were tested during the data analysis phase to ensure understanding and intended meaning.
Member checking	I checked formally with participants for accuracy of data collected and transcribed.
Participant review	
Negative cases or discrepant data	I actively searched for, and recorded, analysed, and reported negative cases or discrepant data that were an exception to patterns or that modified patterns found in data.

Adapted from McMillan & Schumacher (2001: 408)

10.2 Reliability

Actions supporting reliability of the **quantitative research design element** of this study are presented below. Paragraph 7.4 acknowledges the reliability of the LAQ. I therefore did not embark on further reliability procedures with regard to the LAQ.

Reliability of the SDTLQ was assured by the following measures.

- Response items of the SDTLQ were aligned to the outcome of the literature review of this study.
- All respondents received similar pre-briefings.
- The purpose of the SDTLQ and any misunderstandings were dealt with in a face-to-face manner by me thus ensuring comprehension.
- The same questionnaire was administered to all respondents.
- All respondents were literate and representative of the population.

- The SDTLQ was completed in an anonymous manner thus encouraging honesty.
- No time limitations were placed on completion of the SDTLQ.

10.3 Trustworthiness

Actions supporting trustworthiness of the **qualitative research design element** of this study are presented in Table 4.14.

Table 4.14 Ensuring trustworthiness

Strategies	My actions
Credibility	Used more than one source of data. Used more than one data collection method. Used a member-checking technique.
Applicability	Collected data from air traffic control teams and team members. Interpreted data in accordance with research questions and derived criteria. Used a member-checking technique.
Consistency	Used a structured interview approach, with the same format, sequence and questions for each respondent (this approach is presented in Appendices B and C). Presented detailed descriptions of participants, sample drawn, data collection methods, and data analysis strategies. Ensured detailed descriptions/transcripts of information collected.
Neutrality	Ensured non-involvement by the researcher in workplace activities. Recorded phenomena as faithfully as possible, while also raising additional questions, checked out hunches, and moved deeper into analysis of the phenomena. Encouraged respondents to present examples in order to demonstrate their unique way of viewing the world. Did not exert power-based influences during interviews.

Adapted from Krefting (1991: 215)

11 Conclusion

This research design demonstrates the feasibility of an integrated phenomenological qualitative and descriptive quantitative mode of inquiry (illustrated by the typology quan + QUAL). This mode of inquiry supported the employment of mixed-method data collection techniques to uncover the complex, multivariate nature of human performance and learning.

Cohen, Manion, & Morrison (2000: 75) refer to the research design and methodology phase as a process of *operationalisation*. This *operationalisation* (Cohen, Manion, & Morrison, 2000: 75) phase as presented in this chapter allowed me to translate broad research intentions, philosophies, academic and workplace inspired debates, and research methodologies into a streamlined concrete whole. This "choreographed" (Flick: 1998: 230) research design allowed me to engage in a rigorous and complex investigation of the social setting under study.

In Chapter 5 the data analysis and presentation of results as applicable to this study are presented.

CHAPTER 5

ANALYSIS AND PRESENTATION OF RESULTS

Figure 5.1 Chapter 5 orientation

Introduction		
Qualitative results	Results of individual interviews	Results: Impact of teamwork on air traffic control workplace performance outcomes
		Results: Impact of self-directed team learning dynamics within self-managed air traffic control work teams
		Results: Impact of self-directed team learning in the air traffic control workplace continuation training scenario
	Results of focus group interviews	Results: Impact of teamwork on air traffic control workplace performance outcomes
		Results: Impact of self-directed team learning dynamics within self-managed air traffic control work teams
		Results: Impact of self-directed team learning in the air traffic control workplace continuation training scenario
Quantitative results	Self-directed Team Learning Questionnaire (SDTLQ) results	Self-directed Team Performance results
		Self-directed Team Learning results
		Team performances and self-directed team learning relationship results
		Continuation training results
	Team learning approaches and self-directed team relationship results	
Conclusion		

Compiled by the researcher

1 Introduction

Introduction 

In Chapter 4 the research design, methodology, processing and reporting procedures of research data were discussed. Analysis and results of data are presented in this chapter in two phases:

- qualitative results; and
- quantitative results.

Qualitative results, which relied upon individual interview data and focus group interview data, will be reported during the first phase. Individual interview data and focus group interview data collected in this study were categorised in order to facilitate an analysis (and a discussion of findings, integration of findings and contextualising of results in Chapter 6) of:

- the effect of teamwork on workplace air traffic control performance outcomes;
- the influence of teamwork on the individual's work performance; and
- learning that resulted from air traffic control teamwork experiences.

Quantitative results, which relied upon Self-directed Team Learning Questionnaire (SDTLQ) and Learning Approach Questionnaire (LAQ) data, will be reported during the second phase. SDTLQ data will statistically be analysed in terms of:

- self-directed team performance results;
- self-directed team learning results;
- team performances and self-directed team learning relationship results; and
- continuation training results.

LAQ statistical results will focus on:

- learning approach results in terms of learning content (LAQc); and
- learning approach results in terms of social orientation (LAQs).

SDTLQ and LAQ statistical data will be utilised to analyse and present team learning approaches and self-directed team learning relationship results.

2 Qualitative results

Qualitative results	**Results of individual interviews**	**Results: Impact of teamwork on air traffic control workplace performance outcomes**
		Results: Impact of self-directed team learning dynamics within self-managed air traffic control work teams
		Results: Impact of self-directed team learning in the air traffic control workplace continuation training scenario
	Results of focus group interviews	**Results: Impact of teamwork on air traffic control workplace performance outcomes**
		Results: Impact of self-directed team learning dynamics within self-managed air traffic control work teams
		Results: Impact of self-directed team learning in the air traffic control workplace continuation training scenario

2.1 Results of individual interviews

During each individual interview three questions were posed. Twenty-five air traffic controllers were interviewed and recorded individual interview participant views and experiences were transcribed. Transcribed responses received alpha-numerical values which were allocated in accordance with the three questions posed during each individual interview. This first step is illustrated in Table 5.1.

Table 5.1 Alpha-numerical codes[1]

Individual interview question 1	"Explain with the aid of examples how teamwork influences the outcome of the air traffic control service provided by your centre?"											
Rationale for posing this question	Understanding the impact/influence of teamwork on workplace performance outcomes; emphasising the team's contribution towards air traffic control performance outcomes and the team's learning strategies.											
Alpha-numerical codes												
A.1.	B.1.	C.1.	D.1.	E.1.	F.1.	G.1.	H.1.	I.1.	J.1.	K.1.	L.1.	M.1.
N.1.	O.1.	P.1.	Q.1.	R.1.	S.1.	T.1.	U.1.	V.1.	W.1.	X.1.	Y.1.	

[1] The letter **A** refers to the candidate. **A.1.** refers to candidate 1 and his/her response to question 1.

Individual interview question 2			"Explain with the aid of examples how learning from air traffic control teamwork experiences influences your own performance?"									
Rationale for posing this question			Understanding the impact/influence of teamwork on the individual's performance; emphasising the team's contribution towards air traffic control performance outcomes and the team's learning strategies.									
Alpha-numerical codes												
A.2.	B.2.	C.2.	D.2.	E.2.	F.2.	G.2.	H.2.	I.2.	J.2.	K.2.	L.2.	M.2.
N.2.	O.2.	P.2.	Q.2.	R.2.	S.2.	T.2.	U.2.	V.2.	W.2.	X.2.	Y.2.	
Individual interview question 3			"Explain with the aid of examples how learning from experience influences air traffic control teamwork?"									
Rationale for posing this question			Understanding the impact/influence of learning from experience on teamwork; emphasising the team's contribution towards air traffic control performance outcomes and the team's learning strategies.									
Alpha-numerical codes												
A.3.	B.3.	C.3.	D.3.	E.3.	F.3.	G.3.	H.3.	I.3.	J.3.	K.3.	L.3.	M.3.
N.3.	O.3.	P.3.	Q.3.	R.3.	S.3.	T.3.	U.3.	V.3.	W.3.	X.3.	Y.3.	

Compiled by the researcher

Transcripts allowed for categorisation and analysis of data[2]. These transcript categories were inductively analysed and grouped as:

- narrative codes derived from actual statements[3];
- key descriptive terms;
- subcategories; and
- categories.

Narrative codes derived from actual statements were the result of a summary of participant statements. I ensured that the original meaning and intention was not consciously distorted. These summaries allowed me to extract important aspects from the data itself and then to present these in a logical and condensed manner and order. Narrative codes derived from actual statements formed the point of departure for all key descriptive terms, subcategories and categories. Coding of data was primarily facilitated by literature

[2] An external coder was used to ensure that categories and subcategories identified were based on scientific principles. Data were presented as accurately as possible and based on qualitative analysis principles (reference: Appendix J).
[3] Narrative codes derived from actual statements are presented in Tables 5.9-5.11.

referencing in order to ensure coding accuracy and own understanding. Key descriptive terms transpired during transcript analyses and formulation of narrative codes. These efforts allowed me to formulate collective terms that accurately described narrative codes. Key-descriptive terms that emerged are presented in Table 5.2.

Table 5.2 Key descriptive terms

Key descriptive terms		
Co-learning preferences	Personal learning preferences	Planned learning preferences
Critical analysis	Informal discussions	Formal discussions
Resourcefulness	External aided learning	Design considerations
Implementation responsibility	Evaluation focus	Team building
Learning transmission	Encouragement	Inhibitors
Socialising	Involvement	Dynamics
Facilitation considerations	Value	Team roles
Power base	Individual focal point	Synergy
Team relationships	Team assistance	Teamwork criticism
Conformity pressures	Teamwork environment	Status influences
Learning	Team conflict	Diversity
Teamwork problems	Team member focus	Collective focus
Safety concerns	Team planning	Team outputs
Team coordination	Duty responsibility	Team communication
Team's work processes	Supervision activities	Personal reflection
Support needs	Influencing performance	Understanding teams
Personal value	Performance assistance	Performance problems
Team performance	Status impact	Information sharing
Helpfulness	Fellowship	Trust and respect
Performance breakdowns	Characteristics	Formal climate
Conditions	Significance	

Compiled by the researcher

Subcategories were developed by identifying properties in the key descriptive terms that could be linked to SDTLQ topic indicators and literature groups. This approach that followed an alignment with the SDTLQ

was supported in lieu of its triangulation possibilities. Key descriptive terms and associated subcategories that transpired are presented in Table 5.3.

Table 5.3 Key descriptive terms and associated subcategories

Key descriptive terms	Subcategories	Designator
Co-learning preferences Personal learning preferences Planned learning preferences	Individual learning preferences	TLA
Critical analysis Informal discussions Formal discussions Resourcefulness	Participative learning	TLB
External aided learning	Individual learning orientation	TLC
Design considerations	Training design	TLD
Implementation responsibility	Training implementation	TLE
Evaluation focus	Training evaluation	TLF
Team building Learning transmission Encouragement Inhibitors	Operational training characteristics	TLG
Socialising Involvement Dynamics	Learning environment	TLH
Facilitation considerations Value	Team learning facilitation	TLI
Team roles Power base Individual focal point Synergy Team relationships Team assistance Teamwork criticism	Teamwork characteristics	TMA

Conformity pressures Teamwork environment Status influences Learning Team conflict Diversity Teamwork problems		
Team member focus Collective focus	Self-efficacy	TMB
Safety concerns Team planning Team outputs Team coordination Duty responsibility Team communication Team's work processes Supervision activities	Teamwork activities	TMC
Personal reflection Support needs Influencing performance Understanding teams Personal value	Performance reflection	TMD
Performance assistance Performance problems Team performance Status impact	Teamwork performance measures	TME
Information sharing Helpfulness Fellowship Trust and respect Performance breakdowns	Teamwork dynamics	TMF
Characteristics	Continued learning strategies	CLA
Formal climate	Continued learning environment	CLB

Conditions	Continued learning expectations	CLC
Significance	Continued learning value	CLD

Compiled by the researcher

Similar subcategories were then identified and categorised. Categories and associated subcategories that emerged are presented in Table 5.4.

Table 5.4 Categories and associated subcategories

Categories	Category designators	Associated subcategories (designators)
Team learning	TL	TLA, TLB, TLC, TLD, TLE, TLF, TLG, TLH & TLI
Team performance	TP	TMA, TMB, TMC, TMD, TME & TMF
Continued learning	CL	CLA, CLB, CLC & CLD

Compiled by the researcher

2.1.1 Results: Impact of self-directed team learning dynamics within self-managed air traffic control work teams

Team learning narrative codes summarised from actual statements, supportive transcript extracts, summary of key descriptive terms; subcategories; and categories are presented in Table 5.9.

2.1.2 Results: Impact of teamwork on air traffic control workplace performance outcomes

Team performance narrative codes summarised from actual statements, supportive transcript extracts, summary of key descriptive terms; subcategories; and categories are presented in Table 5.10.

2.1.3 Results: Impact of self-directed team learning in the air traffic control workplace continuation training scenario

Team continuation training narrative codes summarised from actual statements, supportive transcript extracts, summary of key descriptive terms; subcategories; and categories are presented in Table 5.11.

2.2 Results of focus group interviews

Three focus group interviews were conducted and each focus group comprised four respondents. Recorded focus group interview participant views and experiences were transcribed[4]. Transcribed responses received alpha-numerical values which were allocated in accordance with the three questions posed during each focus group interview. This first step is illustrated in Table 5.5.

Table 5.5 Alpha-numerical codes[5]

Focus group interview question 1	"What can a team member, joining the air traffic control team, expect from the team?"		
Rationale for posing this question	Understanding the impact/influence of teamwork on workplace performance outcomes; emphasising the team's contribution towards air traffic control performance outcomes and the team's learning strategies.		
Alpha-numerical codes			
ZA.1	ZB.1	ZC.1	
Focus group interview question 2	"How is individual and collective learning planned and executed at your air traffic control centre?"		
Rationale for posing this question	Understanding the impact/influence of teamwork on the individual's performance; emphasising the team's contribution towards air traffic control performance outcomes and the team's learning strategies.		
Alpha-numerical codes			
ZA.2	ZB.2	ZC.2	
Focus group interview question 3	"How can air traffic control team learning at your centre be improved?"		
Rationale for posing this question	Understanding the impact/influence of learning from experience on teamwork; emphasising the team's contribution towards air traffic control performance outcomes and the team's learning strategies.		
Alpha-numerical codes			
ZA.3	ZB.3	ZC.3	

Compiled by the researcher

[4] An external coder was used to ensure that categories and subcategories identified were based on scientific principles. Data were presented as accurately as possible and based on qualitative analysis principles (reference: Appendix J).

[5] The letter **ZA** refers to the specific focus group.
ZA.1. refers to focus group 1 and this group's response to question 1.

Transcripts allowed for categorisation and analysis of data. These transcript categories were inductively analysed and grouped as:

- narrative codes derived from actual statements[6];
- key descriptive terms;
- subcategories; and
- categories.

Narrative codes derived from actual statements were the result of a summary of focus group statements. I ensured that the original meaning and intention was not consciously distorted. These summaries allowed me to extract important aspects from the data itself and then to present these in a logical and condensed manner and order. These narrative codes derived from actual focus group statements formed the point of departure for all key descriptive terms, subcategories and categories. Coding of data was primarily facilitated by literature referencing in order to ensure coding accuracy and own understanding. Key descriptive terms transpired during transcript analyses and formulation of narrative codes. These efforts allowed me to formulate collective terms that accurately described narrative codes. Key-descriptive terms that emerged are presented in Table 5.6.

Table 5.6 Key descriptive terms

Key descriptive terms		
Diagnosis	Skills development	Informal discussion
Formal learning	Internal-directed	Design considerations
Implementation goal	Team building	Learning transmission
Socialising	Involvement	Dynamics
Facilitation considerations	Value	Team relationships
Conformity pressures	Individual focal point	Team roles
Collective focus	Duty responsibility	Reflection
Support provided	Value	Threat
Attitude	Characteristics	Conditions
Condition	Significance	Limitations

Compiled by the researcher

[6] Narrative codes derived from actual statements are presented in Tables 5.12-5.14.

Subcategories were developed by identifying properties in the key descriptive terms that could be linked to SDTLQ topic indicators and literature groups. This approach that followed an alignment with the SDTLQ was supported in lieu of its triangulation possibilities.

Key descriptive terms and associated subcategories that transpired are presented in Table 5.7.

Table 5.7 Key descriptive terms and associated subcategories

Key descriptive terms	Subcategories	Designator
Diagnosis Skills development	Individual learning preferences	TLA
Informal discussion Formal learning	Participative learning	TLB
Internal-directed	Individual learning orientation	TLC
Design considerations	Training design	TLD
Implementation goal	Training implementation	TLE
Team building Learning transmission	Operational training characteristics	TLG
Socialising Involvement Dynamics	Learning environment	TLH
Facilitation considerations Value	Team learning facilitation	TLI
Team relationships Conformity pressures Individual focal point Team roles	Teamwork characteristics	TMA
Collective focus	Self-efficacy	TMB
Duty responsibility	Teamwork activities	TMC
Reflection Support provided Value	Performance reflection	TMD

Threat		
Attitude	Teamwork dynamics	TMF
Characteristics	Continued learning strategies	CLA
Conditions	Continued learning environment	CLB
Condition	Continued learning expectations	CLC
Significance Limitations	Continued learning value	CLD

Compiled by the researcher

Similar subcategories were then identified and categorised. Categories and associated subcategories that emerged are presented in Table 5.8.

Table 5.8 Categories and associated subcategories

Categories	Category designators	Associated subcategories (designators)
Team learning	TL	TLA, TLB, TLC, TLD, TLE, TLG, TLH & TLI
Team performance	TP	TMA, TMB, TMC, TMD & TMF
Continued learning	CL	CLA, CLB, CLC & CLD

Compiled by the researcher

2.2.1 Results: Impact of self-directed team learning dynamics within self-managed air traffic control work teams

Team learning narrative codes summarised from actual statements, supportive transcript extracts, summary of key descriptive terms; subcategories; and categories are presented in Table 5.12.

2.2.2 Results: Impact of teamwork on air traffic control workplace performance outcomes

Team learning narrative codes summarised from actual statements, supportive transcript extracts, summary of key descriptive terms; subcategories; and categories are presented in Table 5.13.

2.2.3 Results: Impact of self-directed team learning in the air traffic control workplace continuation training scenario

Team learning narrative codes summarised from actual statements, supportive transcript extracts, summary of key descriptive terms; subcategories; and categories are presented in Table 5.14.

Table 5.9 Results: Impact of self-directed team learning dynamics within self-managed air traffic control work teams

Alpha-numerical codes	Summary of narrative codes derived from actual statements[7]	Descriptive key terms	Subcategories	Categories
A.2.8	An acceptance to learn from all team members exists Being content/happy with your job assists the learning experience	Co-learning preferences	Individual learning preferences (TLA)	Team learning (TL)
C.3.3	Listening to others			
C.3.7	Watching others at work encourages learning			
E.2.7	People are used as resources – asking the one who most likely will have the answer			
E.2.8	Learning by asking			
F.2.3	Actively seeking others' experiences			
F.2.5	Learning actually starts when you work alone			
F.2.7	Team helps in development of own experience			
F.3.11	Observing others while they are working aids learning			
F.3.12	Learning by observing a work role that you have not yet qualified aids to create further/extended understanding			
G.2.3	Watch others control assist with own learning			
G.3.9	Learning by observing others control			
J.3.11	Learn by observing others			
J.3.13	People want to sit and observe others			

[7] Narrative codes were derived from transcripts.

K.2.6	Controllers observe each other and critically evaluate each other and themselves			
L.2.1	People looking on and learning			
M.2.2	During busy spells everyone gets more focused			
M.3.5	Controllers observe each other at work			
N.2.2	Looking at the task and the teamwork			
W.2.9	I also speak to clients and listen to their feedback			
Supportive transcript extracts[8]				
I would afterwards go and sit with someone else and discuss certain issues – how for instance the height of the cloud ceiling affects things like initial with regards to circuit traffic, things like that – because it just at that stage I did not have that level of experience (F.2.3). *… and then a senior can possibly say – "you know what, I had exactly the same and we did this or that or whatever, or oh hell I didn't realise that." And then you can build upon this, but again it all depends on the dynamics of the team because again there are places where you are just told, "suck it up" – "how on earth can the (senior rank) be making a mistake, it is physically impossible, it cannot happen?" Because you know that when I was a (junior rank) the (more senior rank) said "yours" and I handled it, so obviously you must be sub-standard! So that is the other process that is obviously not going to work for a team … (J.3.11).* *In the beginning it was all watching, so it was just learning, finding out what happens here (N.2.2).*				
B.2.1	People learn from previous mistakes	Personal learning preferences	Individual learning preferences (TLA)	Team learning (TL)
B.2.2	Learning through adverted mistakes			
B.2.9	Learn by observing			
C.2.1	Everyday is viewed as a learning opportunity			
G.1.10	You must improve yourself to improve the team's performance			
G.3.2	Every day is a learning occasion			

[8] Transcript examples that support narrative codes are provided

G.3.11	You need to combine various inputs received and determine your own from a process of combining inputs			
H.3.1	Incidents are important learning opportunities			
I.2.1	I did not feel comfortable with my skills after validation			
I.2.5	I learn by sitting and looking			
I.2.6	I will ask "why?"			
I.2.10	Don't want to show others my or other people's shortcomings			
I.3.1	Use of cues to facilitate attention (rubber band on left hand)			
M.2.1	Individual pressure enhances own learning			
N.2.1	Learning by looking/watching			
N.3.2	Watching others during emergencies is a learning opportunity			
P.1.9	Experience is best acquired during observation			
U.3.3	You learn from your own mistakes			
Y.1.12	Observing others while controlling			
Supportive transcript extracts				
I learn by observing (B.2.9). *I have learned that the more pressure you put onto you sometimes … certain individuals just start performing better. It normally happens; I've seen it in netball, when you play netball you play in a team; the moment you have got a strong team that you are playing against your whole level of … just picks up (M.2.1).* *Because I told an aircraft (ATC procedure) … so every time I work with you I notice that you are doing this and this, which I am not happy about. The one time that I had to approach a senior about what he did during the period … (Y.1.12).*				

N.2.4	One standard of instruction aids own learning	Planned learning preferences	Individual learning preferences (TLA)	Team learning (TL)
N.2.5	Learning standards are passed from one instructor to the next			
N.2.8	Learning starts with a theory foundation			
P.2.4	Certain answers are not obtained through analysis which requires critical thinking			
Q.2.2	Workplace training is reliant on one-to-one training			
Q.3.2	Adequate training is important			
X.3.1	Morning formal briefings are used to share information/experiences			
Supportive transcript extracts				
Well, obviously it starts off with theory – they, you do all your exams … so you do those (number) exams and then you go off to do your practical (N.2.8). *He must have the adequate training … to make it adequate here … I will say … (Q.3.2).*				
A.2.5	Learning is reflected upon and remembered and used when the situation in future demands	Critical analysis	Participative learning (TLB)	Team learning (TL)
A.2.6	Team members learn to change own views due to reflecting upon experiences and by learning from others			
C.2.5	Playing scenarios in my head			
C.3.2	Consciously being aware of own experiences			
F.3.1	Talking about own experiences after a shift			
Supportive transcript extracts				
You discuss it, it is good to talk … (ATC example/situation stated) - afterwards he asked - do you understand the application of my separation? He said doing what you did you created a reduction in my airspace – I never knew that ... "Thanks now I know". That is how you learn by discussing these little things; that is basically how I learn. And also sometimes playing scenarios over and over in your head and – I could maybe do this, I could maybe do that! (C.2.5).				

Alright, very often you have things happening during a period and by means of communicating afterwards about certain …; people do not always have the freedom, lets start there, do not always feel the freedom to express themselves and say –"I have had this experience" (F.3.1).				
A.3.7	Informal learning is prompted by quick chats; talking about recent past events that were problematic – these conversations rely upon mutual respect – in order to be effective the issue and not the person is discussed	Informal discussion	Participative learning	Team learning
C.2.4	After-hours informal discussions aid learning		(TLB)	(TL)
D.3.6	Certain people do not participate in discussions – due to lack of confidence and/or seniority			
E.2.4	Experience plays a big role			
F.2.2	Learning supported by discussions and feedback			
F.3.2	Small group discussions take place amongst members of equal seniority			
F.3.4	Focus of informal discussions is practical encounters			
F.3.10	Sharing experiences aids learning			
G.3.1	During informal conversation seniors share past experiences and stories			
H.2.1	Experiences are continuously shared			
H.2.4	People discuss occurrences and provide inputs and ask more questions			
H.3.8	You learn from situations and then share those experiences			
H.3.9	Constructive experience sharing is required to ensure interest and learning			
I.3.4	Experiences are shared informally by discussion			
J.3.10	Informal learning takes place by discussion			
J.3.12	People discuss occurrences with each other			
J.3.14	People debate solutions			

K.2.5	Experiences are shared			
K.2.8	Controllers engage in post-shift discussions			
K.3.3	A willingness to share information is present			
L.1.4	Information must be shared			
L.2.8	Lot of informal learning			
L.3.1	Everybody talks about situations			
L.3.2	Experiences are valued in effective teamwork			
L.3.4	Informal and socially based learning takes place			
M.3.2	Controllers talk freely about occurrences			
M.3.3	Discussion is held in an informal manner			
M.3.6	Everyone is willing to learn from others' experiences			
M.3.9	Humour/innocently making fun is also used to drive learning messages home			
N.3.5	Everyone discusses what happened			
O.1.11	Sharing of ideas/experiences by discussion			
O.2.1	The team's learning is positively influenced by discussions			
O.2.6	Experience based learning is very helpful			
O.3.1	Experience is shared by means of discussions			
O.3.2	Own mistakes are discussed with others			
P.1.7	Information need to be shared			
P.1.8	Experience examples serve as inputs for conversations			
P.1.11	Shortcomings are addressed by informal briefings			
P.2.5	Experience accumulation is critical for learning			

P.3.1	Training is essentially informal			
Q.3.4	Experiences are shared and everyone learns and participates			
R.3.3	Sharing of experiences is essential			
R.3.4	The team must use experiences to ensure learning takes place			
S.1.1	Teamwork is essential for effective information transfer			
S.2.2	Experiences are shared and performance is discussed			
T.1.8	Team members pass information and experiences to newcomers			
T.2.5	Everyone is involved in team discussions			
T.3.8	Discussions with clients and colleagues serve as a learning occasion			
T.3.9	Attending client meetings serve as a learning event			
U.3.2	You learn from other's mistakes – it is discussed			
U.3.11	I enjoy discussions			
V.2.10	Social things are discussed at work more than work things			
V.2.12	Story telling has also started			
V.3.2	Learning from experience is necessary			
V.3.4	Teamwork is enhanced by discussions			
W.2.5	Workplace errors are discussed			
W.2.6	Team members seek confidants and share experiences with them			
Y.2.6	Controllers sharing own experiences with students			
Y.3.7	Informal gatherings are better than formal gatherings			
Supportive transcript extracts				
Again it depends on the team dynamics, I think personally here it is encouraged because everybody here has realised that I must rather learn from your mistakes				

than go and make the same mistake myself, as well as the ability to allow the junior to voice his concerns because it is seen as … not your formal learning, but your informal learning taking place, where you got a chance to discuss, … as well as then freedom to say – "you know that didn't work today or I don't know why that happened today" (J.3.10). *… and that for me is always a learning experience because the best way of learning is learning from other peoples mistakes and try not to make that same mistake obviously. And if you make a mistake you learn from it as well (U.3.2).* *… we have got extreme personalities in each direction in this tower (colleague names and descriptions stated). I think I know more people on a personal basis in the tower than anybody else in the tower. Like they will talk to me, but they won't stand up in front of the whole crew room and say – "this is what I did, or I have a suggestion for this and that" (W.2.6).*				
B.3.7	Use of briefings	Formal discussions	Participative learning (TLB)	Team learning (TL)
B.3.8	Participation by all during briefings invited/supported			
B.3.11	Attendance of external briefings by senior members			
D.3.9	Suggest a team work-related discussion that favours a more formal approach			
K.3.1	Documented experiences – quality circle book			
L.2.9	Formal learning is usually directed, however informal learning has seemingly more value			
M.3.12	Use is made of discussions after certain situations have occurred			
P.3.4	Formal forums are used to address certain issues			
R.1.6	The supervisor role assists with the sharing of experiences			
R.3.1	Morning briefings strengthen teamwork			
R.3.2	Use of humour assists with team briefings			
S.3.1	Discussion meetings are often held			
S.3.11	Teamwork and personal stuff can be discussed at work if no controlling work is to be done			

T.3.2	Morning meetings make use of a formal discussion process			
T.3.3	Experiences are shared at morning meetings			
T.3.10	Formal feedback sessions by seniors after attending client meetings			
V.1.10	Training is mainly of a formal nature			
W.2.1	Daily briefings that include aspects of learning from the previous day			
W.2.7	I am confident to stand in front of the team and share my work occurrences			
W.3.3	During training of others own experiences are shared to serve learning purpose			
W.3.6	Occurrences/errors are discussed in a formal manner			
X.3.3	After occurrences discussions are held			
Y.1.14	Everybody can participate in the morning briefings			
Supportive transcript extracts				
When it is formal it is normally forced; its to adhere to policies to keep (organisation's regulator) happy and stuff. Just to have statistics that we do formal learning (L.2.9). *… during morning meetings or when we have a quality circle. If something happened, we will discuss it and the juniors can learn from the seniors and vice versa … (T.3.2).* *… "OK we made a mistake!" It comes up quite frequently that we have that discussion especially when we have an incident (X.3.3).*				
B.3.6	Listening to others	Resourceful-ness	Participative learning (TLB)	Team learning (TL)
G.2.6	Learning from other's actions and experience during an emergency			
I.2.3	You learn from other peoples mistakes			
I.3.6	Learning from others mistakes is beneficial			
J.2.4	You learn more from negative things			

L.2.4	I learn from other people's mistakes and experiences			
N.2.10	I ask instructors			
N.2.9	I learn a lot from incidents			
N.3.1	Learn a lot from emergencies			
V.2.5	I prepare and learn by listening to other controllers			
X.2.10	Uncertainties are addressed by discussing it with others			
Supportive transcript extracts				
And then what I do, is I go to the instructor, actually anybody, and I ask them "listen how would you have done it?" That's how I learned to do things; like that (N.2.10). *There are some of my team mates who I go and listen to what they say, how to act and what to do in certain circumstances. Be it RT or be it practical control or be it just the whole calmness of your voice; everything, stuff like that. I think it's got an influence on that for sure – for the better (V.2.5).*				
B.3.4	Accepting inputs/guidance/help from others	External aided learning	Individual learning orientation (TLC)	Team learning (TL)
C.3.10	Freedom to approach seniors for assistance and confirmation			
S.3.5	People do acknowledge and approach certain persons they consider to be experts			
Supportive transcript extracts				
…so I phoned the CATCO – this was the situation … (explaining the situation; followed by CATCO's explanation). Hey now I know! (C.3.10). *People do approach specific people who they regard as experts, … yes they do … I think some people have got a perception about someone … So, I think … they do … if you work here long enough you know everyone and you know who to ask … they get clever. So they ask certain people about certain stuff (S.3.5).*				

B.3.5	No need to talk about own experiences	Internal directed learning	Individual learning orientation (TLC)	Team learning (TL)
E.2.1	Individual work performance drive dictates learning interests			
E.2.2	I always want to know			
E.2.3	I want to be the best			
K.1.6	Personal aim is to continuously gain experience			
T.2.1	A willingness to learn must exist			
Supportive transcript extracts				
… I always want to know everything and I want to be the best (E.2.1 & E.2.2). *Of course there is superiors and rules are in force, however, because the environment is so that people are happy to work here. I know I have to serve another (period) tour here and I am happy to do it here and gain my experience, (aircraft type) experience (K.1.6).*				
D.2.4	Identify areas for improvement in the team	Design considerations	Training design (TLD)	Team learning (TL)
F.3.8	Leadership influences team learning			
H.2.2	Experience based learning is utilised in future situations			
Y.3.4	Use of practical scenarios by instructors aids learning			
Supportive transcript extracts				
You can identify certain; I won't say problem areas, but areas for improvement in the team (D.2.4). *Because the instructor likes to explain a lot and he likes uses scenarios. And that is practical things that I never got, or never thought about at all (Y.3.4).*				

R.3.9	Formal training responsibility is directed at leadership and members do not always take responsibility for such formal learning	Implementation responsibility	Training implementa-tion (TLE)	Team learning (TL)
Supportive transcript extracts				
… and the first response I got was you must teach us this more; and I said this is not my work to teach you, my work is to teach you (other subjects listed) … (R.3.9).				
C.3.8	Recognising that learning has taken place	Evaluation focus	Training evaluation (TLF)	Team learning (TL)
D.2.3	Assess yourself			
J.3.15	You need to evaluate your own performance in a constructive and objective manner			
J.3.16	There is a positive relationship between learning and performance			
N.2.7	My performance is evaluated by instructors			
Supportive transcript extracts				
You can sit back and reflect on what has happened. You can also assess within yourself what went wrong, what was good, what was not (D.2.3). *So, in that case my performance was a lot better in their eyes, if I can say that (N.2.7).*				
D.3.7	Junior controllers have little groups, confidence groups where discussions take place	Team building	Operational training characteristics (TLG)	Team learning (TL)
L.2.12	Assistance to seniors is provided			
N.2.12	Everybody is willing to help			
N.3.10	Teamwork/team-build session once a year – it is a good thing			
N.3.13	Teamwork and learning is interdependent			

O.3.5	Practical problem-solving exercises to build/strengthen the team are suggested			
O.1.3	Teamwork facilitates communication and restricts misunderstanding			
Q.1.5	People understanding is important within a team			
R.1.16	Teamwork enhancement workshops aid team work and relationships			
R.2.2	When assisting with training in a team, team members gain insight into their influence on human behaviour			
R.3.10	Teams need to be educated in terms of teamwork			
R.3.11	Teamwork enhancement programmes are suggested to enhance teamwork			
T.3.4	Annual teamwork enhancement workshop influences the team positively			
U.3.5	Discussing mistakes brings a team closer together			
V.1.11	Teams see teambuilding as a good thing			
V.1.12	Teams rely on organisational support in team build efforts and are discouraged when let down by the organisation			
V.1.13	Team building addresses personal relationships			
Y.1.3	Ideas are generated at ATC team build workshop			
Y.3.2	Sharing with the team of own experiences is motivated			
Y.3.6	Team building workshops must involve all levels, not just the seniors			
Y.3.8	Team building workshop decisions must be monitored back in the workplace			
Supportive transcript extracts				
There are splinter-groups within the team, splinter-groups but they are good groups. It is the way the junior to put forward what has happened and then to analyse it – because they won't approach senior people – they do not have the confidence to do that (D.3.7). *The only formal thing we do have is at the beginning of the year, we have a weekend where we go out and have a work-function type of thing. It goes over a*				

whole weekend where we discuss specifically what are we going to do, who is in charge of what?, what is our goals?, what do we want to do? – so in that case … it is a very nice thing, it is only once a year, I don't know if we should do it more than once a year, but it is a nice thing - just to get together and build the morale of everybody; its very, very nice (N.3.10). *… what I am trying to say if the approach is collective, it tends to help the team a lot. Last year we went to (ATC workshop/team-build), so we came up with the ideal that OK, controller X do this …(Y.1.3).*				
A.3.1	Learning from experience takes a long time	Learning transmission	Operational training characteristics	Team learning
A.3.2	The only shortcut in learning from experience is the willingness of people with experience to share these experiences			
A.3.3	Story telling is viewed as an effective means to communicate experiences and to ensure learning from experiences			
A.3.5	Discussions are also used to promote learning - these discussions emanate from identified trends or known future events		(TLG)	(TL)
A.3.6	A team needs to do more than (listed items are main learning interventions): de-briefs; formal continuation training events; and written tests in order to have a lasting learning impact			
B.3.12	Briefing information not documented			
C.2.2	On position you learn by asking other controllers			
C.3.4	Learning from someone senior supervising during a shift			
D.3.2	Individuals need to be approachable and open to suggestions			

D.3.3	Discussing different work situations			
D.3.4	Discussions are very, very informal			
D.3.5	Discussion helps one to recall previously learned and not used information			
D.3.8	Informal work-related discussions – discussing what happened during the week is supported and valuable			
F.3.13	Learning by means of workplace interaction is important			
G.3.3	Learning takes place by talking			
H.2.3	Talking about incidents and discussing occurrences			
I.3.5	Seniors share experiences			
O.1.8	Interaction takes place within the workplace			
O.2.5	Understand how others think and reason			
P.2.2	Asking questions to controllers aids learning			
P.2.3	Analysing other controller's periods			
P.3.7	Other points of view are encouraged			
Q.3.5	"and there I was" scenarios are shared			
Q.3.7	Incidents and errors should be discussed in an environment free of victimisation			
U.2.3	I will ask for people's opinions			
U.2.4	I will ask for assistance			
Supportive transcript extracts				
Discussions are very informal, very informal. Between approach controllers they will discuss what happened. It happens a lot of times; especially after a weekend especially when some of the junior oaks were working alone in tower. Then on Monday he will debrief you on what happened the weekend (D.3.4). *… they do this weekends away and stuff – I have never seen this here. Or I don't think they do that. But I think it is by …talking. That is how I think (G.3.3).*				

Experiences are shared with … "and there I was" … experiences we put more in line by … its more by word of mouth (Q.3.5).				
A.2.4	Working within a team allows one to learn and often adapt to others' controlling, coordinating and communication techniques and preferences	Encourage-ment	Operational training characteristics	Team learning
A.3.4	Story telling must be interesting and the spirit of delivery must ensure mutual respect and not only be directive in nature			
C.2.3	Learning is directed by the ever-present safety objective			
C.3.1	Willingness to learn from others with more experience		(TLG)	(TL)
C.3.5	Willingness to learn from others' experiences positively influences team communication			
G.2.4	It is satisfying to teach someone else something			
N.2.13	Respect in interaction is important – personal respect			
R.1.10	A freedom to consult with other experts/sources of knowledge exists			
T.3.5	People are more aware of each other after these workshops			
V.1.2	If people know each other also at a personal level then teamwork may benefit from it			
Supportive transcript extracts				
… especially if you are alone up there to be comfortable enough to phone an approach controller and say … "I don't need you to come out, but I need you to explain to me what to do now, this is my situation" (R.1.10). *… if you know someone here; when I got here (period) ago the people I started to know, my work people, are also sort of your friends. Either if you, you know, like them or not you get to do with them on more than one level, not just at work. You always see them after work or wherever. As you get to know the people, I think when a crisis hits then there is a bit more … teamwork between the people. It is more intense than if you don't know the people as such. That is just on the human emotions part (V.1.2).*				

A.3.24	Spatial distance may negatively impact upon team learning results	Inhibitors	Operational training characteristics (TLG)	Team learning (TL)
G.3.4	Due to status differences participation in potential learning conversations is at times reserved/withheld			
I.1.2	An instructor losing the picture has a negative impact on student learning			
Q.3.10	An openness to discuss work issues is necessary			
Supportive transcript extracts				
Experiences are only discussed in formal training, … I think the people are too afraid of discussing especially … because if you are going to say I really messed up today, you have to be a very positive person to get that forward, before anybody investigates you. I wouldn't say there is an openness, definitely not. It sometimes gets out, for training purposes, … continuation training (Q.3.10).				
B.3.10	Social interaction used to talk about work events	Socialising	Learning environment (TLH)	Team learning (TL)
G.3.12	Social interaction due to status differences is not always easy			
G.3.13	A relaxed environment (such as after-hours) supports informal learning discussions			
J.3.17	Social interaction is adequate but does not play a very important role			
K.3.2	Social interaction at work allows for work discussions			
K.3.6	Socialising do take place as a team			
O.2.8	Work discussions continue at social events			
R.1.15	Team social events contribute to team building			
R.1.18	Social events contribute to a positive team attitude			
S.2.5	You want to interact socially with team members when the team is performing well because you feel closer to them			

S.3.10	Social events allow for discussion of personal and work issues			
T.3.11	Social events help with mutual understanding amongst team members			
U.3.12	At socialising events little work is discussed, which I prefer			
U.3.13	Socialising is good because people get to understand each other better			
U.3.14	Socialising strengthen mutual respect			
V.1.1	You tend to get to know team members outside the workplace			
V.1.8	Social activities strengthens the team			
V.1.9	Social events must be supported by the whole team/all members			
V.3.3	Sharing of experiences is important			
V.3.5	Socialising is important for the team because it brings people closer together			
W.2.11	Social events serve a good team purpose			
W.2.12	Team outcasts/trouble makers are ignored at social functions			
X.2.15	Socialising strengthens the team			
X.2.16	Social interaction leads to being more comfortable with each other and status differences tend to be less prominent as a result of socialising			
Y.2.8	Work is not really discussed at social events			
Y.2.9	Status differences are observed at social events			
Supportive transcript extracts				
You can't do everything as a team. People don't agree; if work is finished then work is finished – I like to mix with the people after-hours as well because that is mostly where you learn or get to know people (G.3.12). *Work experiences are discussed at these events. What we did once is to get (person) to come and work so we could go out and discuss issues, or whatever. It is difficult here because it is not like other bases where there are days that there is not flying ... (S.3.10).*				

Teamwork wise I think there should be more social events, … I am focusing more on social events because that brings people closer together … it doesn't matter if you like someone or not, it is always better than not to do anything social at all. Because I don't think it is happening at all due to some lack of interest. A lack of interest in other, … I will rather say … I will try and take the angle of social events to first get in touch with each other, and then from there on together, work related as well, … to do more formal stuff. I mean if I know I have to go and sit to study on my own for a test tomorrow it has got to be worth then if I have one of my friends that can study with me but we know that we got to do this thing together. So, it is obviously going to be more of a bit of motivational … if I know that I will do it the right way (V.3.5).				
A.2.9	A concerted effort/intent exists in terms of capturing workplace-related learning events into SOPs for reference in future (future teams) – thus ensuring the survival of the team output, although it may not be the same team members in future This assists in re-learning and new learning of past experiences	Involvement	Learning environment (TLH)	Team learning (TL)
B.3.2	Learn through others' experiences			
B.3.3	Asking others if understanding does not prevail			
N.3.6	Formal training days are used to revisit theory			
S.3.2	Examples and experiences are shared			
S.3.3	Errors are recorded/documented			
S.3.4	Experience and knowledge are shared			
T.2.6	A freedom exists to approach people who differ from you for further explanations			
U.3.6	Experiences are shared during briefings			
W.3.2	Willingness to obtain and share experiences			
Supportive transcript extracts				
With their experiences we learnt how to work with them, how to handle them. … if something happened we ask (B.3.3).				

So that if someone is not there in the meeting he can go and read it afterwards and also know about it. It is important to share your experiences and knowledge, especially in our environment situations repeat each other. So, next time someone can be slightly more prepared than you were … which can also help (S.3.4). … its not because I have a lot of say, its because I say the things I want to say. But I don't think with my experiences … because I don't see myself as one with a lot of experiences being at this unit for the last so many years. But I can speak to people that has had (aircraft type) in their circuit and things like that (W.3.2).

D.1.5	Good teamwork assists with controller training	Dynamics	Learning environment (TLH)	Team learning (TL)
N.2.3	Standard of instruction maintained amongst all instructors			
N.2.11	Learn by continuously practicing			
O.2.3	Status difference did not influence learning			
O.3.4	More teamwork sessions are required to function better			
P.3.5	Teamwork need to motivated by seniors			
R.1.17	Not all team members are willing to spend time with the team after hours			
T.2.2	In a team you view experiences through the eyes of others			
T.3.1	Learning takes place by experience and experience examples			
U.3.4	Learning helps to improve controlling abilities and working together			

Supportive transcript extracts

But unfortunately you also get members in the group that does not want to spend time with the rest of the guys because they feel it is their time, … it is the only time that they have with their families and now they have to spend it with members that they actually don't want to. So yes I feel it is a good thing, it does the guys good, they feel good, but unfortunately … (R.1.17).

Obviously when I first arrived here, I wouldn't say I was a totally different person, but as my experience grew I sort of adopted, not principles … I don't know the right word … from other team members … and I would say it influences your personality as positively. You get in contact with other types of personalities and maybe see things through their eyes and not necessarily what you think was the only way of doing things … you get to learn from others and see things through

their perspective. That itself, I think is positive, towards teamwork in general (T.2.2).				
F.3.9	Learning requires a supportive mutual respect directed environment	Facilitation considerations	Team learning facilitation (TLI)	Team learning (TL)
I.2.9	Remedial action with a person who has made a mistake is done away from others			
K.2.4	Team members may be natural ATCs or experienced ATCs – this impacts on the team's performance			
K.3.4	A relaxed environment exists that fosters work conversations			
L.1.5	The atmosphere must never become too relaxed			
Q.2.1	Differences in cognition of team members influence individual learning			
R.3.12	Leadership and team expectations need to be communicated and familiar to the team			
X.2.11	Approaching seniors for advice is done with caution			
X.2.12	I need to be comfortable with the members that I approach for advice			
Y.2.7	Understanding others in the team contributes towards being a part of the team			
Supportive transcript extracts				
For myself, from my past experience sometimes yourself as an individual you work faster than other people … you sometimes forget about that people are a bit slower than you are, and you may be the more advanced; I am not saying am more. You tend to forget that people are not the same , especially when you give instruction … (Q.2.1). *… because sometimes … and that is not what is happening here, … in general that is what I find … is that the group does not understand what the leader expect from them, so it is like … grabbing here and grabbing there … and nobody really understands what is expected (R.3.12).*				
D.3.1	Learning improves teamwork and teamwork improves the service	Value	Team learning facilitation	Team learning
F.2.4	Openness/freedom to discuss work problems with colleagues			

I.3.8	Remedial action is freely shared/stated		(TLI)	(TL)
J.3.5	Learn from seniors			
N.3.7	Occurrences are documented in the quality circle book			
N.3.8	Red tag system is used to maintain standards			
N.3.9	Revisiting documented information takes place			
T.1.9	Team members embark on coaching efforts			
T.1.10	Team members don't feel threatened to discuss work issues with seniors			
U.3.7	Experts in the team are identified and approached when required			
V.2.1	Role models exist within a team			
V.2.14	Resources with a lot of knowledge are in the team			
W.3.7	Experts in the team are consulted by members			
Y.3.3	Seniors like to share experiences			

Supportive transcript extracts

We have got a red tag file specifically … we will show them … we will write in and you have to read it and sign it, all of us. So, in that case we all know this is now the set standard; this is what is serviceable, this is what is not (N.3.8).

The experienced guys .. I'll say with extra coaching especially in their initial validation phase, I'll say extra coaching and maybe extra lectures and maybe an extension on hours needed to validate. I think this … the CATCO has got an open-door policy and as well as the seniors in the tower … what I have found is the students … they came out of themselves and approached the seniors (T.1.9).

If there is one thing that they love it is when a junior asks a senior to help you with something, to share his experience. I can mention a lot of them. For instance they love to share their experience …"when I was in this place and that place …". It does help a lot … (Y.3.3).

Compiled by the researcher

Table 5.10 Results: Impact of teamwork on air traffic control workplace performance outcomes

Alpha-numerical codes	Summary of narrative codes derived from actual statements	Descriptive key terms	Subcategories	Categories
A.1.2	Team members fulfil team roles	Team roles	Team work characteristics (TMA)	Team performance (TP)
A.3.14	Breakdowns in team plans/performance can be the result of different team roles (controller positions) where one controller perceives the other as more important			
F.1.2	Understanding work roles and their influence is important			
G.1.4	Team roles are not only ATC-focused but also supportive (admin) roles are fulfilled			
L.2.7	Other roles need to be fulfilled (non-controlling like admin)			
N.1.3	Other tasks need to be performed that support the team			
P.1.1	Teamwork supports the different ATC positions			
A.1.2	Team members fulfil team roles			
Supportive transcript extracts				
Each guy has a very defined role to play in the team (A.1.2). *The same with the coordination between approach, ground and tower and how they influence each other in the actual flow of air traffic as it may be. It has a great influence on the outcome of the whole, call it, flying safety as well as the actual flow of air traffic et cetera (F.1.2).* *Other types of things – you are the junior you have to sort out the (administrative tasks). I don't expect the (higher rank) to do it because he has got things on his hands that I am not capable of doing yet (L.2.7).*				

A.2.7	Team leadership is not dictatorship	Power base	Team work characteristics (TMA)	Team performance (TP)
R.1.1	Understanding of each others' roles is essential for good teamwork			
O.2.11	Team members require leadership support			
R.2.9	Team leader deals with negativity issues primarily			
X.3.4	The need for someone to stand up for the team is voiced			
Supportive transcript extracts				
… being a Chief Air Traffic Control Officer is not a dictatorship (A.2.7). *The Chief Air Traffic Control Officer is our manager, section head, so we refer to him if I detect or any of the other members confront me that there is another member with negativity. So, we usually follow the route via the Chief Air Traffic Control Officer (O.2.11).*				
A.3.13	New team members often think of their own individual role and not of the team's function	Individual focal point	Team work characteristics (TMA)	Team performance (TP)
G.3.6	You must know your job and you must stick to your guns			
G.3.15	You cannot always change other people, you have to change yourself			
H.2.8	The service that you provide needs to match the team's level of service delivery			
I.3.3	Team knows of my difficulties			
M.3.1	You have to be willing to practise to be/strive to be perfect			
M.3.11	When you work you work as an individual			
O.2.9	Personal issues are observed/sensed and then discussed with the member(s) concerned			
P.1.10	Individual confidence is an important trait in ATC			
Q.2.3	People without experience force the team towards an individualistic work approach and do not support the collective effort			

S.1.2	Personal issues should not influence work			
V.2.8	Home/personal issues influence teamwork			
X.3.7	You have to get yourself out of your negative mindset			
Supportive transcript extracts				
You must feel confident that if you make a decision and something queries you or someone queries you - you must be able to say "no", "I will stick to my point or decision because of…" (G.3.6). *… he or she first has to think and make a plan to fit this traffic into his existing pattern, which creates a bit of delays and time to think about what to do with the guy also does not display a lot of confidence in abilities towards the pilot which I feel is essential (P.1.10).* *You know that you cannot become negative because you have a license to protect. It is you work it is your job, this is what you do. So somehow, you get yourself out of that mindset, … you, yourself (X.3.7).*				
A.3.16	In an ATC team one cannot only think of oneself and forget the team	Synergy	Team work characteristics (TMA)	Team performance (TP)
A.3.22	Fellow-controllers need to at an early stage emphasise and reinforce that members are all part of a team			
D.1.6	Common effort to provide a good service despite limited individual experiences			
H.3.2	Incidents (not the member's mistake) strengthen the team against outside attacks			
J.1.5	Rely on other people to assist			
J.1.11	Everybody has to be part of the team			
J.3.1	Once you qualify you are welcomed as part of the team			
L.3.5	Standing together against outside threats strengthens the team			
M.1.3	We understand each other			
N.3.14	Teamwork builds camaraderie			

S.3.12	An ATC team requires team persons			
S.3.13	People who do not fit into the team will eventually conform			
S.3.14	New members may take time to fit into the team			
T.1.7	Teamwork leads to esprit de corps			
W.1.5	Effective teams create a sense of pride and belongingness			
Y.1.1	A collective and effective approach is required			
Supportive transcript extracts				
You need to understand and people need to point out from a very early stage that you are part of the team (A.3.22). *Whether is it the ATSA printing the strips or the approach controller clearing an aircraft on the ILS … everybody has to be part of that team (J.1.11).* *So, if you work together as a team, a good team, … I mean eventually it is teamwork, I mean it is good or not good. When it is a good team working we sometimes call them, jokingly, the A-team (W.1.5).*				
C.1.7	Relations with fellow team members can be good or not so good and these relationships influence cooperation accordingly	Team relationships	Team work characteristics	Team performance
E.3.8	You must know your stuff before you can work successfully with others			
H.2.7	You must show interest in other people		(TMA)	(TP)
H.1.4	No negative feelings			
O.1.7	Unit's team is described as a close-knit family			
P.2.6	Sharing and displaying interest strengthens relationships			
Q.1.1	Good relationships within a team contribute to a good service			
S.2.8	Personal relationships are important for teamwork			
U.1.3	People who have a good relationship and mutual understanding elect to work together			

X.2.1	Preferences to work with certain team members are expressed			
Supportive transcript extracts				
And all depends on who you are working with, because if you have good relations with someone … then you are open to things; … rather than I am not too comfortable working with this guy so I am not going to bog him unnecessary or ask him this or that – he may just come down on me. But with someone else then you feel comfortable with the person then you will - "sure you go for it, I have no objections provided so and so" (C.1.7). *The team at this unit is a very close knit, how can I put it … team (O.1.7).* *So, I mean you must make maatjies and like each other to get through your days and years, or whatever, because I mean its not ideal work circumstances that we have got. Its small spaces and lots of people (S.2.8).*				
E.1.7	Information and experience sharing takes place continuously	Experience	Team work characteristics (TMA)	Team performance (TP)
E.3.4	Sharing of experiences take place daily			
Q.3.1	Experience is important if objectives need to be achieved			
Supportive transcript extracts				
Because there is obviously the people with more experience have got more knowledge – which have to be taken down to the junior people as well. It happens, every single day. It is obvious things actually; somebody that knows their airspace very well, the aircraft performance maybe (E.1.7). *OK, obviously if you are a more experienced person and you work in a team and your team are able to listen to you; you can either be the leader or one of the followers – but I think you definitely need experience to achieve your objectives. I mean you can have the knowledge and not the experience, you will not be able to do it, it will take you much more longer (Q.3.1).*				
G.1.6	Members can call on each other for assistance	Team assistance	Team work characteristics (TMA)	Team performance (TP)
G.2.7	Controllers voluntarily provide assistance during an emergency situation			
G.1.7	Assistance opportunities may not be abused			

H.3.3	Incidents (the member's mistake) create opportunities for intra-team support and assistance to the member involved			
H.3.6	Willingness to correct each other			
I.2.2	Team members helped me and supported me to be more comfortable			
I.3.2	Approach others for assistance			
M.3.8	After absence from work the team ensures that you are brought on par first			
R.1.14	Team members must illustrate that they will ask for assistance when required before such members will be trusted by the team			
S.1.5	Support in terms of diversity is also important			
S.1.8	Teamwork is also supporting one another			
V.1.6	Team members look out for one another			
Supportive transcript extracts				
… it depends on the request. You must not then assume that because there is a lot of people sitting downstairs you can just call because you can't sit or you don't want to sit. Then it tends to get, …it must really be something that cannot prevent you from doing your controlling for that two hours (G.1.7). *I have met quite a few friends here and other people I know which is people but it is not your friends. So, it could have been; I can't actually remember exactly who; but it could of have been my best friend and my other best friend that were coincidently on their different positions and that we were looking out more for each other than for instance just doing your job. I don't know … I think it is just that they knew we were in a difficult situation concerning our (resources) and the people just went out to help as far as they could. I think in normal circumstances it would be like that in any case (V.1.6).*				
H.3.5	Constructive feedback and assistance is provided by seniors	Teamwork criticism	Team work characteristics (TMA)	Team performance (TP)
V.2.3	Controllers critique each other's work			

Supportive transcript extracts				
But also I know for instance that the senior controllers will always try and help you when they give constructive criticism if needed they will never try to down-grade your controlling; they try and help you as far as possible in a good way (H.3.5). *Say for instance at (another ATSU) I saw that everybody was sitting upstairs listening out on the frequency that the controller was controlling on and as soon as one of the people make a mistake or whatever, everyone is there to listen out on that frequency, so everyone is quick to jump on the wagon and say "this and this". But as soon as they go and sit there they all of sudden know that they are also exposed as well (V.2.3).*				
G.2.1	Freedom to express uncertainty	Conformity pressures	Team work characteristics (TMA)	Team performance (TP)
H.1.6	There is a willingness to work			
K.2.2	Individuals expect reward from teamwork			
Y.2.4	Interest in what you are doing is valuable			
V.2.9	Members are irritated when there is no controlling work			
J.1.14	Personality differences do influence teamwork			
L.1.8	New people have to prove themselves in order to gain team acceptance			
L.1.10	Stress is caused by tempers that in turn negatively influence teamwork			
L.2.5	Found it easy to fit in because I knew my place			
M.2.5	Pressure on the team leads to better team performance			
P.1.2	Inadequate teamwork leads to poor controlling			
P.3.6	Slip-ups must be dealt with diplomatically- we are very touchy people			
Q.1.7	Each member in the team must be able to handle pressure – if not the team effort suffers			
Q.2.4	Involvement of people in team projects allows for better team results			
R.1.13	Teams hardships and the past are regarded as important			

R.2.1	The team does not automatically accept newcomers			
T.1.2	Teams consist of people sharing a passion, interest			
T.1.3	Good teamwork makes the team efficient			
W.1.4	Newcomers need to adapt to the team's way of doing things			
W.2.13	Newcomers to the team find it difficult to change the team, normally the newcomers eventually adapt to the team			
X.2.7	You have to remain in practice to ensure competence			
Supportive transcript extracts				
Say for instance when a new person arrives at the tower … you first have to get to know that person to know what he means when he says something … exactly how he expresses himself. Everybody is a bit guarded when any new person enters the tower because the team is so closely knit. As the people open that teamwork element opens up (L.1.8). *I have always liked to see myself being art of a team and … like I said to you the first time … I believe that when you are on a team the performance, when it starts getting more hectic or more pressure gets put on you, you start performing better in a team (M.2.5).* *(Person) coming from (another ATSU) and with (another person) and they have to adapt to the (this ATSU) intensity and how we speak to each other here. We, if I with (another person) I'll just press the intercom and say "yours" and he will know exactly who, where, what and when … it is one word (W.1.4).*				
E.1.1	Work environment dictates teamwork	Teamwork environment	Team work characteristics (TMA)	Team performance (TP)
K.1.4	The environment is comfortable and supportive			
K.1.5	Teamwork creates a calm and relaxed environment			
S.1.3	A happy environment must prevail			
Supportive transcript extracts				
It is a relaxed environment and authority is still there and I think … it is the best way I can explain it … be comfortable, trust each other, rely on each other and				

therefore we can have a good influence on ATC. Either way it goes, from tower to approach, from tower to ground (K.1.4). *I think also, keeping each other happy … your work environment must be happy, you must feel no threats or vibes between people (S.1.3).*				
G.3.5	Status differences do not impact on your work performance	Status influences	Team work characteristics (TMA)	Team performance (TP)
L.2.10	Status differences do not impact on learning			
R.1.11	Status differences do appear to influence teamwork			
V.2.7	Status differences can negatively impact teamwork			
W.1.6	Teamwork breakdowns may be the result of status differences			
W.1.7	Control positions are emphasised rather than the status of the person occupying the position at the time			
W.1.8	Controllers should not budge easily in terms of status influence			
Supportive transcript extracts				
But I think it is a personal thing - doesn't matter of your rank, doesn't matter who you are if you take control of your two hours its yours (G.3.5) *I think rank is sometimes a very difficult thing to be comfortable with, … but that is part of the military unfortunately … (R.1.11).* *… I don't care if it is a (higher rank) sitting down at approach, … if he doesn't have the picture of what is going on in my circuit, he cannot force me …luckily I am one of those people who don't budge easily, I know that I am working with my license. I do believe that the rank structure mostly, … and the fact that under our (number of higher ranks) that we have and even still today after these guys have been transferred in … are struggling to sort each other out; fighting still for their place in the whole structure (W.1.8).*				
A.1.6	Information is drawn from whoever is the strongest in that specific expertise level	Learning	Team work characteristics	Team performance
A.3.25	Controllers fulfilling different roles and that have different levels of experience need interact in order to strengthen the team and to enhance learning			

E.1.6	Strong practical/experience based requirement in the workplace		(TMA)	(TP)
N.3.12	Humour is used in learning			
O.2.4	Learn by observations			
P.2.1	Learn by observing other controllers at work			
Supportive transcript extracts				
They will explain it to the person and from there the person will learn. Obviously a very much, … experience – there is a very big learning curve from experience. It is the same as theory; you still have got your theory basics but it is not the practical things. When you do it practically then it is not quite same as the theory. You still have the basics yes, but you still have got to do the practical phase (E.1.6). *(Further ATC scenarios stated and sometimes people mock him for his actions) – It doesn't hamper professionalism it hasn't bothered me; it is a good thing, it take builds like morale – everybody laughs and stuff; and laughter is the best medicine. I wipe it off my back, I don't have hassles, it is building camaraderie. If you it seriously then there is something wrong (N.3.12).* *I basically just pay attention to other controllers when they are controlling. Not to do fault-finding or anything, but to learn from the way other people do it (P.2.1).*				
G.3.19	Personal differences must be addressed	Team conflict	Team work characteristics (TMA)	Team performance (TP)
J.1.13	It is necessary to address the role/position not the person			
J.3.8	Forced ideas are not readily accepted/supported			
J.3.9	Another problem – I am better than you!			
N.3.11	Freedom to confront each other regarding work issues			
Q.2.8	Personality clashes are detrimental to teamwork			
Q.2.9	Individuals may avoid each other due to differences			
Q.3.8	Corrective/remedial actions should be performed in a constructive manner			

Q.3.9	Fellow team members need to be observed in order to ensure that the team effort and objective is achieved			
Q.3.12	There should not be any doubt about a fellow team member's experience			
Q.3.13	Senior team members must be experienced to fulfil the senior roles			
R.1.2	Understanding of team roles helps to reduce personality clashes			
R.1.3	When team members feel they still have to prove themselves this can have a negative impact on team performance			
R.1.4	People who do not get along on a personal level have difficulty accepting criticism from one another			
R.1.7	Supervisor role helps to alleviate/address conflict amongst team members			
T.2.7	Conflict in a team is managed by means of conversation/discussion after an occurrence			
U.1.1	Conflicts that are not addressed/managed in an effective manner impact negatively on team performance			
U.1.2	People with differences/conflict choose not to work together on shift			
V.2.6	Conflict can have a negative impact			
W.1.9	Senior members may attempt to divide the team to benefit those senior members – thus creating tension			
W.1.11	Tension in the work place is the result of people's mixed emotions, tempers rising, poor concentration			
W.1.12	Conflict is managed in a mature manner by discussion			
R.1.8	Victimisation is reduced by the supervisor presence and activities			
Y.1.4	Sarcasm in the team is not good			

Y.1.9	Spitefulness does not do any good for a team			
Supportive transcript extracts				
Rather than like helping that person, and saying –"this is what is going on, lets sit together and I will show you how to do it, and you can do it on your own". The approach is, I would say, is totally wrong, definitely; it is not just spoon-feed everybody but not everybody tends to understand something in exactly the same way (Q.3.8). *What I have experienced here before was, when working on a certain position and, it has happened to me, where you have a conflict with one of the people working at a different position … it became to such an extent that the person jumped up from that position and came over to me and was shouting at me and then went back to his position. And then obviously after that you don't feel the same any more … you are not providing the same service any more …you are not concentrating any more, because now you are upset about what happened and when it comes to the coordination then the coordination is not what it should be, so the job don't get done the way it should get done, because of the conflict between you and the person or whoever. At that time it had definitely an effect on my controlling and an effect on the other person's controlling as well … that's on the negative side of things (U.1.1).* *I think it is difficult, in my opinion, most of the ATCs all have strong personalities. They tend to clash, whenever you take someone on they will take you back on, no one likes to be tapped over their fingers obviously, except if it is by the boss, then you will say "yes sir". If anyone else takes you on if you feel you have a point to stand on then there is strong personality clashes (V.2.6).*				
A.1.7	Team members have different backgrounds and these background differences are acknowledged and utilised to better team performances	Diversity	Team work characteristics	Team performance
P.3.9	Diversity in a team improves the teamwork			
Q.1.8	Workplace diversity issues require attention		(TMA)	(TP)
R.1.12	Diversity is managed to the benefit of all			
X.2.13	Lack of diverse sensitivity does not influence the work output			
X.2.14	Survival in terms of diversity at a personal level requires adaptation			

Supportive transcript extracts				
I think the diversity of the team improves teamwork quite a bit … I think it has a huge impact on the quality of teamwork, because if, … taking myself … if I didn't have the freedom to address which I perceive as a fault or a problem on a senior controller's side being rank or controller wise, then that input will never be put on the table, it will never be discussed, it will never be implemented or changes made to the process or to how things are done (P.3.9). *… what is definitely a shortcoming is people converging them, basically working together is the black personnel, which I am not criticising at all, it is actually a great bunch of people here, but they don't actually feel part of the group at all. Now I don't know if it is a cultural diversity or something else, but they are more bothered with each other than with the rest of the crew that is not of the same colour (Q.1.8).* *We work together quite nicely but socialising I think we are not adapting to each other; you can still see the coloureds here, the black people here and the white people here. It's a mazed-out situation wherever we go. I don't think it has an influence on the ATC service that we provide … because of the way that we work together, I get along quite well with them here but socially I prefer to be on my side, but in work I adapt and I work with them well together. I think they adapt as well. At work we are fine (X.2.13).*				
A.3.8	Team work problems mainly occur at the communication and coordinating interfaces between people	Teamwork problems	Team work characteristics	Team performance
G.1.3	Unresolved errors can be transferred, creating an escalating problem			
I.3.9	Perceived personal favouritism has a negative team impact		(TMA)	(TP)
I.3.10	Cynical comments do sometimes surface			
Q.1.6	Shifting of blame in a team is a shortcoming			
R.2.7	Sensitivity by the team members in terms of feedback provided is observed			
R.2.8	Work occurrences are not always discussed due to fear of negative repercussions			
T.1.6	Negative influences in a team may be culture and personality differences			
W.2.14	The team does not appreciate taking in someone who is going to harm the team			

W.2.15	This team has unpopular members but the team has a way of dealing with them			
W.3.14	Perceived stupidity of team members is not tolerated			
X.1.5	Assumptions in ATC are not supported			
X.2.17	The team dealt with people who misbehaved or experienced problems			
X.3.5	Team becomes negative if error disparity is evident			
X.3.6	Negativity is not allowed by individuals because it impacts on your own responsibility levels			
Supportive transcript extracts				
… maybe people are under pressure, they like more eager to put the blame on somebody else; other words if they had a bad day they get influenced to make it more miserable to other people as well. Then you can't work as a team (Q.1.6). *Negative points that might influence the outcome of the service we provide is personality clashes although we have more or less the same passion and more or less the same personality there will be personality clashes. We have different cultures in our team so ... besides that I cannot think of any other negative things (T.1.6).* *… it was not a problem but the next day in the briefing the CATCO made it clear that you've got to stipulate in saying, you can't assume that "it doesn't matter to me" - for that student in the aircraft it is a problem (X.1.5).*				
A.1.1	Individual's realisation of teamwork	Team member focus	Self-efficacy	Team performance
A.3.18	Younger/new controllers are restricted in their thoughts – they think ATC (individual focus) and not ATM (team focus)			
G.1.9	Never rely on someone else to back you up, they will not be there when you are working alone		(TMB)	(TP)
Supportive transcript extracts				
We obviously know that it is a team and it has to operate as a team - it is the only way (A.1.1).				

You must never rely on someone else to back you up. If you can do something to improve yourself which will make the team better you must do that also. Otherwise you are just going to depend on other people to do the job and you are just going to sit behind, then get behind as well (G.1.9).				
C.1.1	Dependency on each other (controllers and control positions)	Collective focus	Self-efficacy (TMB)	Team performance (TP)
S.2.6	Teamwork forces a move from you, as individual, to the team (collective)			
V.1.4	In difficult work situations team members support each other proactively			
Supportive transcript extracts				
If you work in a team you must learn to … you are not number one any more I mean if you work for yourself you must now step back and think for fifteen people and not for one. I mean I cannot come to work and say lets do this and this … you must now think …"will this person want to do this and this?" So, you must … your thoughts must change, it is not just you … you must … it is not going to affect you it is going to affect 15 other people. So you must stop thinking about yourself; actually you can't think about yourself in that sense (S.2.6). *OK it was just the fast organising of everything. They got the people out even before we could double-check or if some of the stuff was done, it was already done. And you know that as soon as you call on someone, it has already been done; "don't worry can I help you with something else?" (V.1.4).*				
C.1.6	The deciding factor is safety	Safety concerns	Teamwork activities (TMC)	Team performance (TP)
E.1.2	Safety objective stated			
F.1.4	Coordination supports the team objective - safety			
G.1.1	Common team objective is aircraft safety			
I.1.1	Teamwork positively influences the ATC objective			
J.1.4	Cooperation is essential for safety			
N.1.8	It all goes about flight safety			
O.1.2	Safe orderly flow of traffic			

S.1.4	Safety focus is important			
Y.1.11	Safety focused			
Supportive transcript extracts				
Obviously it is teamwork because you have to work together to get the aircraft safely in the air as well as on the ground (E.1.2). *Basically, if you have got good teamwork you can make the air traffic flow in a positive way and timely fashion (I.1.1).* *… I mean there mustn't be vibes and stuff , you must all make each other happy to have a safe flying environment (S.1.4).*				
A.1.3	Strengths of team members are known and resources are utilised accordingly	Team planning	Teamwork activities (TMC)	Team performance (TP)
A.3.17	Review of team plans relies upon input (verbal) from the team member that is experiencing difficulty during a work period at that that stage			
A.2.3	Depending on the other controller's actions, one needs to be flexible to change own plans			
C.1.3	One decision influences the quality of the next controller's decision			
H.3.4	People and processes change			
J.1.6	Teamwork relies upon a systems work approach			
J.1.8	Activities are interrelated and dependent on one another			
N.1.6	Controllers are willing to change their plan to accommodate your requests			
Q.2.5	Teamwork allows for better work distribution			
R.1.5	The use of team supervisors assists with teamwork and team performance			
R.1.9	Work processes are aligned to support teamwork			
Supportive transcript extracts				
One of the roles is to tell me when it is getting too much. You need to tell me, you need to understand that it is your role and that it is not a personal issue, the traffic plan is not working (A.3.17).				

If I need some help over here, say now a guy is flying (ATC procedure described) … then approach is more than happy to help me out in that case – that is good teamwork I reckon. And you know … it always happens that they will help me out (N.1.6). *… used one of our personnel to reduce the workload, but actually got shifted away from you it is worries that is taken away. So, definitely to get more team members involved … qualified members … you will definitely get all the workloads, … much of it will be, how can I put it … spread more evenly(Q.2.5).*				
A.1.9	Customer service relies upon experience sharing and experience sharing shapes the quality of service delivery	Team outputs	Teamwork activities	Team performance
B.1.5	Professional service relies on teamwork			
D.1.4	Professional focus maintained		(TMC)	(TP)
G.1.8	You must ensure that you are fit and capable to do your job			
H.1.7	People want to work and assist/contribute			
H.1.8	Service is not hampered by physical distance between controller stations			
K.1.10	It is important not to compromise professionalism for friendliness			
K.2.1	Individuals strive towards higher standards at the individual and collective levels			
K.3.5	Despite team differences we all share common goals			
M.1.2	Work has priority			
N.1.7	A need to portray an image of good teamwork			
O.2.10	Negativity is sensed but it does not influence the team's outcome			
O.3.3	It is an integral part of teamwork to improve service			
P.1.3	Everybody is working towards a better service			
V.2.2	You always strive to be professional			
W.1.1	When control positions work effectively together then service delivery is more effective			

W.3.1	All team members share in the teams responsibility			
W.3.4	Team members need to check and check again what they are doing			
W.3.5	Team members must make doubly sure that what they are doing is correct			
W.3.13	Team members cannot be fearful of the work			
Supportive transcript extracts				
Professionalism is expected – you need to do your job as trained, even better. He must strive to do his utmost, his best, be professional. Thus enabling the approach controller, which ever person, or in team context, to do their best – thus performing at 110% (D.1.4). *OK, you get two ways – the bad way – the team can be substandard and you are working above the teamwork and sometimes that is frustrating because if you are juniors … you are working at a standard that just reaches the bare minimum, but you want to work at a standard that achieves maximum professionalism, effort and get reward out of that – with you appreciating the reward (K.2.1).* *Basically on a daily basis your teamwork … who is doing … everybody knows what is going on elsewhere and therefore can provide a better service(P.1.3).*				
A.3.23	Spatial distance in the workplace tends to create an us and them scenario that is not favourable for teamwork	Team coordination	Teamwork activities	Team performance
D.1.1	Teamwork is a day-to-day constant working relationship			
I.1.3	Controllers at times ignore the intercom, making coordination difficult		(TMC)	(TP)
W.1.2	Coordination between positions is essential			
X.1.1	Coordination plays a big role in teamwork			
Supportive transcript extracts				
Positive way; if you want to contact the approach controller when they are sitting downstairs, especially now the last time that the (aircraft type) was here and trying to get departure clearances or basically just to tell them something has started and sometimes they ignored us. Especially the ground controller because according to them the aircraft is safe on the ground and doesn't have a problem; it is only when it becomes airborne that it becomes a problem. You know, so				

what they sometimes did was ignore the intercom system and aircraft had to be delayed due to this (I.1.3). *… because sometimes you work with a guy, when (person) just came here and what I saw now when I went to (another ATSU) the teamwork there is absolutely like there is no coordination between approach and them, approach just dumps aircraft (W.1.2).*				
B.1.1	People voluntarily assist to fulfil vacant needed team roles	Duty responsibility	Teamwork activities (TMC)	Team performance (TP)
B.2.4	Pushing oneself to be better			
B.2.8	Ability to multi-task is important			
E.1.4	Picking up mistakes and correcting them is essential			
M.2.7	You always want to be professional in the service that you provide			
M.3.7	You can rely on support from others/supervisor			
N.1.1	Everyone likes to be part of the action			
N.1.4	I am free to ask for assistance and receive it			
P.1.6	Realisation by all of the importance to comply with ATC taught practices/rules			
P.3.2	On position the controller accepts all responsibility irrespective of status			
R.3.13	Team objectives must belong to the team, not simply following meaningless organisation objectives			
R.3.14	Realistic team objectives supports effective teamwork			
S.1.7	Business as a controller forces you to focus on the work			
T.1.1	Teamwork emphasises efforts to achieve a common goal			
T.1.4	Teams realise that errors can be made and are aware thereof			
U.1.5	Teamwork is essential for ATC			
U.3.15	The work is always bigger/more important than the personal conflict issues			

V.1.3	Effective team members know their procedures and work			
W.3.16	You must have the maturity and freedom to confront others and the situation			
Y.1.6	You are ultimately responsible for what happens when you control and controllers take this responsibility seriously			
Supportive transcript extracts				
We have controlling positions, there might be a (junior rank) on a senior controlling position or any controlling position for that matter and he is in charge of that position and he has got nobody else who's got any say unless he screws up (P.3.2). *… the juniors saying at the end of this year I want to be … (examples stated) … and everybody knows and works together towards those objectives; because the moment you have common objectives that is important to everybody and not to the system … I think that is more effective (R.3.14).* *… when you are a tower controller, you are in charge in the tower there, so they are good … it's that guy's life. Obviously during emergencies you break all the rules, but the point is when you are a tower controller you are in charge, even if there is a senior controller in the tower and they are distracting you … "excuse me (senior ranks) I can't focus here, do you mind going downstairs?" (Y.1.6).*				
E.1.5	In correcting errors you may need to approach a colleague	Team communication	Teamwork activities (TMC)	Team performance (TP)
E.1.9	Controllers do not accept unclear situations – they will ask for clarification			
E.2.5	Questioning work procedures			
E.2.6	Clarify uncertainties and a freedom to ask for clarification			
E.3.1	Controllers are expected to trouble-shoot each other's controlling while on shift			
F.3.6	Innovative solutions are shared, however, not very often			
I.2.4	People will tell you if you made a mistake			
J.3.6	Unwillingness to share leads to isolation of the team – being pushed out			
M.1.7	You are well tuned to other controllers – what they are doing			

M.1.8	When very busy information may get lost			
X.1.4	People differ in the manner that they communicate (phraseology)			
X.1.9	Controllers are willing to ask for assistance when controlling			
Supportive transcript extracts				
Innovative things are shared, sometimes they would come up with things that they have learned and things that have happened and was handled in a positive way. They would come up and say – I have found that this actually works for me in this period; that type of thing and there would be a discussion about it. It is not something that happens often (F.3.6). *… I have noticed that the team tend to isolate them, they tend to push them out … you do get this feeling that this person thinks he is better than we are, they don't want to speak to us about it, … and you do have people with a lot of experience that uses it as a power-base. I think that they think that sharing this information will do something to them, their ability to control the people around them, they use it as a form of authority … this information. Or alternatively I think they are just spiteful; there are a few of them and they are out there, but they are very strange (J.3.6).* *Most people say something that is not really unnecessary for instance if there is an aircraft coming into the ATZ for instance, then some people say (different RT phrases by different controllers) – you maybe will see that it is not necessary and the other person will see it as necessary (X.1.4).*				
I.1.5	Geographical separation not viewed as a major problem	Team's work processes	Teamwork activities (TMC)	Team performance (TP)
J.1.2	ATCs from other units are used when situations dictate			
J.3.3	Team members can bring the team apart or break the team up			
K.1.1	Teamwork supports the various ATC functions			
L.1.1	Teamwork supports the various ATC functions			
L.3.6	Transforming the ATC work environment requires teamwork			
M.1.1	Teamwork supports the various ATC functions			
N.1.5	There is a relationship between control positions			

O.1.1	Teamwork supports the different ATC positions			
O.2.2	Team members are encouraged to be open-minded			
P.2.10	You must not try to interfere in another controller's work			
Q.1.3	Cliques may be dangerous to a team – in cliques the focus is on the person primarily and secondarily on the work			
X.2.2	People transferred into the team may have different controlling styles			
Y.3.1	This requires from you to be flexible in controlling			
Supportive transcript extracts				
Air traffic control is simple, area, approach, the tower and there is the ground controller. Well, first of all if you don't work as a team, for example the tower controller … (K.1.1). *Teamwork is really important. You have to work in a team because … like the coordination between ground control, the ATSA, tower and approach control positions. There has to be a close-knit team in order for the whole system to work properly (L.1.1).* *Teamwork is very important because it is a very interactive work that we do. We have got four positions that you work with, as you probably know, it is ATSA, ground control, if we have, tower control, approach and then also GCA. All of those positions constantly have to understand each other and know what is happening in a situation that they find themselves in at that moment (M.1.1).*				
M.2.3	Supervisor available to assist	Supervision activities	Teamwork activities (TMC)	Team performance (TP)
M.2.4	Supervisor will intervene when required and that is accepted			
X.1.8	Presence of the supervisor may be daunting but it is also a soundboard			
Y.1.2	Supervisors provide advice			
Y.1.8	The supervisor role is advisory			

Supportive transcript extracts				
The SATCO is a non-controlling position, that person is rostered and will only influence your work when they start seeing that you loose the picture and, or either you cannot handle the amount of traffic that is on you at the moment and then that person will take over. Normally the SATCO will just stand at the back and just keep the overall picture and make sure that everybody knows what is going on. He will only intervene when he sees that you are either not seeing something or anything like that (M.2.4). *The team uses it, but sometimes it feels like someone is watching over your shoulder, checking up what you are doing, but sometimes when it becomes hectic you have someone to lean on; you ask – "what do I do now; is it a good decision I made?" (X.1.8).*				
C.1.8	Reflective discussions are influenced by the quality of interpersonal relationships	Personal reflection	Performance reflection (TMD)	Team performance (TP)
D.2.2	After a shift one can reflect on what happened			
G.3.10	Observing others allows you to agree or disagree with actions you observe			
H.2.5	I file information somewhere in my head; others may write it down			
J.3.2	You can see at the different bases what works and what does not			
J.3.7	Teams critically review and react to actions from their members			
K.1.8	After work I review the day's experiences			
K.2.3	Past experience allows for comparisons and decisions			
L.2.2	People making decisions in their own minds			
M.3.4	Controllers ask themselves – how would I have handled …			
N.3.3	We all reflect on occurrences			
N.3.4	Thinking about how to do things better			
O.1.9	Where can we do better			
O.1.10	Through discussions individuals are left with things to think about			

O.2.7	Asking in your mind questions and answering or have answers provided			
P.1.12	I practice things through my mind on a daily basis			
R.2.3	The team forms a perception of its members			
R.2.4	Team members may try to find out for themselves why a certain client perception is being held			
R.2.6	I reflect on the day's occurrences			
T.2.3	I think things over			
U.2.2	After a good period an individual and the team feels good			
U.3.1	Occurrences and associated reflection allows one to evaluate your own performance and ensures that remedial measures are put in place			
W.1.3	Evaluate this team in terms of other team experiences			
W.2.8	I do make use of an internal debriefing session			
W.3.15	Feedback in terms of own performance is important to counter fear and a sense of incompetence			
X.2.9	After a shift I think about what happened			
Y.1.13	After a shift I think about what has happened			
Y.2.1	I had an experience …			
Y.2.2	I was behind the other guys and needed to catch up/meet the standard required			
Y.2.3	You must have a broader mind and understanding of what you are thinking about			
Y.3.5	I think about particular subjects			
Supportive transcript extracts				
I am a kind of a person that everyday after I have worked, whichever position … giving instruction, worked approach, worked FIS … I will think about what I did				

and what I could better … and here I tend to do it even more, I tend to do it a lot more, because we discuss emergencies sometimes in the morning and what somebody did, and then you think, … (R.2.6).

When the shift is over I just relax after that … when something went wrong, or when I am not sure about something then I start going over and over it in my mind (X.2.9).

At times it gets busy … when they are talking … I am thinking about this particular subject and everybody is quiet …. (Y.3.5).

E.3.5	There is always someone looking over your shoulder	Support needs	Performance reflection (TMD)	Team performance (TP)
I.2.7	Approaching others for assistance depends on the quality of the relationship			
J.2.1	Team members need to click			
J.2.5	You cannot work outside a team			
K.2.9	Working in a team has improved my performance			
L.3.7	Social togetherness allows for synergy			
S.2.4	Unhappiness at work can influence relations outside the workplace			
S.2.7	Personal relations are important to counter a non-ideal work environment			

Supportive transcript extracts

I have found that you get a certain synergy in certain groups of people that just click. They work very, very well. Things that happens … you know what the other person is going to do before they do it. Where with other groups you can still work, it is not the system itself failing … (J.2.1).

Teamwork has improved my performance; it has given me alternative ideas to use; it has given me information that I have never known before, sometimes it has given me bad habits as well. … ATC is dynamic, you don't want to stereotype ATC and sometimes teamwork can make you stereotype … you have to think of each situation, no matter how similar, it is differently; I think ATC cannot be stereotyped, it will never repeat itself; no two plans are the same (K.2.9).

A.3.15	Due to perceived differences in status (as a result of team role differences) people doubt their own capabilities and express concern about their individual performances	Influencing performance	Performance reflection (TMD)	Team performance (TP)
A.3.21	Controllers need to understand fellow-team members			
A.3.26	Limited interaction leads to group forming and is not supportive of teamwork			
A.3.27	A strict militarised atmosphere favours groups not teams			
C.3.6	Knowing others' moods and preferences positively influences teamwork			
E.3.9	You learn to adapt to different people's different needs			
Supportive transcript extracts				
If you have a very strict militarised atmosphere that is so ... it is not conducive to people actually picking up. You have to be able to be careful about some things (A.3.27). *It is great working here for one and the people – I think we are a very good team we get along well with each other; it is a fairly new team, so to say also, but we are getting along, getting to know each other – even when someone is not in the best mood and not to do this to that one or this to that one; talk this to that one and this to that one (C.3.6).*				
B.2.5	Observing others handling abnormal situations	Performance occurrences	Performance reflection (TMD)	Team performance (TP)
B.2.6	Being aware of loss of information resulting from others' actions			
B.2.7	Predicting problems in operations			
B.3.9	Observing minority not doing their part			
C.1.5	Inputs from other team members are used or not used. However, the individual ultimately makes the final call			
C.3.9	Informal non-work related discussions allow one to get to know the other person better			

F.2.1	Team has certain expectations concerning new members			
Y.1.7	Supervisor's input is evaluated before implementation of the input is considered			
Supportive transcript extracts				
That is how I learned, I always listen what is going on and what other people are doing. That is why I don't talk about it (B.2.6) *So that he can instruct the guy to go-around. And there was an other member in the tower as well standing and they also elected to push on other than what was taking place - do this, do that. It is information but it is like - use it don't use it! Because at the end of the day it is you are the guy working (C.1.5).*				
G.3.16	Personal differences must not impact on performance	Understanding teams	Performance reflection (TMD)	Team performance (TP)
G.3.18	Teams have reputations that are made known – often not favourable			
H.1.1	Teamwork encourages and allows for professionalism			
K.2.7	Observation allows for subconscious changes rather than instructed/demanded changes			
L.1.3	Different personalities play a role. However, you have to focus on the work			
L.1.9	People who do not fit into to the team are personally but not work-wise segregated			
L.3.8	ATC team viewed as a secluded club			
O.1.4	Teamwork contributes towards professionalism			
R.3.6	The team is concerned about its reputation			
S.3.6	Teams are reinventing themselves as members come and go			
S.3.7	Such team changes/reinvention can be traumatic for members staying behind			
S.3.8	Social efforts help in times when teams have changed			
S.3.9	Social events and participation must be balanced			
V.1.7	Strong teams are proud and regret being broken up			
V.2.13	Friendliness in the team is important			

X.3.2	The team has certain expectations from clients which do not always materialise			
Supportive transcript extracts				
I would say teamwork, our teamwork is rather good because you have got, … it makes the service more professional. Everybody is getting to do the work, and everybody wants to work (H.1.1). *… then there will be misunderstandings; there will not be proper communications, which will then lead to an insufficient service provided to the customer, the pilot. That is why teamwork is so important and not teamwork alone; there must be focused, …it must be professional…(O.1.4).* *… it was the best crew that I have ever worked with; we were all friends. We always used to after hours go to someone's house, even the bosses place or whoever's place and … but in the last (period) that strong link has been broken up. You must build new bonds between people … (V.1.7).*				
H.1.5	You feel wanted	Personal value	Performance reflection (TMD)	Team performance (TP)
H.2.6	You must show interest in the service			
H.3.11	Teamwork in this tower makes me feel proud			
K.1.7	Work satisfaction is important			
L.3.10	I am proud to be part of this team			
S.2.1	A good day at work makes you feel good			
U.2.1	Working in a team can enrich you personally			
V.2.4	I want to be the best and clients must be reassured when they hear that I am controlling			
W.1.10	I like to be happy when I work, because I really like my work			
W.2.3	When working with people of lesser competence my own situational awareness must increase			
X.2.6	Prior to a shift you start to mentally prepare to work with those rostered with you			
X.2.8	Prior to a shift you start to mentally prepare for the work ahead			

Y.1.10	I learned to adapt to other people			
Supportive transcript extracts				
It has the opposite effect, normally it will make you feel dispensable, but in this case it rather makes you feel wanted because the people is willing to help you in a time, …a crisis, instead of just making the job well done (H.1.5). *What is interesting also is that when there is an emergency or when there is something big going on everybody always phones the tower to get the information – its like the people in the tower always knows or is suppose to know. I think our image towards the base and towards the rest of the people is that we are people with knowledge that knows what is going on, people that can make things happen.* *I am proud to be part of such a team. (L.3.10).* *I learned to adapt to other people to provided a safe service … because when I was under training … (Y.1.10).*				
A.1.4	Acknowledgement of specific experience and skills levels/abilities of team members	Performance assistance	Teamwork performance measures (TME)	Team performance (TP)
B.1.3	Each controller checks to make the work easier for the next controller			
C.1.9	As far as possible team members' requests are accommodated			
C.1.4	Post-occurrence discussions with team members involved			
D.1.2	The better the teamwork the better the job outcome			
D.2.1	Work effectiveness brings team members closer together			
E.3.6	Assistance may sometimes be viewed as criticism and not favourably received			
J.2.7	People assist each other during the execution of their tasks			
Supportive transcript extracts				
This also depends on the kind of service you get; as far as possible you do as much as possible to accommodate everyone's requests (C.1.9). *The person looking over your shoulder is the bystander, the supervisor, the person working at the next control position. You have got individuals that stick their noses in where it doesn't belong. But that is more individually, most people will help. We've got a few individuals that may be naaah, …, some people may*				

approach it in a too direct manner and it will be taken up as criticism, but it depends again on the individual and how the criticism is taken (E.3.6).				
A.3.11	Breakdowns in team plans lead to team failures	Performance problems	Teamwork performance measures (TME)	Team performance (TP)
A.3.12	Breakdowns in team plans can most often be linked to teamwork failure rather than individual failure			
J.1.1	Incidents point to a breakdown in teamwork			
N.2.6	You need to be very disciplined			
O.1.13	Willingness to improve and even to rate the team's performance			
S.2.3	Lack of traffic/low business influences personal relations negatively			
Y.2.5	Accepting that mistakes may occur due to a lack of experience			
Supportive transcript extracts				
I think it is easier for examples that shows when teamwork breaks down. Every single day when everything is working perfectly the teamwork is for example … nothing happened, there was no incident there was no accident, however, every incident related to an ATC environment would be an example of where the teamwork breaks down. When the teamwork breaks down there is effects on the outcome (J.1.1). *… I mean you are so depressed, you don't want to come to work, you don't want to go upstairs … Then we organise a pub-lunch, but you don't want to go on a pub-lunch because you sit with these people in the crew-room talking absolute nonsense, playing cards and immediately it affects your personal life and your personal feelings because now you are depressed, because you don't feel valuable (S.2.3).*				
F.1.1	More "eyes" as a result of teamwork impacts upon ATC outcomes	Team performance	Teamwork performance measures (TME)	Team performance (TP)
F.1.3	Teamwork enhances coordination			
J.1.3	When we work together teamwork is great			
L.1.7	Teamwork is better when under pressure			

L.1.11	The good service is definitely linked to teamwork			
L.3.9	Client surveys used to determine team effectiveness			
M.1.9	Traffic is well coordinated between controllers			
O.1.6	Teamwork enhances customer service			
O.1.12	Quality of control work has improved			
Supportive transcript extracts				
Teamwork in the ATC environment is very important. A simple thing like animals which is especially a problem at our ATC centre on and around the runway poses a great threat. With more eyes looking around for and seeing animals crossing or near the runway while you are busy you may have missed as well as vultures and other birds that is already great proof of how teamwork can change the outcome of things (F.1.1). *We deliver quite a good service …in my short experience … and it is linked to teamwork … yes definitely I would say so (L.1.11).*				
J.1.12	Status difference is viewed as a negative influence on teamwork	Status impact	Teamwork performance measures (TME)	Team performance (TP)
J.3.4	Lower status positions have less influence			
N.3.17	Status differences are managed through respect			
P.3.3	Status is not an inhibiting factor when it comes to voicing shortcomings in controlling			
P.3.11	Status and ability do play a role but are not restrictive			
Supportive transcript extracts				
I would actually prefer to have no rank system at all, or alternatively do something that (another nation) do – you are screened at an early age and you go onto approach or tower – you would have for example a (high rank) on tower and a (junior rank) on approach – it has nothing to do with … it is a position and I advocate – don't call me (rank), call me approach, I am working … I am approach right now. Unfortunately it does … because of the way of doing things it gets to your senior people, again personalities … you do get dominant personalities where you find that both experienced people end up ultimately telling, in a military perspective, telling the person what to do in an ATC environment, based on his rank (J.1.12).				

With combining that with the military part of a rank structure where you have got seniority and rank … so its done formally but at the same time informally, to say it like that. The tower controller, the approach controller whoever was controlling at that position irrespective of rank has got the opportunity to address shortcoming which he believes … as experienced as shortcomings during a team's performance. Whether it be against a (senior ranks) it is regardless because at the end of the day it goes about lives (P.3.3).				
A.2.2	Each controller needs to be ahead by an in-time understanding of the other controller's planned and perceived actions	Information sharing	Teamwork dynamics (TMF)	Team performance (TP)
A.1.8	Experiences are shared amongst team members			
B.1.2	During emergencies team members observe each others' actions			
B.1.4	Flow of all relevant information paramount			
B.2.3	Coordination between controllers			
C.1.2	Realise that the entire spectrum of work must be shared			
E.3.3	Collective knowledge and experience is favoured			
F.2.6	Openness for others to provide input and willingness to accept such input			
F.3.5	Mistakes are not easily shared when fear of prosecution is present			
I.1.4	Communication problems may exist due to coordination problems			
I.1.6	Teamwork allows for an understanding of what is happening at other positions			
I.1.7	Teamwork assists in safe planning			
J.2.6	You listen to other people to keep the picture			
K.1.3	You have to rely on information from others			
K.1.9	Teams require rules that all agree to			
L.1.2	Communication lines are opened			

L.1.6	Mutual expectations must be carefully coordinated and monitored			
L.2.3	Assistance and input from others are welcome			
L.2.6	Status and respect are considered important to certain members			
M.1.4	Sharing of information is a critical success factor			
M.1.5	You listen to others and plan accordingly			
M.1.6	Communication is enhanced by people listening to one another in a proactive manner			
P.1.4	Prior knowledge of what is going to happen is evident in good teamwork			
P.1.5	Everybody must know what is going on			
Q.2.6	Effective communication within a team is important			
T.2.4	When necessary I will discuss own experiences with team members			
T.1.5	Team communication is important			
W.2.10	Clear messages need to be sent and received amongst team members			
W.3.11	Delegation of tasks need to be done fairly			
X.1.2	Information flows between control positions			
X.1.3	Mutual understanding is important between control positions			

Supportive transcript extracts

Let also me explain it the other way around - if she only tells approach control only that aircraft is airborne he does not know when it started and where it is going he doesn't also not know what is going on and he will also sound unprofessional over the radio (B.1.4).

Teamwork is definitely important, specially I saw that with the (aircraft type) now; we were not that busy before that, especially with the (aircraft type), especially when they are doing (types of flights) as well as (types of flight). They come in with a (type of approach) you have to have teamwork between your tower controller and approach controller and that they don't send and aircraft and drop it onto you while you have got a busy circuit. You have to have teamwork in the sense that the approach controller understands at least or has knowledge of what is going on in the circuit as well as your tower controller has to have some

knowledge what is going on in the approach area (I.1.6). *They don't delegate the work evenly amongst the juniors. Because some people are smarter than other people, … they just do it half the first time or they don't do it at all and it comes down to one person (W.3.11).*				
A.1.5	Team members have the freedom to assist each other and make suggestions, irrespective of work status	Helpfulness	Teamwork dynamics	Team performance
A.2.1	Team members need to work closely together			
A.3.9	Teamwork relies upon team plans and less on individual plans		(TMF)	(TP)
D.1.3	Working relationships carry more weight than personal relationships			
D.2.5	Allows for critical debate with colleagues			
E.1.3	Relying on others to identify your mistakes			
E.1.8	Freedom to ask for and receive assistance/information			
G.1.5	You are never really alone; you know help is available			
G.2.2	Know that you can rely on others			
G.2.5	During emergencies the team automatically supports each other more intensely			
G.3.8	Freedom to provide input and/or assistance to others			
G.3.14	Personal relationships are important			
H.1.2	Everyone is willing to help one another			
N.1.2	People are willing to assist			
P.3.8	Everybody participates in the creation of solutions			
Q.1.2	Team members need to work together and understand each other			
U.1.6	Mutual understanding is essential for effective ATC and teamwork			

V.1.5	Team members are attuned to one another during a shift			
X.1.6	Students can rely on assistance from other team members			
X.1.7	A system of supervisors is used to assist ATCs			
X.2.5	Knowing another controller in terms of performance and expectations makes controlling easier			
Y.1.5	Team players must support each other			
Supportive transcript extracts				
Everyone that is here, is part of the team – you never know when you are sitting upstairs you might not feel right, you might be upset – you must always know that there is someone that can help. You are never really alone. Or when you are busy controlling and you have to do some admin work and you cannot get time for it, then those people can help – to help you with your daily tasks as well, or just to listen out (G.1.5). *The best aid will be able to work together and to understand … I don't want to use the word "respect" each other for doing something but then if there is any, how can I put it, … shortfalls you can work according to the shortfalls and correct it at the time. Then you will be able to rectify it and you can work as a team and it will work (Q.1.2).* *But with certain people you don't even have to bother about that, you just know it is going to flow. Especially here at (ATSU) with so many aircraft flying … having to cope with someone who doesn't coordinate with you; you just hear someone calling you and then you have to work out – what am I going to do now (X.2.5).*				
A.3.10	Younger/new team members do not realise the importance of team plans	Fellowship	Teamwork dynamics (TMF)	Team performance (TP)
B.3.1	Use and invite others' strengths as a resource			
E.3.7	Communication is important			
F.3.7	Certain situations dictate improved teamwork			
G.1.2	Working together is essential			
J.1.9	Pre-empting and thinking ahead of time is part of the team's activities			

J.1.10	The entire team works towards a common situational awareness			
O.1.5	Teamwork allows for proactive approaches to problems			
Q.3.3	The right attitude is important			
R.2.5	In the workplace you have the freedom to ask for assistance from team members			
W.2.4	Working with people that display competence makes the work effort less			
X.2.3	You try to adapt to newcomers in terms of controlling by picturing their traffic situation			
X.2.4	You play the scenario of other controllers in your head while working			
Supportive transcript extracts				
All I can think of now is with the (aircraft type) that are here – most of the controllers here have never worked with the (aircraft type) before and we have three ex -… (ATSU) controllers and they have given their inputs on emergencies and how their (approaches) look (B.3.1). *You need the picture - you are situationally aware but you cannot be situationally aware if you are not being included in the team … if somebody is excluding you and withholding information it is going to be difficult for you to build your situational awareness and at the end the whole thing is about teamwork (J.1.10).* *So, you try to adapt to them, you try to put the scenario into your head (ATC example stated) … and then figure it out yourself – what am I going to do know? (X.2.3).*				
E.3.2	Trust is critical	Trust & respect	Teamwork dynamics (TMF)	Team performance (TP)
G.3.7	Respect at all levels is important to the team			
G.3.17	Mutual trust is critical			
H.1.3	Cooperation allows for the development of a better trust relationship			
H.3.7	Trust links to willingness to share experiences			
I.2.8	There are some people whom I will not approach			
I.3.7	Own mistakes are resolved through humane conversation with seniors			

K.1.2	Trust is important			
L.2.11	Trust is very important			
L.3.3	Trust and respect are the highest priority			
M.3.10	Team members trust each other's competence			
N.3.15	Trust is important			
N.3.16	Respect is important			
P.2.7	I must be able to trust a person's ability			
P.2.8	I must be able to trust the person as a person			
P.2.9	You must respect the other member's responsibilities			
P.3.10	Freedom needs to be exercised with respect			
Q.1.4	Lack of respect in a team is a major shortcoming			
Q.2.7	Trust in people is important			
Q.3.11	Trust amongst and across status levels is necessary			
S.1.6	Respect is important			
W.2.2	Controllers respect each other in terms of capability primarily and status secondarily			
W.3.12	Trust in working relations is important			
Supportive transcript extracts				
If you sit in the tower where there is issues and people don't trust each other – I see that as an accident waiting to happen. Everyone is different, you get people if they don't trust you then you know, if you did something now then in 10 years time they will still blame you for that and they will still not trust you; and they won't fix It (G.3.17). *Respect, … OK we have got the (organisation) hierarchy and in that case you have to have respect for your superiors, but I must say my personal view is that rank cannot work in a tower – especially when you are working (N.3.16).*				

Teamwork shortcomings … I would say OK, in a personal way … it will be more respect for each other … I would say it is not in place, … Teamwork shortcomings … I would say OK, in a personal way … it will be more respect for each other … I would say it is not in place, … (Q.1.4).				
J.1.7	Overt indicators indicate breakdowns in teamwork	Performance breakdowns	Teamwork dynamics (TMF)	Team performance (TP)
J.2.2	Within a team split-teams have been noticed that work very well together			
J.2.3	Similar types (cautious and cautious) work better than others (cautious and risk-taker)			
M.2.6	An unwritten rule exists in the team – perform!			
U.1.4	Individuals that experience conflict do not communicate well			
Supportive transcript extracts				
… as soon as you see tension developing inside – questions being asked, questions being shouted, strips being thrown, headsets being thrown … these are indications that something is wrong, something has slipped (J.1.7). *People try to work around the situation. At times, from what I have seen, there are people who would just go on and do their job the way it should be done and then there is people who cannot deal with it (reference to the conflict situation) or who can't just go on and do their job, they still feel that this person … I am still not happy with or I don't get along with this person – there is communications that shouldn't be there – so there is always something … the whole information gets lost. That I think is only because, … its an individual thing (U.1.4).*				

Compiled by the researcher

Table 5.11 Results: Impact of self-directed team learning in the air traffic control workplace continuation training scenario

Alpha-numerical codes	Summary of narrative codes derived from actual statements	Descriptive key terms	Subcategories	Categories
F.3.3	Formalised continuation training is also used to aid learning	Characteristics	Continued learning strategies (CLA)	Continued learning (CL)
Q.3.6	Continuation training should be linked to local experiences			
R.3.7	A formal form of continuation training without fun is poorly supported			
T.3.6	A formal continuation training process is utilised			
T.3.7	Quizzes, presentations and exams are utilised in terms of continuation training			
U.3.8	Continuation training takes place in a formal manner			
U.3.10	Continuation training methods are exams, case studies, discussions and lectures			
V.2.11	Continuation training consists of tests, which are supported			
W.3.8	Workplace occurrences are worked into continuation training briefing sessions			
W.3.9	Briefings and exams are used during continuation training			
W.3.10	People experiencing difficulties and voicing them, need to prepare a continuation training briefing to address them – this does not motivate voicing of concerns			
X.3.8	Continuation training takes place twice a month			
X.3.11	Informal discussions may take place after continuation training exams			
Supportive transcript extracts				
How we deal with that at this unit is we have got a training officer in our section and the person will identify needs coming from juniors or seniors in our work environment … if there is a lack of knowledge, and then she will appoint someone, a junior or a senior person and that person will have ample time … a week or				

two … to do research and prepare himself … (T.3.6). *… but then the training officer will come to you and say that this and this happened and the CATCO wants you to prepare a briefing; and then (the person) will put that briefing into continuation training or in our files. We have got like school books with home work … and then the training officer will put up ten questions and you have got to look all over the show for the answers. If something like that happens yes, … like I said if you had a bad experience and the training officer feels that you have to learn from it, … the training officer gets the overall freedom … if 60% of the people of the tower don't know something then the training officer makes something big of it to give continuation training on a thing like that (W.3.9).* *No formal discussions take place after these exams, discussions, … maybe with your colleague or you discuss "what did you think?" (X.3.11).*				
A.3.19	Further formal training (approach training) helps to create ATM mental models. However, it is no guarantee	Formal climate	Continued learning environment (CLB)	Continued learning (CL)
A.3.20	Professional training and experience leads to better teamwork			
Supportive transcript extracts				
When you see the bigger picture or are suppose to see the bigger picture. Then you have to; then you really start to realise what we have to do together. But even then there is some of them that probably doesn't see it and that is where the weakness is also sometimes in approach controllers. They might get individual situations right but they don't have a whole traffic plan. *The more professional training and experience one undergoes leads to better teamwork at the end (A.3.19 & 20).*				
H.3.10	Teamwork should be included in training courses	Conditions	Continued learning expectations (CLC)	Continued learning (CL)
R.3.5	Continuation training cannot be viewed by the team as punishment because then it won't be accepted			

Supportive transcript extracts				
Because training is very individualised at the moment. It is more about you than the rest of the team and then more stress the fact that experience needs to be shared between people instead of just been kept to yourself (H.3.10). *The team is very negative about continuation training … in this team I think they see it as punishment which is not the case; that's the first thing … and I got the idea, and this is absolutely a perception, because this is my perception coming from the outside … (R.3.5).*				
R.3.8	Continuation training allows for the identification of team members' lack of knowledge areas	Significance	Continued learning value (CLD)	Continued learning (CL)
U.3.9	Formal continuation training helps the people			
V.3.1	Continuation training tests situational awareness			
X.3.9	Continuation training forces us to learn			
X.3.10	Continuation training is good			
Supportive transcript extracts				
And that, I think, has definitely helped the people around here, especially the people who has just come from tower course or whatever course you did and you just come to validate and you don't open the book again. So, you get rusty and continuation training definitely keeps you on your toes and keeps the mind going (U.3.9). *One of the others also said that he finally understands something he has been writing exams about for two, three years, and he finally understands things now (X.3.10).*				

Compiled by the researcher

Table 5.12 Results: Impact of self-directed team learning dynamics within self-managed air traffic control work teams

Alpha-numerical codes	Summary of narrative codes derived from actual statements	Descriptive key terms	Subcategories	Categories
ZA.2.12	Close-mindedness of especially young members does not encourage observing others at work	Diagnosis	Individual learning preferences (TLA)	Team learning (TL)
ZA.3.2	Time for learning needs to be set aside, albeit a little at a time			
ZB.3.2	Client needs influence learning opportunities			
ZB.3.11	New members have a need to consolidate alone once qualified			
Supportive transcript extracts				
We've got no formal time for learning. Say you have got time, even if it is 20 minutes in the morning when everyone is having their coffee … but also that can't … really work … you've got 20 minutes and say … OK, this sounds silly, but say aircraft types … my aircraft type recognition is bad, very bad. If you just say … I think the (rank) made a point about it this morning. Say you have a picture of a (aircraft type) and you show it in the morning and everyone gets one and you go this is this, this is what it is used for … Or you take an aircraft emergency; like here we've got … it's a small thing – and someone gets to present it or just read it; everyone listens – something will go in (ZA.3.2). *Then you don't really consolidate and what makes this place different, danger … is sit here for two or three weeks doing the normal, then all hell breaks lose and suddenly you have to be at the top of the game … (ZB.3.11).*				

ZB.2.5	Members want to learn by seeing what is taking place	Skills development	Individual learning preferences (TLA)	Team learning (TL)
ZB.3.5	Practical hands-on controlling provides the input for informal learning			
ZB.3.6	Simulation capability in the workplace will assist with continued learning			
Supportive transcript extracts				
ATC is practical, if you don't do any practical work then you will not be sharp enough. Because then all the theory means nothing, you have to experience it on the job, there … practically (ZB.3.5). *And things like this; just because you are here now, you are focusing a lot of our attention on training and learning skills. So, the more you are involved with things like this … if I perceive a sudden opening up and thinking again of our training environment, I am sure everybody else also to a certain extent think about it again. You are so busy doing your day-to-day task that you actually forget about … you know what at the school we did this and we did that and this is how … the planned learning environment. We have spoken about it; … if each tower had a simulator … with different scenarios … it would assist greatly (ZB.3.6).*				
ZA.1.12	A great deal of learning will be of an informal nature	Informal discussions	Participative learning (TLB)	Team learning (TL)
ZA.2.5	Less formal learning is facilitated by open-book tests, quizzes and lectures			
ZA.2.8	Informal discussions at all levels are encouraged and do take place			
ZA.2.9	New workplace demands encourage informal learning			
ZA.2.16	Storytelling is used when people show an interest			
ZA.3.3	Learning may be experienced-based, problem-based and descriptive-based			
ZB.2.4	Work-related conversations lead to team discussions			
ZB.3.7	More practical experience/exposure unlocks more discussion			

Supportive transcript extracts				
Everybody is more than welcome to say (implying junior members) … we had it fairly recently when people say "I really don't understand it" maybe we should look at this or where junior people has expressed concern over up-coming events that they have never dealt with. Then they say - listen we need to have to have a talk around a table as a group around this subject (ZA.2.8). *Everybody knows about it and everybody is talking about it, especially (person); he likes talking so everyone is drawn into the conversation as I said – people aren't scattered, it is a strange magnet, they are drawn upstairs (ZB.2.4).*				
ZA.1.13	A formal induction and training phase does exist for newcomers and will be conducted by the training officer	Formal learning	Participative learning (TLB)	Team learning (TL)
ZA.2.6	Formal learning consists of exams and validation periods and further development courses			
Supportive transcript extracts				
When somebody arrives here the training officer will take him and obviously you have your standard training profile that you will go through with the person; you will see very regularly the person taking that person off to the side and showing them … (ZA.1.13). *There will be a curriculum and set exams that he has to go through … he will obviously get the necessary lectures on each subject, specifically things like the area and that which is unique which is not generic like let-downs. And then he will go through the exams and then do the prescribed validation periods … (ZA.2.6).*				
ZC.1.8	Newcomers to the team need to take responsibility for their own induction to a large extent	Internal directed	Learning individual orientation (TLC)	Team learning (TL)

<table>
<tr><th colspan="5">Supportive transcript extracts</th></tr>
<tr><td colspan="5">A person joining this team can expect … I don't think non at all for the first 3 or 4 months until the people get to know you. I think it is you for yourself and you might as well "skrop your paadjie" (ZC.1.8).</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td>ZA.3.5</td><td>Information needs to be processed and made available for learning purposes</td><td rowspan="4">Design considerations</td><td rowspan="4">Training design

(TLD)</td><td rowspan="4">Team learning

(TL)</td></tr>
<tr><td>ZB.2.9</td><td>Other planned learning is driven by the leader and training officer</td></tr>
<tr><td>ZB.2.10</td><td>Shortcomings/training needs identified are communicated to the training officer by any member</td></tr>
<tr><td>ZC.3.4</td><td>Use of questions (experience based) is suggested to enhance learning</td></tr>
<tr><th colspan="5">Supportive transcript extracts</th></tr>
<tr><td colspan="5">We have a book up here, that's been lying here for a while on case studies of all the near miss events in England for a year – what did the controller do wrong? what did the aircraft do wrong? It's been lying here we could have used it for training, I suppose we should have already. But that kind of information is readily available … (ZA.3.5).
… you think that more than one person in the tower doesn't know it … then she will make it part of the continuation training for instance, by asking questions related to that situation or scenario (ZC.3.4).</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td>ZB.2.11</td><td>Learning is streamlined into being purposeful</td><td>Implementation goal</td><td>Training implementa-tion (TLE)</td><td>Team learning

(TL)</td></tr>
<tr><th colspan="5">Supportive transcript extracts</th></tr>
<tr><td colspan="5">The learning experience is streamlined by purposeful learning – "why do you do something, does it have purpose, what is the reason for doing it this way?" – that question is asked a lot. If it doesn't get answered then it gets changed (ZB.2.11).</td></tr>
</table>

ZA.2.29	The need for team building initiatives is not supported, however, social building is supported	Team building	Operational training characteristics (TLG)	Team learning (TL)
ZC.3.1	More should be done in terms of team learning, away from work, involving everyone			
Supportive transcript extracts				
… socials is the closest that we get to it. We are not formalised on one of those … type of things – no not formalised but a lot of socials and interactions – which is easier here because we live together. We have just had a big team building session with the (country) here, with the (aircraft squadrons). We don't need to go out and know someone better; how well can you know by knowing what this person is able to do?, and what he does every day. In that comes respect … now you've got this team and we are constantly working as a team – there is no need for team building – there is actually a need for lets not be a team any more! Let's be friends, … Because we are constantly team building – working together. In the last two months we've been working our asses of. People have been under enormous pressure in doing their jobs and that is how you identify, or get to know the real person. Put him under pressure and see what he does. We have seen it, we have seen it from everybody (ZA.2.29).				
ZA.1.9	The team will identify learning opportunities – what can be learned from newcomers	Learning transmission	Operational training characteristics (TLG)	Team learning (TL)
ZA.1.17	Once newcomers finish their training they will still be watched			
ZA.1.18	Newcomers and people experiencing work difficulties will receive more attention			
ZA.2.13	Formal training at college level needs to fulfil all work and attitude requirements			
ZA.2.19	The team expects people to display/gain more than the minimum knowledge			
ZB.2.1	Validation training is planned learning			
ZC.2.1	Each ATC must assume responsibility for his/her competence			

Supportive transcript extracts				
Planned learning is the validation, when you get here there is a plan, you will start at zero hours and you will work through. You have to write your exams, you have to pass your exams you are under continued evaluation during validation; that's the plan (ZB.2.1). *I think it is each ATC, looking at individual roles, … its his responsibility to maintain a high level of knowledge in the ATC line … he must make sure he is up to date with changes in the environment … keep yourself on a high standard (ZC.2.1).*				
ZC.3.2	Team learning should be built upon a social foundation	Socialising	Learning environment (TLH)	Team learning (TL)
ZC.3.3	An environment of freedom to ask should be cultivated in order to ensure that learning takes place			
Supportive transcript extracts				
If you make it interesting, … there is such a whole wide world out there with regards to what you can learn and what other people can learn. I think if you start to do it more on a social basis you won't have to feel like you are at school (ZC.3.2).				
ZA.1.8	The team will develop so that you become part of the team	Involvement	Learning environment (TLH)	Team learning (TL)
ZB.2.7	People who are experts/have a lot of knowledge like to share information/experiences			
ZC.3.7	People who have a special interest in aviation should share this during learning events			
ZC.3.15	A willingness to share information and experiences is important			
Supportive transcript extracts				
What I also see is people who have a certain extent of knowledge about the subject … relevant or irrelevant … it is sort of a challenge to note something that somebody else don't know (example provided). And then they share it (ZB.2.7). *If it can work … I mean if I feel that I can talk about this aircraft then I can do it. If I was at an air show this weekend at (venue) and this is what I saw and, and, and ... You can get a broader picture not just (industry/organisation specific) (ZC.3.7).*				

ZA.3.4	Access to information is an important team learning resource	Dynamics	Learning environment (TLH)	Team learning (TL)
ZB.2.3	Certain occurrences are also documented for future reference			
ZB.3.10	Experienced controllers should not be neglected in terms of work allocation due to student training priorities			
Supportive transcript extracts				
People should think "what is that?" Having it more visual, having more aids! And access to information … currently we don't get … you remember now in the olden days we got, yearly all the newest ICAO docs …nowadays you don't; there is some of it on the internet but you have to actually subscribe to get some of the documents – that is not done anymore (ZA.3.4). *… it gets put into the occurrence log and that is briefed very comprehensively in as far as possible whoever were involved and not involved … what did we learn out of that? … especially positive (ZB.2.3).*				
ZA.1.10	Newcomers must show eagerness/readiness to learn	Facilitation considerations	Team learning facilitation (TLI)	Team learning (TL)
ZA.1.14	There is a subtle move from coaching towards mentoring			
ZB.2.6	Use of formal training days is made			
ZB.3.9	Teams like new challenges to learn from			
ZC.3.5	A culture should exist whereby every person can suggest/identify learning opportunities on behalf of the team			
ZC.3.10	Members are not willing to sacrifice their own time for formal learning			
ZC.3.11	A trigger of interest is required for a team to learn			
Supportive transcript extracts				
… and you get set in those ways, you don't do things differently and you get used to it and don't think of other ways of doing it (ZB.3.9).				

So, first of all you have to trigger the interest; you have to trigger the passion again … OK it is no one's job, no one has to do that, but if you want the team to work together you have got to trigger their interest once again. Otherwise you are going to get this response over and over again (ZC.3.11).				
ZA.1.11	A mutual sharing of information, experience, knowledge expectation is held	Value	Team learning facilitation (TLI)	Team learning (TL)
ZA.1.15	Leadership monitors not only work performance but also assists with mentoring			
ZA.1.16	Senior controllers will too a large extent take care of weak performers (work)			
ZA.3.9	Individual learning queries are often best solved by the individual concerned or another individual, not necessarily the team			
ZB.3.8	Information sharing is possible if more practical experience is gained			
ZC.1.5	Learning about diversity is taking place			
ZC.2.2	Formal training needs expressed by members are not always satisfied			
Supportive transcript extracts				
But a lot of it will happen quickly and then they will realise that this guy has serious issues getting to work or getting to his people or whatever – and then there is assistance there sometimes. We find that we need as a group nowadays … as a CATCO you look at more than just the ATC side, there is a lot of the personal issues that the younger people come with that is not resolved. They don't have the tools to resolve – and that the group also looks after. I've had a few of those where I had to worry about more than ATC, … I had to teach them … (ZA.1.15.). *When I look in your face you see it as good manners. I think that we are all learning, I think we are all learning and trying to adapt, … off the culture … (ZC.1.5).*				

Compiled by the researcher

Table 5.13 Results: Impact of teamwork on air traffic control workplace performance outcomes

Alpha-numerical codes	Summary of narrative codes derived from actual statements	Descriptive key terms	Subcategories	Categories
ZA.1.2	Focus of newcomers will be on task	Team relationships	Team work characteristics (TMA)	Team performance (TP)
ZA.1.3	When a newcomer arrives he/she is considered part of the group socially			
ZA.1.6	The team assesses newcomers to determine the type of person			
ZB.1.1	Newcomers can expect support from the team that will make adjustment easier			
ZB.1.2	Support to newcomers is provided in terms of work support			
ZB.1.3	Support to newcomers is provided in terms of social support			
ZB.1.6	The team will defend its unity			
ZB.1.10	Members will test individuals to see what individuals can give/provide to the team			
ZB.1.19	Strong unity is important			
ZC.1.9	Newcomers need to prove themselves prior to being accepted by the team			
ZC.1.11	Rumours and perceptions often arrive at the team before the individuals arrive			
Supportive transcript extracts				
I would like to maybe add that the team would at assess you at first and see what type of person you are … (ZA.1.6). *Strong unity … especially this team does not like anybody trying to split up the team … any such effect is put down as soon as possible (ZB.1.19).*				
ZA.1.4	The team will not adapt around a newcomer	Conformity pressures	Team work characteristics	Team performance
ZA.1.5	Newcomers must work from their side in order to become part of the team			

ZA.1.21	Non-conformers are monitored closely by the team		(TMA)	(TP)
ZA.2.25	Members will not be allowed to pull down the team			
ZA.2.26	People who do not fit into the team tend to leave the team voluntarily			
ZB.1.5	Newcomers that do not show commitment and effort will find themselves distanced from the team			
ZB.1.13	Members will not cover up mistakes			
ZB.1.15	If you sell the team short or backstab you will be isolated			
ZC.1.1	A "know-it-all" approach by a newcomer is not well received by the team			
ZC.1.2	Newcomers need to first understand the team before becoming part of the team			
ZC.1.3	The team can see who will adapt and who will fit in			
ZC.1.4	Diversity issues impact upon this team's acceptance of newcomers			

Supportive transcript extracts

If you get someone who doesn't want to work with or try to blend in or accept where they work they make the rest of the people negative …you are also going to try and, not push them aside, but you not going to allow, …say you are happy here and you are enjoy your work and you take everything that you get here, but there is someone that just put down their foot and say they will not like it and they will never like it then you will tend just to let that person go. Because if you going to keep on trying to help them they are going to pull you down. Then you are going to be negative and you are not going to enjoy your job and you are not going to like A, B and C and E because they don't like it. So, I think that if it takes … the group … shutting the person out but you must not allow that one or two persons can pull down your whole group (ZA.2.25).

One thing that I can say even if you do want to fit in … I think culture has got a great impact on the team, specifically here … there is definite lines, you can see who will adapt to who and who will fit in where (ZC.1.3).

ZA.2.14	People should have a burning desire to do this type of work	Individual focal point	Team work characteristics (TMA)	Team performance (TP)
ZA.2.17	Members should illustrate an interest that is more than simply meeting work requirements			
ZA.2.18	Uninterested parties are distanced			
ZA.2.20	People who do not display adequate knowledge, will not represent the team			
ZA.2.21	Professionalism remains crucial			
ZA.2.24	Individual mistakes are felt by the team			
ZB.1.9	Newcomers must be able to accept jokes and make jokes			
ZB.1.16	Professionalism is important			
ZB.1.17	Discipline is important within the team			
Supportive transcript extracts				
I think that, that statement of the (rank) links in to what was said previous – what not to expect. If that is the guys attitude you tend to say to yourself why bother telling him which year the (aircraft type) was designed, built and painted and why was it done that way, because he shows no interest. He can do his job, he can tell you "clear to land", " clear to take off", but further than that he does not want to explore. He just wants to do what the piece of paper says he must be able to do, but nothing beyond (ZA.2.17). *… but you will find all of a sudden … everybody is very busy the weekend; they can't take your responsibility, they are not willing to make the sacrifice. I honestly don't feel that the professional capacity will be compromised when it comes to controlling (ZB.1.16).*				
ZB.1.11	There is no unresponsive or silent partner in the team, each member must contribute	Team roles	Team work characteristics (TMA)	Team performance (TP)
ZB.1.12	Assistance is provided by the team to members and by members to the team			
ZC.1.6	Team members consider the impact of newcomers to the team in terms of their own individual positions			

Supportive transcript extracts				
There is no silent partner in the team; there is either an active participant in the team in all aspects … To become a valued member of the team you have to put something into it. This is what it goes all about. The team will not carry dead wood, you have to become an active and useful member of the team; … (ZB.1.11).				
ZA.1.7	The team assesses newcomers to determine the person's work contribution	Collective focus	Self-efficacy (TMB)	Team performance (TP)
ZB.1.18	Everyone must be a team player			
Supportive transcript extracts				
Ultimately because each member of the team is relying on another member, … if you slip up … (example stated) … then it is the whole team who has the problem. I think that is the big thing, each member knows exactly what he is responsible for, and he is not responsible to the CATCO he is not responsible to the (higher rank), he is responsible to the team initially … everyone is a team player (ZB.1.18).				
ZA.1.1	Newcomers can expect assistance, suggestions and help from the team	Duty responsibility	Teamwork activities (TMC)	Team performance (TP)
ZA.2.15	People who ask questions are appreciated			
ZA.2.22	The team will not allow its members to negatively influence service delivery			
ZB.1.4	Newcomers must also invest/make an effort to pull their own weight			
ZB.3.1	The team realises that performance is dependent on the challenges posed by clients			
ZB.3.3	The team environment is dynamic			
ZB.3.4	Members share information			
ZA.1.1	Newcomers can expect assistance, suggestions and help from the team			
Supportive transcript extracts				
As soon as the team starts suffering because the person not willing, or not doing his job correctly, … that will be addressed immediately – the person will not be				

left to just screw up further. But you will find that an ATC team is a very close-knit group and is very easy … (ZA.2.22).

I think there is a great deal of support when that person tries … I can verify it, I was delayed for a month due to my move and I found a lot of understanding, they understood my situation … (ZB.1.4).

ZA.1.20	The team identifies certain aspects/indicators that help them to form a perception of the newcomer's attitude	Reflection	Performance reflection	Team performance
ZA.2.10	People after shift/work think about what happened during the day			
ZA.2.11	Close-mindedness of especially young members does not encourage reflection		(TMD)	(TP)

Supportive transcript extracts

… that you will hear or see something that you haven't seen before; or learn something from them. It is absolutely imperative for a person to be able to stand to the side and learn what is going on there, because no ATC situation is ever the same … out of every two-hour period that you work or somebody else work you will see stuff that is been done differently to the way you should have done and you can actually afterwards say to yourself "that's maybe the better way to do it" or "I wouldn't have done it that way I would have done it this way" (ZA.2.10).

ZA.2.23	ATC team is a tight unit	Support provided	Performance reflection (TMD)	Team performance (TP)
ZB.1.8	Newcomers will get to learn the personalities of others			
ZB.1.14	The team provides a support mechanism and is a close-knit team			
ZC.1.7	Prevailing organisational culture is part of the team and newcomers/juniors need to adapt to it			
ZC.1.10	Assistance from the team by a newcomer is appreciated			

Supportive transcript extracts

But there is confidence in the support; the team becomes a support group; I think we said it right at the beginning as well, we are such a close group of people, we work together, we live together to a large extent, and we act together … ultimately that is your strength … (ZB.1.14).

ZB.2.8	It is satisfying and motivational to assist clients and colleagues	Value	Performance reflection (TMD)	Team performance (TP)
ZB.3.12	It is important for the team to obtain client feedback relating to their quality of service			
Supportive transcript extracts				
… ATCs because of an inherent need to help people, they want to do something. This is a case of you want to get your knowledge to help. You actually feel good, a sense of accomplishment, by knowing something that your colleagues don't know and you can assist them because they want to know that. And you get a positive response out of that (ZB.2.8).				
ZC.1.12	Teams may feel threatened because of newcomers	Threat	Performance reflection (TMD)	Team performance (TP)
Supportive transcript extracts				
… we tend to hear that a person is like "that and that and I promise you when they come to the tower they are going to do this and this" – and automatically the crew is on the defensive before they even get to know the person. I don't know if people are threatened by new incomers but I think they build up a theme before that person comes in so that they can be ready to whatever comes their way to adapt to that or accept the situation (ZC.1.12).				
ZA.1.19	Newcomers must enter the team with the right attitude and interest or else they will not be successful	Attitudes	Teamwork dynamics (TMF)	Team performance (TP)
ZB.1.7	Newcomers can expect respect from the team and will not force compliance			
Supportive transcript extracts				
I think a person coming here must be in the right mindset to give his 110%. If that person is not willing to do what he must … should not expect to be treated as				

good as he would have been treated if he had done his part. If he does his best he would get twice that back from the team supporting him. If a person does not, I don't want to use … conform to the team, it is not the right word, … But if he is not doing what he should, he should not expect what … 110% support from the team (ZA.1.19).

Compiled by the researcher

Table 5.14 Results: Impact of self-directed team learning in the air traffic control workplace continuation training scenario

Alpha-numerical codes	Summary of narrative codes derived from actual statements	Descriptive key terms	Subcategories	Categories
ZA.2.1	Continuation training is programmed for a year and takes place monthly	Characteristics	Continued learning strategies (CLA)	Continued learning (CL)
ZA.2.2	Questionnaires are used and occurrences that were observed/reported are included as continuation training			
ZA.2.3	Day-to-day shortcomings are addressed by presentations and exams			
ZA.2.28	Continuation training comprises of (1) revision and (2) new stuff			
ZA.3.7	Informal continued learning is by means of discussions			
ZB.2.2	Continuation training includes debriefings after occurrences			
ZC.2.4	Continuation training needs may be the result of weaknesses in SOP knowledge			
ZC.3.8	A proper level of foundation knowledge is important in order to make a success of continuation training			
ZC.3.12	Continuation training should be more fun			

ZC.3.17	Continuation training needs to be more visual (notice boards used)			
Supportive transcript extracts				
Collective learning is obviously continuation training. A person is appointed to do that every month; and then he sets up the programme for the year (ZA.2.1). There is two components to continuation training, the way we see it, the one is revision and the other one is new stuff. All the CATCOs and everybody I have ever been to loves the new stuff – learning about a little bit wider, everyone hates the revision. To go through the (document) from page one again and re-read … is not stimulating. But, every stimulating subject is normally received with joy, whatever, the people enjoy it. But, the other component that your (organisation) hammers on is the revision – "when last did you read through …" that is not normally enjoyed. Personally I enjoy it, I like to see what I still remember … it should actually be about what can't I remember and go take the time and read up on it (ZA.2.28).				
ZA.3.1	Time for continuation training is reported as being limited – we have got no time for formal learning	Conditions	Continued learning environment (CLB)	Continued learning (CL)
ZC.2.5	Resource availability hampers continuation training			
ZC.2.6	Resources constitute internet, magazines and documents			
ZC.3.6	Continuation training should not be one person's responsibility			
ZC.3.9	Without passion and interest in the work the continuation training efforts may not be successful			
ZC.3.13	Members must be comfortable with their involvement in continuation training			
ZC.3.14	The team must collectively take responsibility for continuation training			
ZC.3.16	Continuation training should be conducted in a culture of spontaneity			
Supportive transcript extracts				
If something was identified and we need to do continuation training or just revision, or lets learn something new not everybody is ever able to give their undivided attention for an hour to get this done, to make it interesting, get the people to learn – there is just not time for this (ZA.3.1).				

… so it helps a lot, I am very keen on the continuation training … I think it is nice, but I just say … why must everything be initiated by one person in the team? Why must the training officer say everyone can give a briefing? Why can an individual not go to the SATCO, CATCO or any one of the (senior ranks) and say … "I would like to give a briefing to the members about …" (ZC.3.14).				
ZA.2.7	Continued formal learning is not guaranteed	Condition	Continued learning expectations (CLC)	Continued learning (CL)
Supportive transcript extracts				
There is a lot of people that is allowed from the people for courses that they are willing to do or would like to do, however, in practice nowadays the wish list is a lot bigger than what actually happens. There is a definite difference between what we all would like to do and what we all can do. That is unfortunately something that has to be managed (ZA.2.7).				
ZA.2.4	Client surveys are used to identify continuation training needs	Significance	Continued learning value (CLD)	Continued learning (CL)
ZA.2.27	Continuation training is generally supported by all members			
ZC.2.3	Collective learning is found in continuation training			
Supportive transcript extracts				
People do not have an option to not participate in continuation training – … One tries to be nice about it, to sell it as a concept as oppose to dictate it as a concept … I can't make you write the right answer … I can just make you write something. I can't imagine any individual having that attitude, I have never seen that, because it is up to his own benefit and the team's benefit – you can only benefit by this. He cannot be negatively … nothing negative can happen to him while doing continuation training. I have never seen anybody have a problem at that level (ZA.2.27).				

Collective learning … I think collective learning is continuation training and that should be determined by looking at the group … where is the weakness in the link … in terms of knowledge or SOP knowledge or anything like that (ZC.2.3).				
ZA.3.6	Formal continuation training is limited	Limitations	Continued learning value (CLD)	Continued learning (CL)
ZA.3.8	Some team members miss continuation training experiences due to work loads			
Supportive transcript extracts				
We've got everything in place for the training, we just don't have the time. The way we do it currently, the continuation training, the only way that we can get it done is the team member has got a little booklet, exam or the topic for discussion or revision is put on a piece of paper and put into your little booklet and its left there (ZA.3.6). *So, but the unfortunate thing is that only one or two people are part of that, not the whole team. You can't afford …you haven't got time for the whole team to sit around a table and discuss. So, a lot of people lose something … one or two people have now learnt a lot but poor old (name) which was busy (activity) missed it. And what is the chance that he will ever pick up on that again (ZA.3.8).*				

Compiled by the researcher

3 Quantitative results

Quantitative results	Self-directed Team Learning Questionnaire (SDTLQ) results	Self-directed Team Performance results
		Self-directed Team Learning results
		Team performances and self-directed team learning relationship results
		Continuation training results
	Team learning approaches and self-directed team learning relationship results	

3.1 Self-directed Team Learning Questionnaire (SDTLQ) results

SDTLQ data were collected from 25 respondents. The composition of this respondent group is presented in Table 5.15.

Table 5.15 Biographical data (V2 – V11)

Respondent gender						
Male						15
Female						10
Number of respondents per air traffic control centre						
FALW (Langebaanweg)						9
FALT (Makhado)						7
FAHS (Hoedspruit)						9
Military rank held per respondent						
Non-Commissioned Officer	Candidate Officer	Second Lieutenant	Lieutenant	Captain	Major	Lieutenant-Colonel
0	0	5	9	4	5	2
Validations held per respondent						
Flight information service						8
Ground control						20
Aerodrome control						25
Approach control						9
Ground-controlled approach						4
Period of employment at a centre per respondent						
Less than one year						5
More than one year but less than three years						11
More than three years						9
Respondent positions						
Command and Control Assistant	**Air traffic controller**	**Senior air traffic controller**	**Chief air traffic controller**			
0	18	5	2			

Compiled by the researcher

SDTLQ data allowed for the description and comparison of phenomena as well as intra-team and inter-team comparisons. SDTLQ data analysed presented learning and performance characteristics of the three self-directed teams and identified team-based similarities and differences with regard to predetermined characteristics.

Question 23 (V150 – V153) of the SDTLQ encouraged respondents to provide additional information that was considered to be appropriate to this study. Only two respondents made use of this opportunity to provide additional information. From a qualitative perspective this information was reported. However, no trend could be established.

3.1.1 Self-directed Team Performance results

Self-directed team performance data (V12 – V71) were collected from 25 respondents (N=25). Data analysed are presented in 6 cumulative categories as illustrated in Table 5.16.

Table 5.16 Cumulative data categories

SDTLQ question number	V- numbers	Data category
7	V12-V25	Team work characteristics
8	V26	Self-efficacy
9	V27-V40	Team performance activities
10	V41-V47	Individual reflection
11	V48-V63	Teamwork performance measures
12	V64-V71	Team performance dynamics

Compiled by the researcher

To satisfy my need to describe and compare phenomena I needed to determine which viewpoints held by respondents were reported foremost. Creating this awareness aided understanding of self-directed team performance phenomena from a qualitative perspective. Of interest to me was thus to determine each V-number's modus and associated frequency within each data category. These are presented below.

- Team work characteristics (V12-V25) are graphically illustrated with reference to modus and frequency in Figure 5.2.

- With respect to self-efficacy (V26) 17 respondents reported that air traffic control team performance is characterised by setting goals and involvement by all team members during difficult controlling periods/tasks.

- Team performance activities (V27-V40) are graphically illustrated with reference to modus and frequency in Figure 5.3.

- Individual reflection activities (V41-V47) are graphically illustrated with reference to modus and frequency in Figure 5.4.

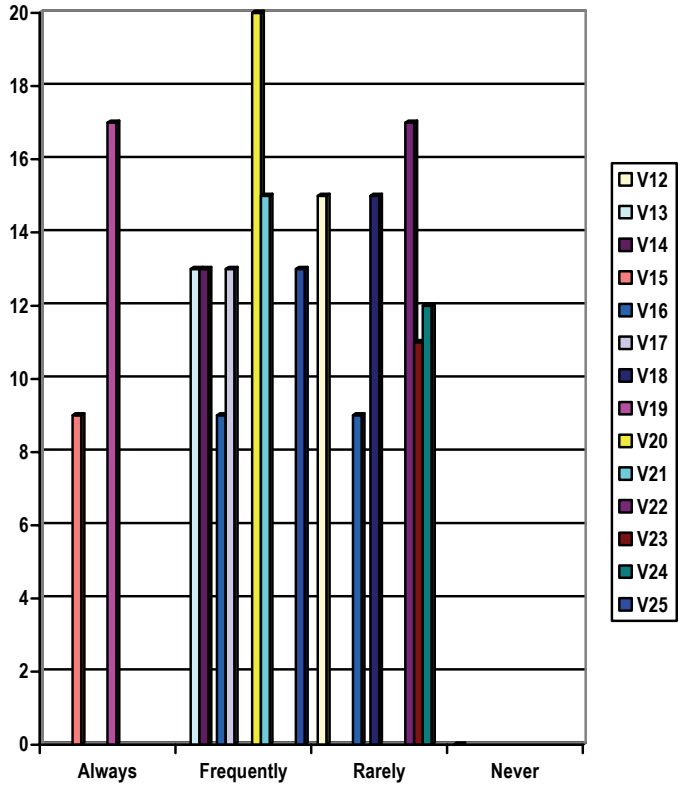
- Teamwork performance measures (V48-V63) are graphically illustrated with reference to modus and frequency in Figure 5.5.

- Team performance dynamics (V64-V71) are graphically illustrated with reference to modus and frequency in Figure 5.6.

- Two respondents provided team performance data in response to question 23 (V152).

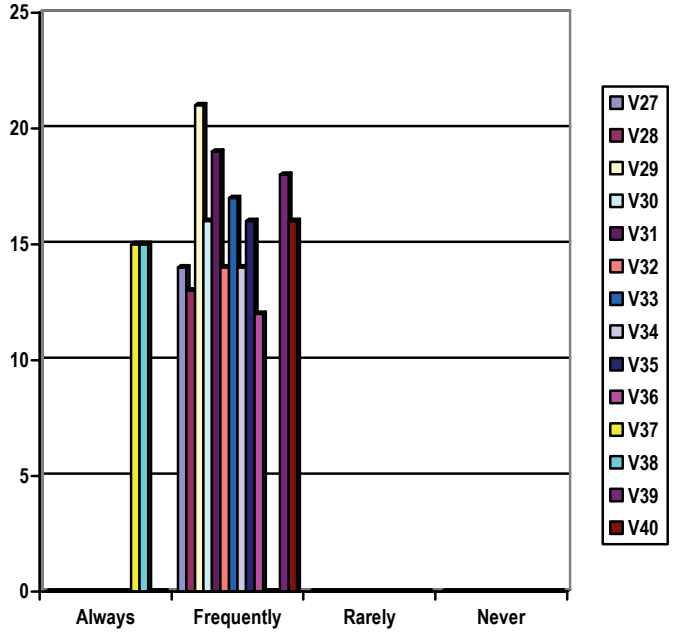
    - One respondent stated that during heavy and difficult traffic density periods the effort relies heavily on the team.
    - One respondent stated that as a newcomer to a team it takes time to work together and to really get to know a team.

Figure 5.2 Teamwork characteristics

Graphic presentation	Explanation
	The following were rated as **always**: • Certain air traffic control roles are considered more important than others (V15). • The air traffic control team is willing to learn as a result of experience (V19). The following were rated as **frequently**: • Pressures to conform (V13). • Power shared amongst team members (V14). • Individual contributions are encouraged (V17). • Internal commitment amongst members is present (V20). • Team members handle criticism well (V21). • The pace set by the team meets the needs of all team members (V25). The following were rated as **rarely**: • The team covers up blunders/mistakes (V18). • Conflict occurs between team members (V12). • Misunderstandings prevail (V22). • Team members act defensively when confronted (V23). • Team members attempt to understand why people behave in certain ways (V24). The following was rated equally as **frequently** and **rarely**: • The team is viewed as being more important than team members (V16).

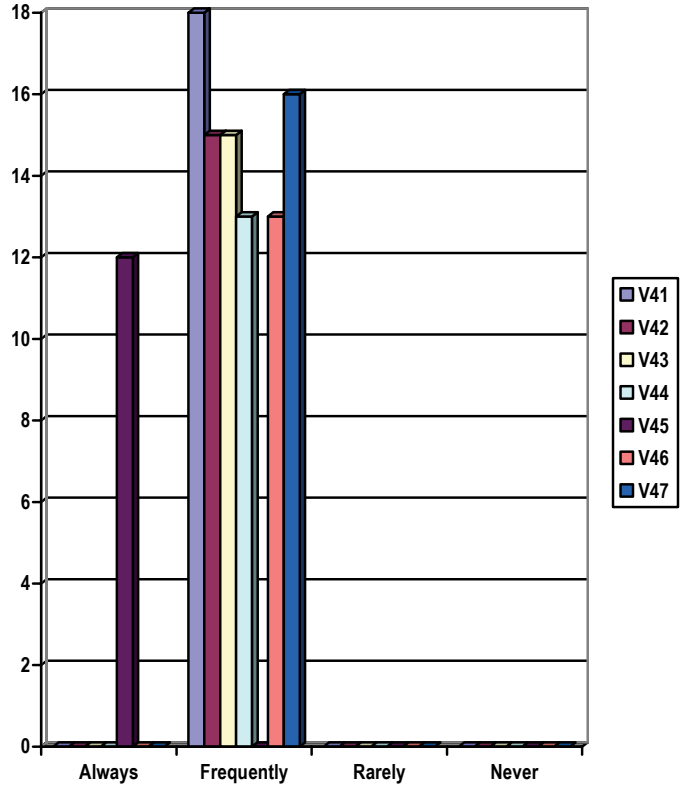
Compiled by the researcher

Figure 5.3 Team performance activities

Graphic presentation	Explanation
	The following were rated as **always**: • Upholding air traffic control standards and processes (V37). • Safeguarding air traffic control standards and processes (V38). The following were rated as **frequently**: • Gathering of information (V27). • Reporting of information (V28). • The creation of new ideas (V29). • Experimenting with new ideas (V30). • Exploring new opportunities (V31). • Assessing the applicability of new work processes (V32). • Establishing new ways of making things work (V33). • Implementing new ways of making things work (V34). • Delivering safety-focused outputs (V35). • Integrating the work of others (V40). • Coordinating the work of others (V39). • Continuously checking the working of the air traffic control system (V36).

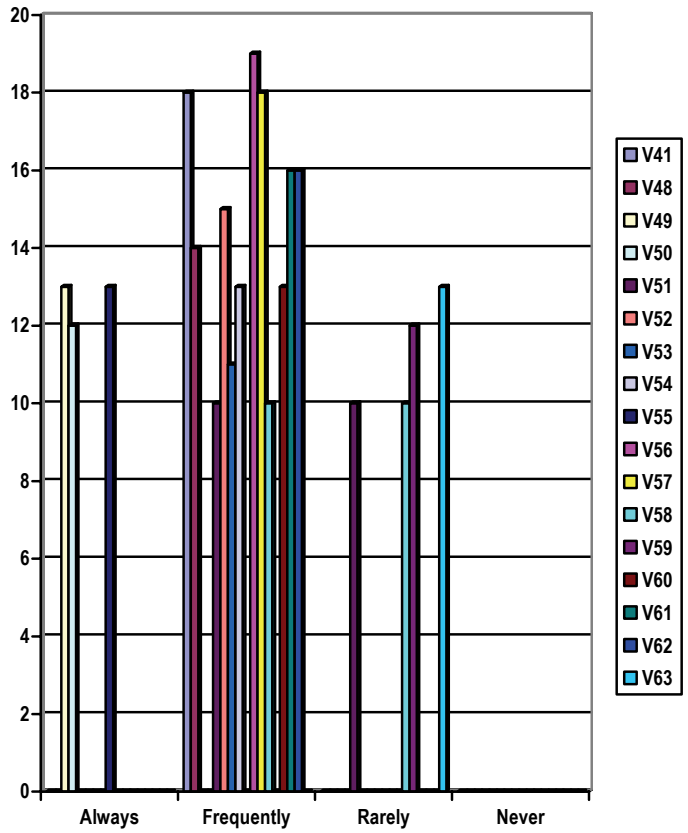
Compiled by the researcher

Figure 5.4 Individual reflection activities

Graphic presentation	Explanation
	The following were rated as **always**: • Thinking about contributions to aviation safety (V45). The following were rated as **frequently**: • Revisiting an air traffic control shift in their minds and thinking about what actually happened during a shift (V41). • Thinking about ways to improve air traffic control skills as a result of a team's opinion concerning personal present performance (V42). • Thinking about ways to improve air traffic control skills as a result of inputs received from others concerning present performance (V43). • Thinking about the social relationships encountered in the work team (V44). • Thinking about own personal values and its role in work life (V46). • Thinking about the expectations of the aviation industry, organisation, centre and team (V47).

Compiled by the researcher

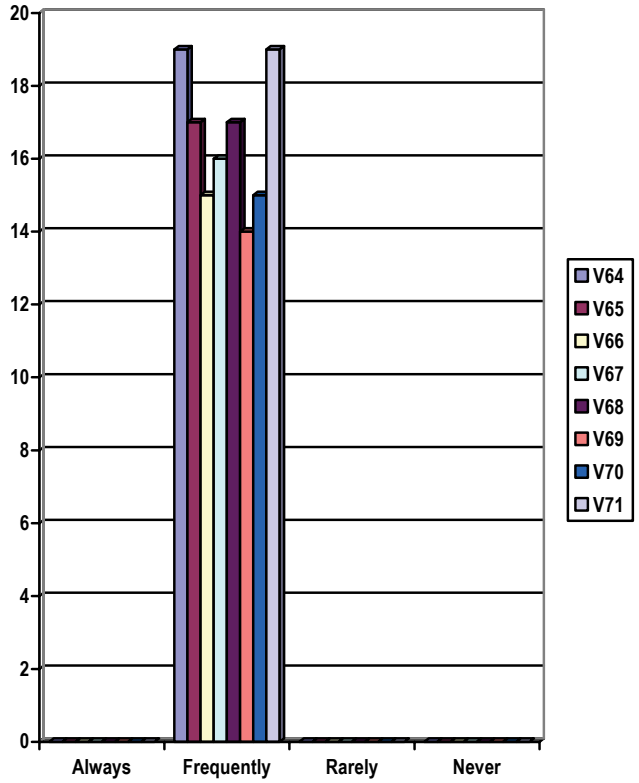
Figure 5.5 Teamwork performance measures

Graphic presentation	Explanation
	The following were rated as **always**: • Using accident occurrences as an indicator to measure air traffic control teamwork performance (V49). • Using application of traffic separation standards as an indicator to measure air traffic control teamwork performance (V50). • Using compliance with unit operational rules as an indicator to measure air traffic control teamwork performance (V55). The following were rated as **frequently**: • Using incident occurrences as an indicator to measure air traffic control teamwork performance (V48). • Using efficient airspace utilisation as an indicator to measure air traffic control teamwork performance (V52). • Using traffic capacity management as an indicator to measure air traffic control teamwork performance (V53). • Using traffic sequencing abilities of the controllers as an indicator to measure air traffic control teamwork performance (V54). • Using quality of team support provided as an indicator to measure air traffic control teamwork performance (V56). • Using individual contributions by team members as an indicator to measure air

	traffic control teamwork performance (V57). • Using handling of emergency situations as an indicator to measure air traffic control teamwork performance (V60). • Using quality of radio-telephony practices as an indicator to measure air traffic control teamwork performance (V61). • Using effectiveness of information (coordination) sharing as an indicator to measure air traffic control teamwork performance (V62). The following were rated equally as **frequently** and **rarely**: • Using number of flight delays as an indicator to measure air traffic control teamwork performance (V51). • Using work overload occurrences as an indicator to measure air traffic control teamwork performance (V58). The following were rated as **rarely**: • Using number of unnecessary requests made to pilots as an indicator to measure air traffic control teamwork performance (V59). • Using number of interpersonal conflict situations as an indicator to measure air traffic control teamwork performance (V63).

Compiled by the researcher

Figure 5.6 Team performance dynamics

Graphic presentation	Explanation
	The following were rated as **frequently**: • Shared judgement calls (V64). • Shared problem-solving actions (V65). • Shared decision-making abilities (V66). • Shared situational awareness (V67). • Similar skill levels (V68). • Shared positive attitudes (V69). • Trust amongst team members (V70). • Shared information amongst team members (V71).

Compiled by the researcher

3.1.2 Self-directed Team Learning results

Self-directed team learning data (V72 – V149) were collected from 25 respondents (N=25). Data analysed are presented in 6 cumulative categories as illustrated in Table 5.17.

Table 5.17 Cumulative data categories

SDTLQ question number	V- numbers	Data category
13	V72-V78	Individual learning preferences
14	V79-V84	Learning participation
15	V85	Individual workplace learning orientation
16	V86-V90	Workplace training design
17	V91-V95	Workplace training implementation
18	V96-V100	Workplace training evaluation
19	V101-V115	Operational training characteristics
20	V116-V130	Continuation training characteristics
21	V131-V141	Workplace learning environment
22	V142-V149	Team learning facilitation

Compiled by the researcher

In order to satisfy my need to describe and compare phenomena I needed to determine which viewpoints held by respondents were reported foremost. Creating this awareness aided understanding of self-directed team learning phenomena from a qualitative perspective. Of interest to me was thus to determine each V-number's modus and associated frequency within each data category. These are presented below.

- Individual learning preferences (V72-V78) are graphically illustrated with reference to modus and frequency in Figure 5.7.

- Learning participation initiatives (V79-V84) are graphically illustrated with reference to modus and frequency in Figure 5.8.

- With respect to individual workplace learning orientation (V85) 15 respondents reported that their own workplace learning experience is externally directed focused (relying on others to assist with own learning).

- Workplace training design responsibilities (V86-V90) are graphically illustrated with reference to modus and frequency in Figure 5.9.

- Workplace training implementation responsibilities (V91-V95) are graphically illustrated with reference to modus and frequency in Figure 5.10.

- Workplace training evaluation responsibilities (V96-V100) are graphically illustrated with reference to modus and frequency in Figure 5.11.

- Operational training characteristics (V101-V115) are graphically illustrated with reference to modus and frequency in Figure 5.12.

- Continuation training characteristics (V116-V130) are graphically illustrated with reference to modus and frequency in Figure 5.13.

- Workplace learning environment characteristics (V131-V141) are graphically illustrated with reference to modus and frequency in Figure 5.14.

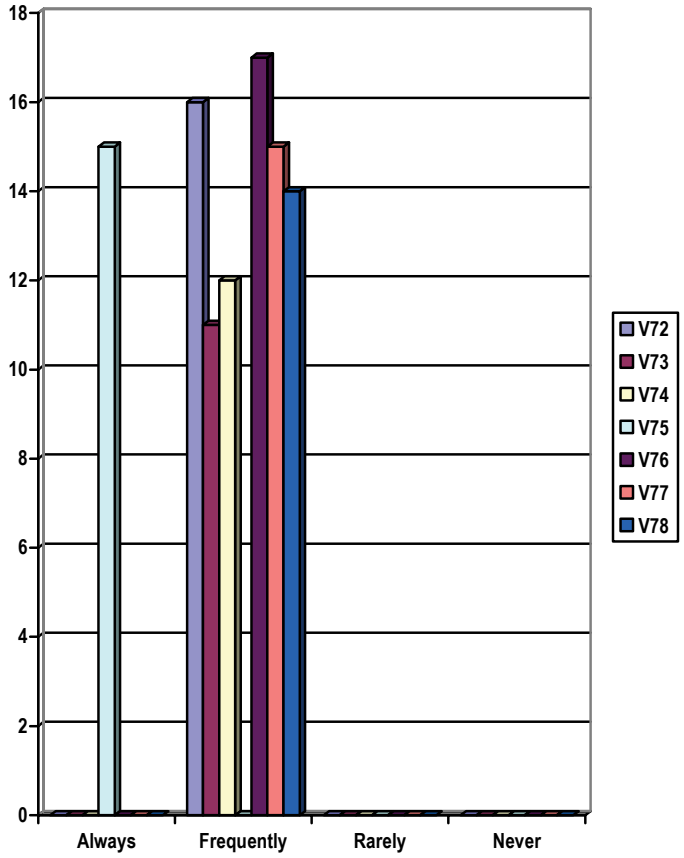
- Team learning facilitation characteristics (V142-V149) are graphically illustrated with reference to modus and frequency in Figure 5.15.

- One respondent provided personal self-directed learning data in response to question 23 (V150). This respondent stated that he/she learns by reflecting on situations and then replaying them in his/her mind to determine what he/she could have done better, and how.

- Two respondents provided team self-directed learning data in response to question 23 (V151).

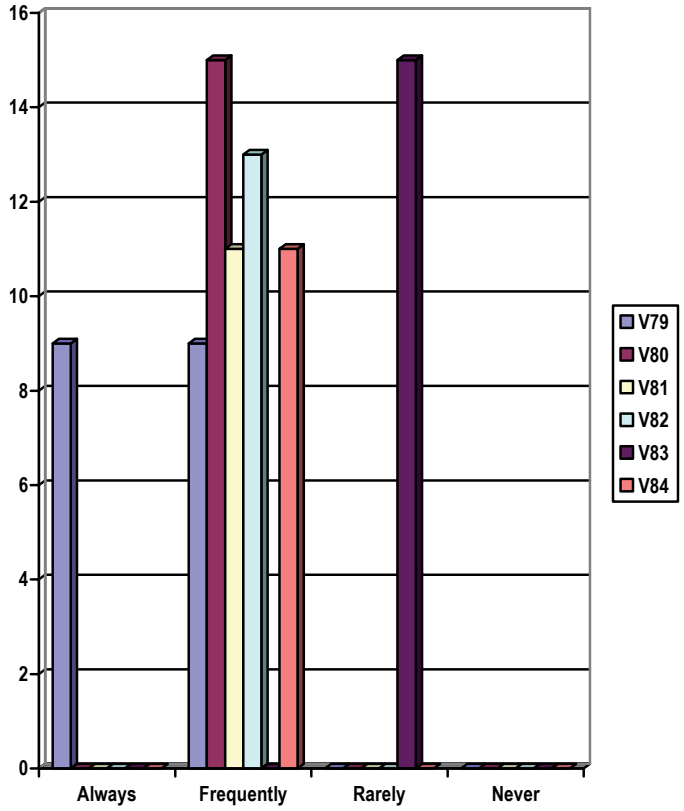
    - One respondent stated that recently trained air traffic controllers require a great deal of "spoon feeding" from other team members in order to ensure competence of these junior controllers.
    - A second respondent commented that a lack of experience is apparent amongst senior team members.

Figure 5.7 Individual learning preferences

Graphic presentation	Explanation
	The following were rated as **always**: • Preference to learn as a result of curiosity (V75). The following were rated as **frequently**: • Preference to learn as a result of novel, difficult and unfamiliar air traffic control problem situations (V72). • Preference to learn as a result of routine and expected air traffic control situations (V73). • Preference to learn as a result of familiar and trained-for air traffic control problem situations (V74). • Preference to learn as a result of feedback received from others (V76). • Preference to learn as a result of an own diagnosis of learning needs (V77). • Preference to learn as a result of a systematic and sequential learning plan that is provided (V78).

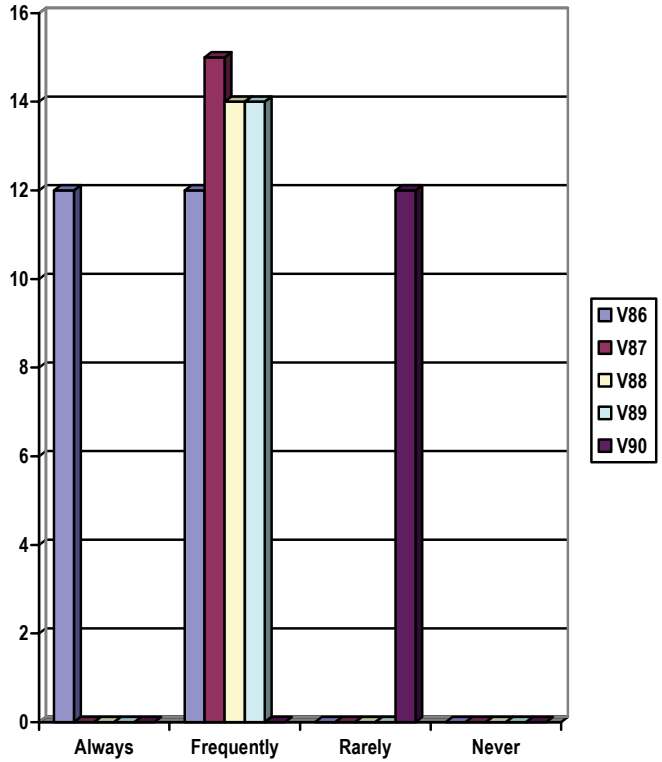
Compiled by the researcher

Figure 5.8 Learning participation initiatives

Graphic presentation	Explanation
	The following was rated equally as **always** and **frequently**: • Participation in formal team discussions at their air traffic control centre (V79). The following were rated as **frequently**: • Participation in informal team discussions at air traffic control centres (V80). • Participation in formal individual feedback sessions (example: a structured one-to-one discussion) at air traffic control centres (V81). • Participation in informal individual feedback sessions (example: a semistructured or unstructured one-to-one discussion) at air traffic control centres (V82). • Participation in critically analysing and reflecting upon own performance at air traffic control centres (V84). The following was rated as **rarely**: • Participation in setting of learning contracts/agreements at air traffic control centres (V83).

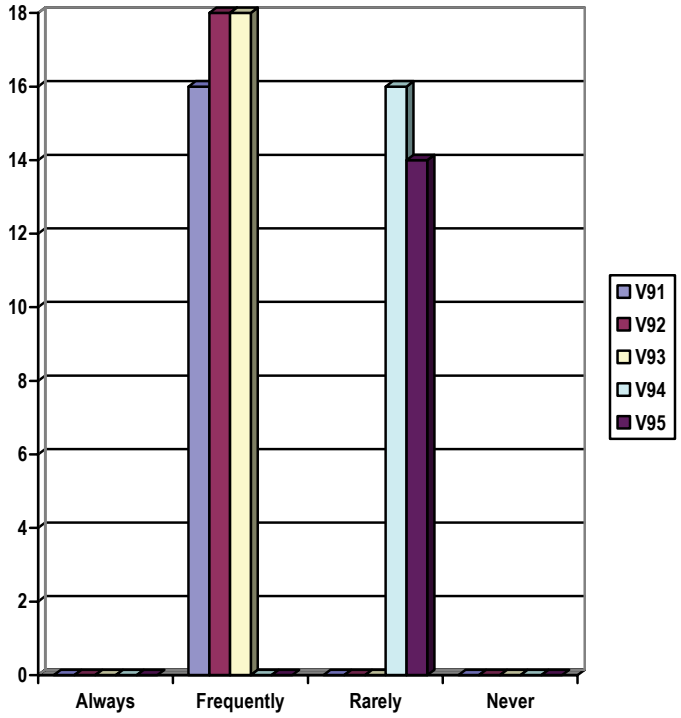
Compiled by the researcher

Figure 5.9 Workplace training design responsibilities

Graphic presentation	Explanation
	The following was rated equally as **always** and **frequently**: • Air traffic control training objectives for the air traffic control team are decided upon by the chief air traffic control officer (V86). The following were rated as **frequently**: • Air traffic control training objectives for the air traffic control team are decided upon by the senior air traffic control officer (V87). • Air traffic control training objectives for the air traffic control team are decided upon by the air traffic control training officer (V88). • Training objectives for the air traffic control team are decided upon by the air traffic control team (V89). The following was rated as **rarely**: • Air traffic control training objectives for the air traffic control team are decided upon by individual air traffic controllers (V90).

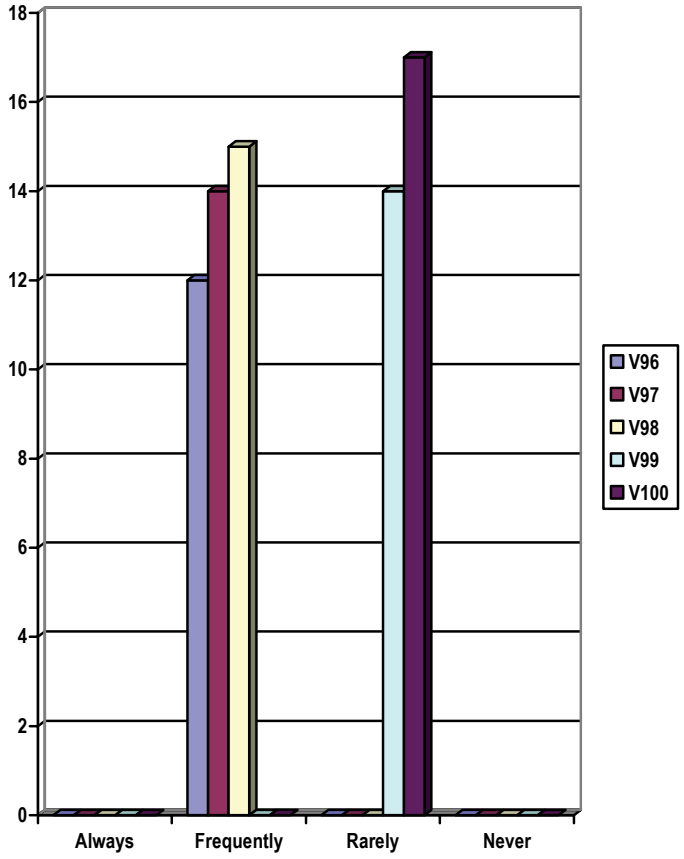
Compiled by the researcher

Figure 5.10 Workplace training implementation responsibilities

Graphic presentation	Explanation
	The following were rated as **frequently**: • Chief air traffic control officer presents air traffic control training initiatives to the air traffic control team at the centre (V91). • Senior air traffic control officers present air traffic control training initiatives to the air traffic control team at the centre (V92). • Air traffic control training officers present air traffic control training initiatives to the air traffic control team at the centre (V93). The following were rated as **rarely**: • Air traffic control team members present air traffic control training initiatives to the air traffic control team at the centre (V94). • Individual air traffic controllers present air traffic control training initiatives to the air traffic control team at the centre (V95).

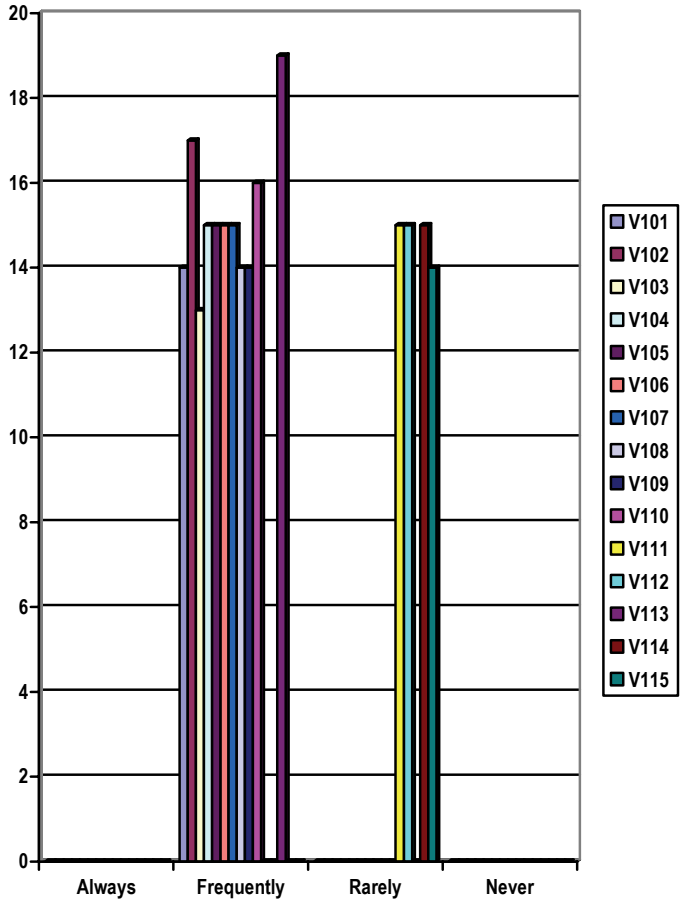
Compiled by the researcher

Figure 5.11 Workplace training evaluation responsibilities

Graphic presentation	Explanation
	The following were rated as **frequently**: • A chief air traffic control officer evaluates air traffic control training initiatives presented to air traffic control teams at the centre (V96). • Senior air traffic control officers evaluate air traffic control training initiatives presented to air traffic control teams at the centre (V97). • Air traffic control training officers evaluate air traffic control training initiatives presented to air traffic control teams at the centre (V98). The following were rated as **rarely**: • All air traffic control team members evaluate air traffic control training initiatives presented to air traffic control teams at the centre (V99). • Individual air traffic controllers evaluate air traffic control training initiatives presented to air traffic control teams at the centre (V100).

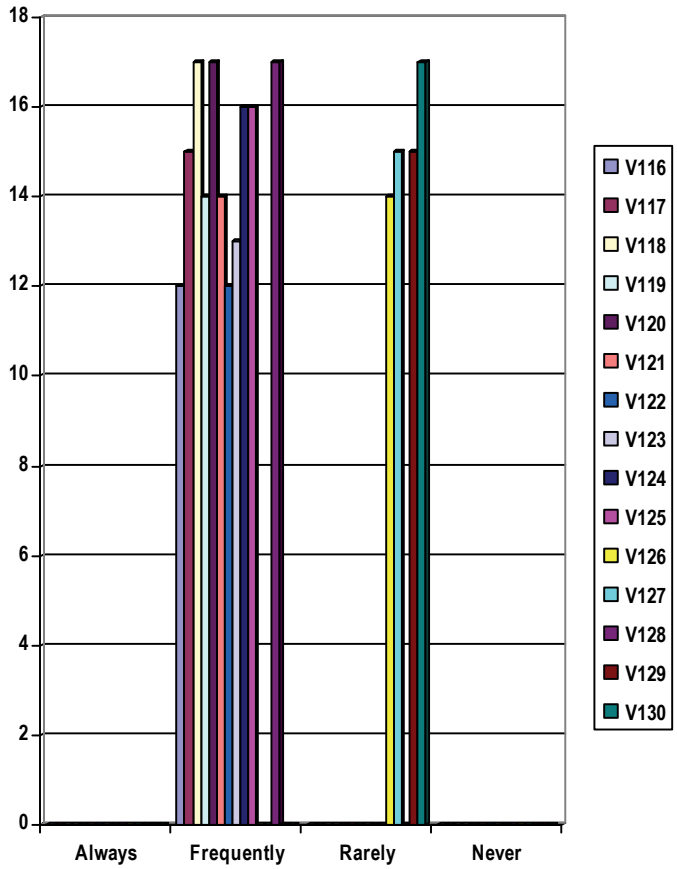
Compiled by the researcher

Figure 5.12 Operational training characteristics

Graphic presentation	Explanation
	The following were rated as **frequently**: • Passing information to team members who need it, before they need it (V101). • Identifying the need to assist other team members (V102). • Encouraging team members to communicate their observations (V103). • Encouraging team members to communicate their concerns (V104). • Encouraging team members to communicate their suggestions (V105). • Encouraging team members to communicate their requests (V106). • Learning to adapt performance strategies quickly as a result of changing demands (V107). • Learning to adapt performance strategies appropriately to changing task demands (V108). • Knowledge of tasks performed by all air traffic control positions (V109). • Team situational awareness skills (V110). • Coordination activities and processes (V113). The following were rated as **rarely**: • Stress coping strategies (V111). • Getting to know team members at a personal level (V112). • Fostering mutual trust (V114). • Creating team cohesion (V115).

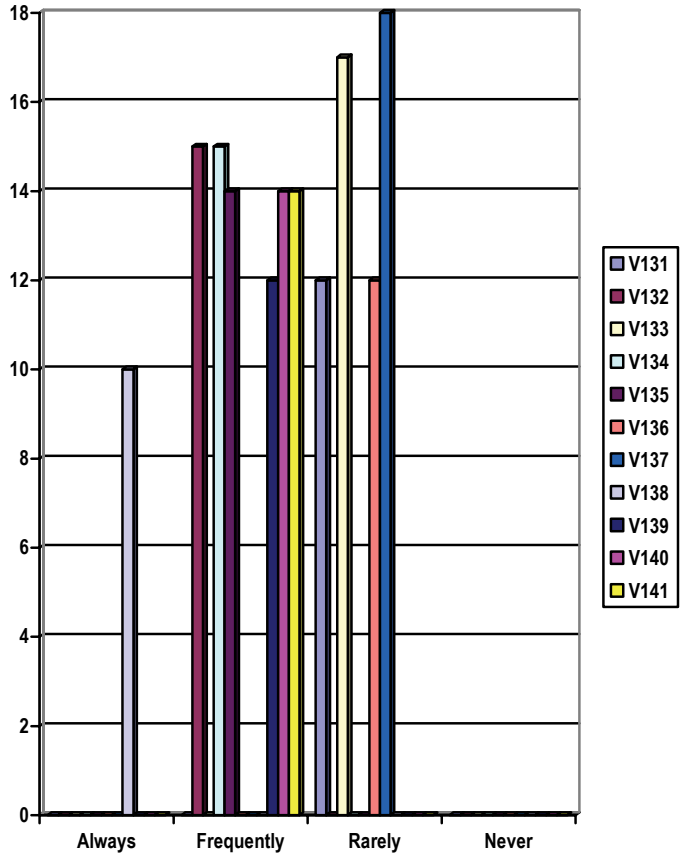
Compiled by the researcher

Figure 5.13 Continuation training characteristics

Graphic presentation	Explanation
	The following were rated as **frequently**: • Passing information to team members who need it, before they need it (V116). • Identifying the need to assist other team members (V117). • Encouraging team members to communicate their observations (V118). • Encouraging team members to communicate their concerns (V119). • Encouraging team members to communicate their suggestions (V120). • Encouraging team members to communicate their requests (V121). • Learning to adapt performance strategies quickly as a result of changing demands (V122). • Learning to adapt performance strategies appropriately to changing task demands (V123). • Knowledge of tasks performed by all air traffic control positions (V124). • Team situational awareness skills (V125). • Coordination activities and processes (V128). The following were rated as **rarely**: • Stress coping strategies (V126). • Getting to know team members at a personal level (V127). • Fostering mutual trust (V129). • Creating team cohesion (V130).

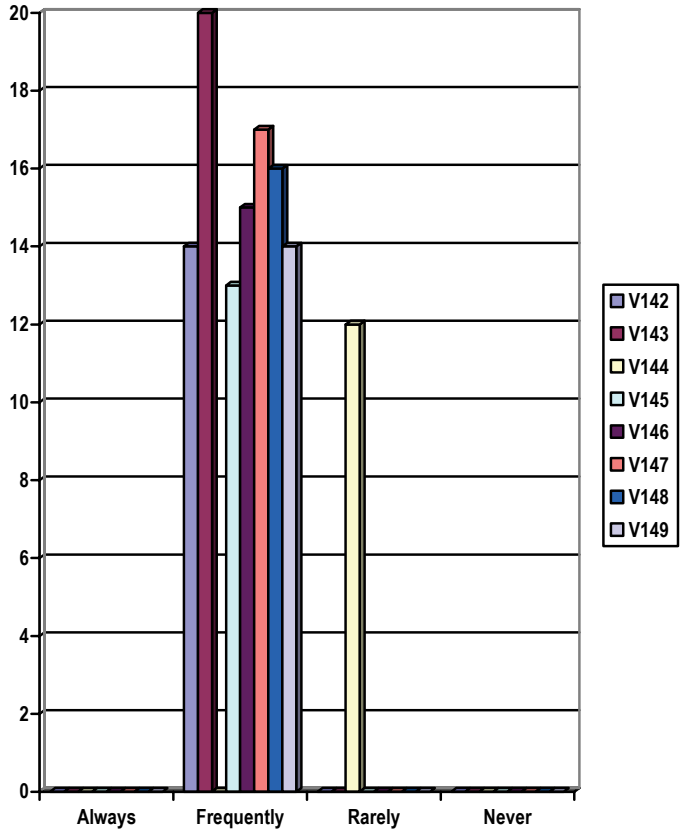
Compiled by the researcher

Figure 5.14 Workplace learning environment characteristics

Graphic presentation	Explanation
	The following was rated as **always**: • Support from management to encourage team members to learn from workplace experiences (V138). The following were rated as **frequently**: • Team members that ensure that learning does take place within the team (V132). • Planned continuation training events (V134). • Ad hoc lectures/presentations (V135). • Adequate resources to facilitate learning (V139). • An open forum that encourages discussion and sharing of experiences amongst team members (V140). • Team members that will plan their own learning when the need arises (V141). The following were rated as **rarely**: • Weekly planned learning sessions (V131). • Use of learning contracts/agreements (V133). • Social gatherings where work related matters are discussed in an informal manner (V136). • Social gatherings where work related matters are discussed in a formal manner (V137).

Compiled by the researcher

Figure 5.15 Team learning facilitation characteristics

Graphic presentation	Explanation
	The following were rated as **frequently**: • A supportive team learning atmosphere (V142). • Known team roles and responsibilities (V143). • A shared motivation to learn (V145). • Pre-planning for learning (V146). • Guiding leadership support (V147). • Adequate resource availability (V148). • Participation from experienced team members (V149). The following was rated as **rarely**: • Sensitivity towards personality differences (V144).

Compiled by the researcher

3.1.3 Team performances and self-directed team learning relationship results

A statistical view was regarded as noteworthy in order to investigate the possibility of a relationship between self-directed team learning and self-directed team performance for each team. An understanding of any reciprocating association between team performance and team learning as illustrated by an analysis of SDTLQ data was thus sought.

For each respondent in team 1 (9 respondents), in team 2 (7 respondents) and in team 3 (9 respondents) self-directed team performance means (defined as SDPM) were calculated for V12 to V25 (team work characteristics), V27 to V40 (team performance activities), V41 to V47 (individual reflection), V48 to V63 (team work performance measures) and V64 to V71 (team performance dynamics). Similarly self-directed team learning means (defined as SDLM) were calculated for V72 to V78 (individual learning preferences), V79 to V84 (learning participation), V86 to V90 (workplace training design), V91 to V95 (workplace training implementation), V96 to V100 (workplace training evaluation), V101 to V115 (operational training characteristics), V116 to V130 (continuation training characteristics), V131 to V141 (workplace learning environment), and V142 to V149 (team learning facilitation) for each respondent in team 1, in team 2 and in team 3.

In order to test, for each team, whether there is a statistically significant difference between team performance and team learning a difference variable was calculated by subtracting self-directed team learning means from self-directed team performance means. For each team, Shapiro-Wilk tests for normality suggested a normal distribution for the differences. Therefore a t-test could be used to test the null hypothesis that the mean difference between the SDPM and SDLM equal zero against the alternative that the mean difference is unequal to zero. Table 5.18 presents the mean difference between SDPM and SDLM, the Standard deviation (SD) of the difference, and the t-statistic (two-sided t-test) and *p* value for testing for a difference between self-directed team learning means and self-directed team performance means.

Table 5.18 Mean difference, Standard deviation (SD) of difference, and t-statistic and *p*-value for testing for a difference between self-directed team learning means and self-directed team performance means

Dimension		Sample size (n)	Mean difference	SD of difference	t-statistic	*p-value*	Effect size
1	Team 1	9	0.117	0.14	2.46	0.0391*	0.63
2	Team 2	7	0.088	0.22	1.07	0.3248	0.31
3	Team 3	9	0.349	0.17	6.02	0.0003*	1.38

*: Statistically significant at the 5% level of significance

Clearly, for team 1 and team 3, the null hypothesis could be rejected at the 5% level of significance. However, this was not the case for team 2. Furthermore, the corresponding effect sizes suggest practical significance. I concluded that a relationship existed between self-directed team learning and self-directed team performance for teams 1 and 3. However, in the light of the small samples the results were viewed with extreme circumspection.

3.1.4 Continuation training results

In this section continuation training differences reported in the SDTLQ (reference V116 to V130 as completed by the three teams) were statistically analysed. This analysis was conducted in lieu of the potential and value of continuation training when considering the sustainability of self-directed team learning within this workplace. An analysis of variance (ANOVA) was used to determine whether differences in continuation training between the three teams existed. The *p*-value (0.6087) was larger than .05 considered in this case. From Table 5.19 it follows that no statistical difference between the three continuation training means existed.

Table 5.19 Results of ANOVA for the continuation training (CT) differences (dependent variable) between the three teams (Least Squares Means, LSM, used for multiple comparisons)

	Teams						*p*-value
	1		2		3		
	LSM	Std Error	LSM	Std Error	LSM	Std Error	0.6087
CT	2.75	0.15	2.92	0.17	2.71	0.15	

ANOVA and post hoc comparisons indicate no statistically significant differences between the three teams regarding continuation training. Clearly, no statistically significant differences existed between the three teams in terms of continuation training (CT). Thus one cannot use continuation training (CT) to distinguish between the three teams.

3.2 Team learning approaches and self-directed team relationship results

The focus and purpose of the SDTLQ and LAQ differed, however, essentially they endeavoured to measure aspects of team learning dynamics within a defined workplace. I realised that this possibility of a latent difference may require further investigation. Findings may possibly have some bearing on qualitative data analysis. Hence I determined whether a relationship could be traced between learning approaches from the LAQ (Table 5.20) and the self-directed team performance and self-directed team learning from the SDTLQ.

Table 5.20 Learning approaches described by the LAQ

Learning approaches in terms of learning content (LAQc)							
Deep approach (DA)		Achievement approach (AA)		Self-efficacy (SE)	Surface approach (SA)		
Strategy (DS)	Motive (DM)	Strategy (AS)	Motive (AM)		Strategy (SS)	Motive (SM)	Fear of failure (FF)
Learning approaches in terms of social orientations when learning (LAQs)							
Dependent (DEPEN)		Independent (INDEPEN)		Inter-dependent			
				Competitive (COMP)		Cooperative (COOP)	

Adapted by the researcher from Schaap (2000: 556)

This paragraph elaborates on information relating to LAQ criteria presented in Table 5.20 and LAQ relationships. The LAQ allowed for measurement of learning approaches in terms of learning content (LAQc) and social orientations (LAQs). The **LAQc** allowed for measurement of learning approaches in terms of learning content, consisting of deep approaches (DA), achievement approaches (AA), surface approaches (SA) and self-efficacy (SE). A deep approach (DA) is synonymous with the use of appropriate deep learning strategies (DS) in relation to an individual's motives (DM) (Schaap, 2000: 556). An achievement approach (AA) refers to achievement learning strategies (AS) in relation to an individual's motives (AM) (Schaap, 2000: 556). According to Schaap (2000: 556) effective learning also relies on high

scores for self-efficacy (SE) and low scores for fear of failure (FF). Fear of failure (FF) is grouped as with surface learning strategy (SS) and an individual's motives (SM) under surface approach to learning (SA) (Schaap, 2000: 556). Schaap (2000: 556) states that the higher the deep approach (DA) and achievement approach (AA) dimensions are relative to the surface approach (SA), the more effective learning is resembled. The **LAQs** measured dependent (DEPEN), independent (INDEPEN), and inter-dependent learning approaches in terms of social orientations in a learning situation (Schaap, 2000: 556). An inter-dependent learning approach comprises cooperative (COOP) and competitive (COMP) learning approaches in terms of social orientations in a learning situation (Schaap, 2000: 556). An ideal learning approach within group learning situations requires distinct cooperative (COOP) and independent (INDEPEN) orientations (Schaap, 2000: 556). Orientations strongly supporting competitiveness (COMP) and dependency (DEPEN) do not allow for an ideal group learning approach (Schaap, 2000: 556).

This paragraph provides a description of the SDTLQ criteria. Self-directed team performance means (defined as **SDPM**) were calculated for V12 to V25 (team work characteristics), V27 to V40 (team performance activities), V41 to V47 (individual reflection), V48 to V63 (team work performance measures) and V64 to V71 (team performance dynamics) for each team. Self-directed team learning means (defined as **SDLM**) were calculated for V72 to V78 (individual learning preferences), V79 to V84 (learning participation), V86 to V90 (workplace training design), V91 to V95 (workplace training implementation), V96 to V100 (workplace training evaluation), V101 to V115 (operational training characteristics), V116 to V130 (continuation training characteristics), V131 to V141 (workplace learning environment), and V142 to V149 (team learning facilitation) for each team. Four relationship categories were identified. Relationship categories for each of the three teams were calculated by using Spearman's correlation coefficient. These categories consisted of the following:

1. LAQc (learning approaches in terms of content) as derived from the LAQ correlated and self-directed team performance (SDPM) as derived from the Self-directed Team Learning Questionnaire;
2. LAQc (learning approaches in terms of content) as derived from the LAQ correlated and self-directed team learning (SDLM) as derived from the Self-directed Team Learning Questionnaire;
3. LAQs (learning approaches in terms of social orientations when learning) as derived from the LAQ correlated and self-directed team performance (SDPM) as derived from the Self-directed Team Learning Questionnaire; and

4. LAQs (learning approaches in terms of social orientations when learning) as derived from the LAQ correlated and self-directed team learning (SDLM) as derived from the Self-directed Team Learning Questionnaire.

The Spearman correlation coefficient was used because it measures whether there is a monotone increasing/decreasing relation between the two variables (linear or non-linear); unlike the Pearson correlation coefficient that measures the linear relationship between two variables. Spearman correlations were calculated between the variables SDPM and SDLM with the LAQc and LAQs variables separately. In cases where *p*-value ≤ .05, the null hypothesis (no correlation exists between the pair of variables for which the correlation coefficient is given) can be rejected.

LAQ variables were presented as percentile-variables (with reference to P-variables; for example PCOOP) and stanine variables (with reference to S-variables; for example SCOOP). P-variables took on values of 1, 2 & 3, and were deemed unsuitable for correlation in this respect. **Variables considered for this analysis were LAQ S-variables because they took on integer values from 1 to 9**. 16 LAQ S-variables were analysed for each team. Significance was set at the 5% level. All Spearman correlation coefficients between LAQc and SDPM and SDLM; and LAQs and SDPM and SDLM (only considering LAQ S-variables) for teams 1, 2 and 3 are presented in Appendix G. Noteworthy correlations and the corresponding *p*-values for *p* are presented in Table 5.21.

Table 5.21 Spearman correlation coefficients between LAQc and SDPM and SDLM; and LAQs and SDPM and SDLM (only considering LAQ S-variables) with corresponding *p*-values

				SDTLQ	
Team	**n**	**LAQ (S-variables)**	**LAQ description**	**SDPM**	**SDLM**
Team 1	9	SCOOP	Cooperative interdependent learning approach in terms of social orientation	**r = 0.9613** ***p* < 0.0001***	**r = 0.7352** ***p* = 0.0240***
Team 2	7	SDS	Deep learning approach strategy in terms of learning content	r = 0.4304 *p* = 0.3351	**r = 0.7671** ***p* = 0.0441***
		SDM	Deep learning approach motive in terms of learning content	r = -0.0181 *p* = 0.9691	**r = 0.8728** ***p* = 0.0103***
		SDA	Deep learning approach in terms of learning content	r = 0.1853 *p* = 0.6908	**r = 0.7783** ***p* = 0.0393***

		SSE	Self-efficacy learning approach in terms of learning content	r = -0.1889 *p* = 0.6849	**r = 0.9449** ***p* = 0.0013***
		SDAAASE	Deep-achieving approach to learning	r = 0.0197 *p* = 0.9666	**r = 0.8078** ***p* = 0.0280***
		SCOOP	Cooperative interdependent learning approach in terms of social orientation	r = 0.1101 *p* = 0.8142	**r = 0.8994** ***p* = 0.0058***
Team 3	9	SDM	Deep learning approach motive in terms of learning content	**r = 0.7378** ***p* = 0.0232***	r = 0.5027 *p* = 0.1677
		SDA	Deep learning approach in terms of learning content	**r = 0.6900** ***p* = 0.0397***	**r = 0.8142** ***p* = 0.0075***
		SAM	Achievement learning approach motive in terms of learning content	r = 0.4546 *p* = 0.2188	**r = 0.7199** ***p* = 0.0287***
		SFF	Fear of failure in terms of surface approach to learning content	**r = -0.9139** ***p* = 0.0006***	**r = -0.6817** ***p* = 0.0431***
		SINDEPEN	Independent learning approach in terms of social orientation	**r = 0.8306** ***p* = 0.0056***	**r = 0.7638** ***p* = 0.0166***

r is the correlation coefficient and ***p*** is the corresponding *p*-value

*: $p \leq .05$ (statistically significant at the 5% level of significance)

In the following discussion conclusions are presented where the null hypothesis (which stated that no correlation[9] existed between the pair of variables for which the correlation coefficient was given) was rejected[10].

- In **team 1** a cooperative interdependent learning approach (COOP) in terms of social orientation (from the LAQ) correlated with self-directed team performance (SDPM) and self-directed team learning (SDLM) as derived from the Self-directed Team Learning Questionnaire. From Table 5.21 and the accompanying LAQ description[11] it was clear that the cooperative approach to learning illustrated a social orientation in terms of group learning within team 1. The cooperative approach to learning also showed a relationship with self-directed team performance criteria and self-directed team learning criteria as described in the SDTLQ's SDPM and SDLM[12].

[9] In this discussion use of the terms "correlated" and "correlation" implied statistical significance at the 5% level of significance.
[10] Statistical analysis and results reported were verified by the author of the LAQ (reference: Appendix H).
[11] LAQ criteria and relationships are described on page 319.
[12] SDTLQ Self-directed team performance criteria are described on page 320.

It can be concluded that in the case of team 1 a cooperative interdependent learning approach within a social learning orientation supported self-directed performance and learning criteria.

- In **team 2** a deep approach (DA) to learning {inclusive of strategy (DS) and motive DM)} resulted in a deep approach in terms of learning content (DAAASE). The deep approach in terms of learning content correlated with self-directed team learning (SDLM) as derived from the SDTLQ[13]. A self-efficacy learning approach (SE) in terms of learning content (from the LAQ[14]) correlated with self-directed team learning (SDLM) as derived from the Self-directed Team Learning Questionnaire. A cooperative interdependent learning approach (COOP) in terms of social orientation (from the LAQ) also correlated with self-directed team learning (SDLM) as derived from the SDTLQ.

  In the case of team 2 a deep approach in terms of learning content (DAAASE) supported by a self-efficient learning approach (SE) showed a relationship with the SDTLQ's SDLM. In this regard Schaap (2000: 556) stated that a self-efficient learning approach (SE) combined with a deep learning approach contribute towards effective learning (Schaap, 2000: 556). The deep approach in terms of learning content reported by team 2 was also supported by a cooperative interdependent learning approach (COOP) in terms of social orientation (from the LAQ). In this case a favourable learning approach within group learning situations can be expected (Schaap, 2000: 556). It can thus be concluded that in the case of team 2 the LAQ criteria listed in this paragraph were considered to be supportive of self-directed team learning.

- In **team 3** a deep learning approach (DA) correlated with self-directed team performance (SDPM) and learning (SDLM) from the SDTLQ[15]. It was also found that a deep learning approach motive (DM) correlated with self-directed team performance (SDPM). Achievement learning approach motive (AM) in terms of learning content correlated with self-directed team learning (SDLM). Fear of failure (FF) correlated negatively with self-directed team performance (SDPM) and learning (SDLM). An independent learning approach (INDEPEN) in terms of social orientation (from the LAQ[16]) correlated with self-directed team performance (SDPM) and learning (SDLM). This

[13] SDTLQ Self-directed team performance criteria are described on page 320.
[14] LAQ criteria and relationships are described on page 319.
[15] SDTLQ Self-directed team performance criteria are described on page 320.
[16] LAQ criteria and relationships are described on page 319.

independent approach to learning illustrated a social orientation in terms of group learning within team 3.

According to Schaap (2000: 556) a positive relationship has been demonstrated between a deep learning approach (DA) and an independent learning approach (INDEPEN). Schaap (2000: 556) agrees that a negative correlation in terms of fear of failure (FF) should support effective learning. It can thus be concluded that in the case of team 3 the LAQ criteria listed in this paragraph were considered to be supportive of self-directed team performance and self-directed team learning.

In summary 12 LAQ S-variables from the 48 LAQ S-variables analysed allowed for the rejection of the null hypothesis (which stated that no correlation existed between the pair of variables for which the correlation coefficient was given) at a 5% level of significance. It is possible to conclude that a broad-spectrum relationship existed between focal points of the LAQ and the SDTLQ when considering team learning approaches (both learning content and social orientations when learning) and self-directed team learning results (both self-directed team performance and self-directed team learning). Within these three teams statistically significant (at the 5% level of significance) relationship categories were all in support of self-directed team learning criteria and/or self-directed team learning criteria. As a result statistical significant relationships (statistically significant at the 5% level of significance) identified in Table 5.21 were considered to be supportive of learning approaches that sustained self-directed team learning and self-directed team performances.

4 Conclusion

Conclusion 

In this chapter the data analysis and presentation of results that formed the main focus of this study were discussed. Qualitative results, which relied upon individual interview data and focus group interview data, were reported during the first phase. This first phase was followed by quantitative results, which relied upon Self-directed Team Learning Questionnaire (SDTLQ) and Learning Approach Questionnaire (LAQ) data.

During the analysis of data collected at the three research sites I observed a likely relationship between qualitative results and quantitative results. In my opinion this relationship was the result of similarities found

in team performance, self-directed learning and continuation training focus areas. I concluded that this perceived relationship between inductive qualitative data analysis and the SDTLQ indicators (quantitative data), which relied upon deductive data analysis may have contributed towards content-related validity and trustworthiness.

In Chapter 6 findings are discussed further and results are contextualised.

CHAPTER 6

DISCUSSION OF FINDINGS AND CONTEXTUALISING RESULTS

Figure 6.1 Chapter 6 orientation

Introduction		
Findings	Self-directed air traffic control team performance results	Aspects identified that advanced my understanding of self-directed air traffic control team performance results
		Relationships inferred from an analysis of self-directed air traffic control team performance results
		Reported practices that influenced my understanding of self-directed air traffic control team performance results
		Summary
	Self-directed air traffic control team learning results	Aspects identified that advanced my understanding of self-directed team learning dynamics within self-managed air traffic control teams
		Relationships inferred from an analysis of self-directed team learning dynamics within self-managed air traffic control teams
		Reported practices that influenced my understanding of self-directed team learning dynamics within self-managed air traffic control teams
		Summary
	Future/continued air traffic control team learning possibilities	Aspects identified that advanced my understanding of future/continued air traffic control team learning possibilities
		Relationships inferred from an analysis of future/continued air traffic control team learning possibilities
		Reported practices that influenced my understanding of future/continued air traffic control team learning possibilities
		Summary
Contextualising results		
Synthesis		

Compiled by the researcher

1 Introduction

Introduction

In this chapter findings are discussed and results are contextualised. I realised that this phase will require high standards of objectivity and systematic reporting.

My reporting was therefore guided by a comparative approach. Firstly findings that originated from different data sources were compared within the boundaries of each research question. Secondly these findings were integrated and then compared with theoretical understanding. Finally results were contextualised and synthesised in order to present my understanding of the findings. This comparative approach also allowed for triangulation.

My interpretations presented in this chapter were directed by my conceptual orientation. A point of departure followed by me was that there are multiple interpretations of, and perspectives on single events and situations (Cohen, Manion & Morrison, 2000: 22). McMillan and Schumacher (2001: 463) are in agreement that most qualitative researchers lean more toward the interpretivist/subjectivist and less towards the technical/objectivist style. **Analysing qualitative data is described by McMillan and Schumacher (2001: 463 & 464) as an eclectic activity and the researcher must accept that there is no one "right way" and data can be analysed in more than one way.**

These inductive analysis views expressed by Cohen, Manion and Morrison (2000: 22) and McMillan and Schumacher (2001: 463) guided my reporting conduct. Phenomena were reported within its real life contexts in order to explore views, meanings, experiences, accounts, actions and events that had transpired.

2 Findings

Findings	Self-directed air traffic control team performance results	Aspects identified that advanced my understanding of self-directed air traffic control team performance results
		Relationships inferred from an analysis of self-directed air traffic control team performance results
		Reported practices that influenced my understanding of self-directed air traffic control team performance results
		Summary

	Self-directed air traffic control team learning results	Aspects identified that advanced my understanding of self-directed team learning dynamics within self-managed air traffic control teams
		Relationships inferred from an analysis of self-directed team learning dynamics within self-managed air traffic control teams
		Reported practices that influenced my understanding of self-directed team learning dynamics within self-managed air traffic control teams
		Summary
	Future/continued air traffic control team learning possibilities	Aspects identified that advanced my understanding of future/continued air traffic control team learning possibilities
		Relationships inferred from an analysis of future/continued air traffic control team learning possibilities
		Reported practices that influenced my understanding of future/continued air traffic control team learning possibilities
		Summary

Findings resulting from data analysed in Chapter 5 are discussed with reference to the following categories:

- Self-directed team performance results.
- Self-directed learning results.
- Future/continued team learning possibilities.

These discussions were guided by the following key questions associated with this impact study (Readership Institute, 2005: 1):

- What features were identified to advance and enhance understanding of the research focus area(s)?
- What relationships were inferred between aspects/elements that are being studied?
- How did observed practices influence the research focus area(s)?

2.1 Self-directed air traffic control team performance results

Air traffic controller behaviours and performances are directed by specific rules, regulations, instructions, procedures and a common team objective; namely aviation safety (Barbarino & Isaac, 2000: 271 and Manning, 2000: 257). Such an important team objective/vision suggests adherence to self-directed team performance principles and conditions. Creating understanding in this regard required an investigation of the nature of air traffic control teams' collective/team mental models and tracing the associated success/impact thereof upon air traffic control operations (Cannon-Bowers, Salas & Converse, 1993:

221-246 and Hacker, Dunlosky & Graesser, 1998: 20). The impact of identified behaviours and performances on air traffic control operations observed from an individual, collective and organisational perspective is accordingly reported in this section[1].

Self-directed air traffic control team performance should ultimately be aimed at achieving results that support aviation safety and illustrate the importance of teamwork within a community of practice (Smith-Jentsch, Zeisig, Cannon-Bowers & Salas, 1997: 201-206 and ATNS, 2003: 20). Key questions driving an impact study (Readership Institute, 2005: 1) were adapted in order to facilitate this discussion of self-directed team performance results. These questions are presented below and associated discussions of findings are offered in paragraphs 2.1.1, 2.1.2, 2.1.3 and 2.1.4.[2]

- What aspects were identified that advanced understanding of self-directed team performance results?
- What relationships were inferred between aspects/elements that resulted from an analysis of self-directed team performance results?
- How did reported practices influence my understanding of self-directed team performance results?

2.1.1 Aspects identified that advanced my understanding of self-directed air traffic control team performance results

Self-directed work teams are multiskilled and take on the responsibilities of the work while realising the importance of continuously developing skills and knowledge of team members (Irwin & Rocine, 1994: 10, Schmidt and Moust, 2000: 21-23 and Williams, 2004: 1-5). Reported attitudes displayed by team members supported a belief in the importance of teamwork in order to ensure efficient air traffic control operations (Table 5.10 *teamwork characteristics and teamwork activities*; Table 5.13 *teamwork characteristics* and Figures 5.3 & 5.4). Team members were in agreement that the air traffic control work team was not more important than team members (Figure 5.2).

From my study I found that power was shared amongst team members, individual contributions were encouraged and internal commitment amongst members was present (Table 5.10 *teamwork characteristics*

[1] With reference to Chapter 5 Tables 5.10 and 5.13 (Results: Impact of teamwork on air traffic control workplace performance outcomes) and Figures 5.2 to 5.6 (Self-directed team performance results).
[2] Subcategories are included as part of references to Tables 5.10 and 5.13 (for example: Table 5.10 *teamwork characteristics* – in this regard reference is made to Table 5.10 and specifically the subcategory titled "teamwork characteristics").

and Table 5.13 *teamwork characteristics and self-efficacy*). These findings corresponded with Smith-Jentsch, Zeisig, Cannon-Bowers and Salas' (1997: 201-206), ATNS (2003: 22) and ICAO's (2001: 2.1) views that an air traffic control team has a shared common purpose regarding the goals and functions of such a team.

Air traffic control team performance was influenced by commonly understood and introduced teamwork performance measures that encouraged effective teamwork dynamics (Table 5.10 *teamwork performance measures* and Figure 5.5). Teamwork performance measures were described in terms of implemented air traffic control practices (including compliance with unit operational rules and separation standards) and team performance support occurrences within this community of practice (Table 5.10 *teamwork performance measures* and Figures 5.3 & 5.5). Reports applicable to air traffic control operational output features considered during performance evaluation included incident reports, airspace efficiency measures, team performance indicators, communication breakdowns and emergency management assessments (Table 5.10 *teamwork characteristics and teamwork performance measures*; Table 5.13 *teamwork characteristics* and Figure 5.5). These team performance findings revealed that teams have knowledge of individual and team performance problems, associated impact indicators and means to identify/predict these problems was evident. These team performance reports pointed towards the existence of a collective/team mental model (Cannon-Bowers, Salas & Converse, 1993: 221-246).

Team members rarely attempted to understand why colleagues behave in certain ways (Figure 5.2). This may point towards a prevailing sense of confidence in a team's collective ability (Smith-Jentsch, Zeisig, Cannon-Bowers and Salas, 1997: 201-206 and Rouse & Morris, 1986: 349-363). Reports were also received that status differences within teams were viewed as an inhibiting factor (Table 5.10 *teamwork characteristics*). I noted that these status differences did not negatively impact upon individual or team performances or learning initiatives (Table 5.10 *teamwork characteristics*). An explanation in this regard may be that collaborative efforts and increased synergy as described by Kraiger and Wenzel (1997: 2) and Smith-Jentsch, Zeisig, Cannon-Bowers and Salas (1997: 201-206) were presented as team performance strategies considered when teams had to address performance difficulties.

From my study I found that team performance was also supported by individual and team performance reflection opportunities, thus allowing for personal and collective explorative events (Table 5.10 *performance reflection*; Table 5.13 *performance reflection* and Figures 5.3 & 5.4). Applied reflection focused on air traffic control skills and relationship events, which prompted self-directed learning opportunities (Table 5.10 *performance reflection*; Table 5.13 *performance reflection* and Figures 5.3 & 5.4). I found that these

individual and team reflective practices corresponded to air traffic control performance characteristics reported by Smith-Jentsch, Zeisig, Cannon-Bowers and Salas (1997: 201-206) and Kraiger and Wenzel (1997: 2).

2.1.2 Relationships inferred from an analysis of self-directed air traffic control team performance results

Cannon-Bowers, Salas and Converse (1993: 221-246) and West, Farmer and Wolff (1991: 27-29) acknowledge that relationships and high levels of shared understanding (shared mental models) between team members ensure efficient and successful goal accomplishment. Intra-team relationships rely upon team members' contributions towards information sharing, helpfulness and fellowship (Smith-Jentsch, Zeisig, Cannon-Bowers and Salas, 1997: 201-206).

In my research I found that helpfulness and fellowship within air traffic control teams were essential in terms of work performance and ensuring reliance amongst team members (Table 5.10 *teamwork dynamics*; Table 5.13 *teamwork dynamics and teamwork characteristics* and Figure 5.6). Team cohesion, situational awareness and collective efficacy resulted from a need to work together within a community of practice that embraced a sense of shared purpose and positive attitudes, thus resulting in team competence (Table 5.10 *teamwork dynamics, teamwork performance measures and teamwork characteristics*; Table 5.13 *teamwork dynamics and teamwork characteristics* and Figures 5.3, 5.4 & 20). Individual and collective goal setting and involvement during difficult controlling periods/tasks strengthened team relations and performances (Table 5.10 *teamwork characteristics and self-efficacy and teamwork activities*).

I found that similar skills levels and shared judgements, problem-solving and decision-making efforts strengthened team relations and emerged as cue-strategy associations, and subsequently enhanced team performance (Figure 5.6). Trust and respect emerged as important individual and collective features of a self-directed team (Table 5.10 *teamwork dynamics* and Figure 5.6).

I discovered that teamwork problems, conflict situations, personal differences and communication shortcomings led to possible performance breakdowns (Table 5.10 *teamwork dynamics*; Table 5.13 *teamwork characteristics* and Figure 5.5). Conflict was addressed by means of team self-correction skills that included supervisor interventions, work schedule changes and conversations/discussions (Tables 5.10 & 5.13 *teamwork characteristics*). During these performance breakdowns teams still strived towards

continuation of air traffic control service delivery (Tables 5.10 & 5.13 *teamwork characteristics* and Figure 5.3).

2.1.3 Reported practices that influenced my understanding of self-directed air traffic control team performance results

Self-directed team performance requires an upholding and safeguarding of air traffic control standards and processes as a shared priority (Smith-Jentsch, Zeisig, Cannon-Bowers & Salas, 1997: 201-206, Fuller, Johnston & McDonald, 1995: 1 and ICAO, 2001: 2.1). In an attempt to understand these air traffic control practices and their impact upon operational performance I uncovered certain teamwork characteristics and activities.

I discovered that a collective orientation towards safety concerns, work processes and duty responsibilities impacted upon team planning initiatives, communication and information exchange, supervision responsibilities and performance activities (Tables 5.10 & 5.13 *teamwork activities and performance reflection* and Figures 5.3 & 5.4). Reports signifying power sharing and a notion that certain team roles were more important than others provided evidence in support of mental models of team role-interaction patterns and boundary spanning of roles and responsibilities (Tables 5.10 & 5.13 *teamwork characteristics* and Figure 5.2). I found that teams illustrated knowledge of performance-related team member characteristics and task expectations (Tables 5.10 & 5.13 *teamwork activities and performance reflection* and Figures 5.3 & 5.4). I believe that this shared knowledge may have been influenced by critical views held by air traffic controllers, sensitivity towards team diversity and pressures exerted by teams towards conformance.

My study of air traffic control performance practices showed acceptance of personal and professional responsibilities, presence of team cohesion/synergy, experience-sharing opportunities and occurrences, and practical/experience-based learning (Tables 5.10 & 5.13 *teamwork activities; performance reflection and teamwork dynamics* and Figures 5.3, 5.4 & 5.6).

From my study I discovered that air traffic control team performance practices corresponded with ATNS (2003: 22) and Barbarino and Isaac's (2000: 271) views of an air traffic control community of practice that approves self-directed team performance.

2.1.4 Summary

In this section I presented my understanding of the impact of self-directed team operations as applicable to this study and considered associated enablers, assessment criteria, inferred relationships and observed practices in this regard. Evidence provided supported an opinion that air traffic controllers valued effective self-directed teamwork that led to desired air traffic control operational outcomes. This summary of self-directed air traffic control team performance impact indicators highlighted these teams' shared professionalism in upholding and safeguarding air traffic control standards and processes in continuous pursuit of aviation safety objectives as well as employment of self-directed learning routines (Tables 5.10 & 5.13 *teamwork activities; performance reflection* Figures 5.3, 5.4 & 5.12).

My understanding of self-directed air traffic control team performance results was consistent with team and team member generic attitudes, cognitive, knowledge and behavioural skills/competencies as described by Smith-Jentsch, Zeisig, Cannon-Bowers and Salas (1997: 201-206) and Cannon-Bowers, Salas and Converse (1993: 221-246).

2.2 Self-directed air traffic control team learning results

Self-directed learning viewed from an adult learning and experiential learning perspective requires collaborative and/or cooperative learning initiatives, experience-based stimuli, reflective practices and an integration of learning and life (Panitz, 1996: 1 & 2, Kolb, 1984: 22, Argyris, 1982: 87 and Hammond & Collins, 1991: 13). Appreciation of self-directed learning phenomena within a defined workplace is challenging as self-directed learning relies upon different forms of individual and collective schemata (Mezirow, 1981: 3-24, Silverman & Casazza, 2000: 21, Zimmerman & Lebeau, 2000: 309 and Rogers, 2002: 9 & 71). The impact of self-directed learning expectations, characteristics, dynamics and influences observed from an individual, collective and organisational perspective is accordingly reported in this section[3].

Self-directed air traffic control team learning should ultimately be aimed at achieving results that support aviation safety and effective team behaviour. Key questions driving an impact study (Readership Institute, 2005: 1) were adapted in order to facilitate this discussion of self-directed team learning results. These

[3] With reference to Chapter 5 Tables 5.9 and 5.12 (Results: Impact of self-directed team learning dynamics within self-managed air traffic control teams) and Figures 5.7 to 5.15 (Self-directed team learning results).

questions are presented below and associated discussions of findings are offered in paragraphs 2.2.1, 2.2.2, 2.2.3 and 2.2.4.[4]

- What aspects were identified that advanced my understanding of self-directed team learning dynamics within self-managed air traffic control teams?
- What relationships were inferred from an analysis of self-directed team learning dynamics within self-managed air traffic control teams?
- How did reported practices influence my understanding of self-directed team learning dynamics within self-managed air traffic control teams?

A statistically significant relationship was found between self-directed team learning and self-directed team performance for teams 1 and 3[5]. In the light of the small samples used, these results were viewed with caution. In the case of team 2 supportive qualitative indicators that supported an absence of a relationship between self-directed team learning and self-directed team performance were not evident. Data presented below (from all three teams) suggested a relationship between self-directed team learning and self-directed team performance.

2.2.1 Aspects identified that advanced my understanding of self-directed team learning dynamics within self-managed air traffic control teams

Self-directed learning focuses on experiences, competencies and challenges (Brockett & Hiemstra, 1991: 104 & 105, Gibbons, 2002: 32 and Zimmerman & Lebeau, 2000: 309). In my study I found that learning and training efforts were directed by air traffic control safety objectives and team performance needs (Table 5.9 *operational training characteristics and learning environment*).

I found that air traffic control teams emphasised an attitude and willingness to learn from experience, appreciate benefits associated with learning from experience and that learning from experience was regarded to be multifaceted (Tables 5.9 & 5.12 *individual learning preferences, participative learning, operational training characteristics and learning environment* and Figures 5.7, 5.8, 5.12 & 5.13). Work environment and social influences reportedly impacted both in a supportive and unsupportive manner upon self-directed team learning (Tables 5.9 & 5.12 *team learning facilitation* and Figure 5.15). Despite these

[4] Subcategories are included as part of references to Tables 5.9 and 5.12 (for example: Table 5.9 *participative learning* – in this regard reference is made to Table 5.9 and specifically the subcategory titled "participative learning").
[5] Reference: Chapter 5 paragraph 3.1.3.

divergent views I found that both individuals and teams agreed that collaborative learning from experience was occurring and that it was advantageous with regard to individual and team development, as well as operational performance (Tables 5.9 & 5.12 *individual learning preferences, participative learning, operational training characteristics and learning environment* and Figures 5.7, 5.8, 5.12 & 5.13).

My research findings of the impact of self-directed team learning could therefore be linked to Boud, Cohen and Walker's (1993: 9-16) five propositions on learning from experience (experience as stimuli for learning, learners construct their experiences, learning is a holistic process, socially and culturally constructed and influenced by the socio-emotional context).

I found that learning-by-doing (experiential learning) presented opportunities to teams and team members to practice skills, reflect upon performances and evaluate service delivery (Tables 5.9 & 5.12 *individual learning preferences and learning environment* and Figures 5.7 & 5.14). Learning took place by means of the competent practice of skills, critical revision of personal practices, creation of new perspectives and direct experiences (Tables 5.9 & 5.12 *individual learning preferences and learning environment* and Figures 5.7 & 5.14). I discovered that these self-directed team learning activities (within the scope of workplace performance) were consistent with Mulligan (1993: 56) and Heron's (Postle, 1993: 33-35) multimodal learning view.

In my research I found that individual and collective learning within air traffic control teams was characterised by planned and unplanned training and learning strategies. I found that training objectives were determined by specific team members (Figure 5.9). A reported reliance on external aided learning (Table 5.9 *individual learning orientation*) by air traffic control teams served as an example of planned training and learning. Acceptance and support for a centralised planned training and cooperative learning approach within the workplace was reported by the teams. This responsibility was generally entrusted to specific members and the teams relied upon their efforts (Table 5.12 *training design* and Figure 5.9). From my study I concluded that planned training and cooperative learning was aligned to a need to provide access to shared meaning structures facilitated by a requirement to interpret and present information by means of individual and collective guided dialogue. In my study I found that learning efforts demonstrated and supported a stance that effective self-directed team learning was dependent upon meta-cognitive competencies that included conscious and deliberate learning strategies as described by West, Farmer and Wolff (1991: 81), Zimmerman and Lebeau (2000: 309) and Zimmerman (1990: 4). My self-directed learning findings were consistent with Dixon's (1994: 43) view of shared meaning structures (which include accessible meaning structures, collective meaning structures and private meaning structures).

I discovered that informal learning activities within the air traffic control workplace served as an example of unplanned/unintentional training and learning occurrences (Tables 5.9 & 5.12 *participative learning*). Unplanned individual and team training and learning initiatives were stimulated by premeditated and ingenuous contributions from team members and personal motives (Tables 5.9 & 5.12 *individual learning preferences and participative learning* and Figures 5.7 & 5.8). These unplanned learning opportunities correspond with a view held by Brookfield (1985: 9) that successful self-directed learning is placed within a social context and relies upon actions and experiences of other team members in order to reinforce learning.

Self-directed team learning reports illustrated a favourable attitude towards purposeful participative/collaborative learning approaches brought about by personal and collective learning needs and opportunities (Tables 5.9 & 5.12 *participative learning* and Figure 5.8). Critical investigations, informal discussions, formal discussions and assuming personal responsibility/resourcefulness were put forward as participative learning initiatives employed within air traffic control teams (Tables 5.9 & 5.12 *participative learning* and Figure 5.8). These self-directed learning initiatives are consistent with Ober, Yanowitz and Kantor (1996: 50), Goleman (1998: 28) and MacLeod's (2001: 26) view that self-directed learning is dynamic and shaped by different individual perspectives.

2.2.2 Relationships inferred from an analysis of self-directed team learning dynamics within self-managed air traffic control teams

Reports from the teams illustrated a shared realisation of the importance of workplace learning and shared support and motivation to learn (Tables 5.9 & 5.12 *team learning facilitation* and Figure 5.15). Value associated with this finding was summarised by a team member who stated: *"learning improves teamwork and teamwork improves the service"* (Table 5.9 *team learning facilitation*). From a learning-relationship perspective I noted that team members acknowledged the existence and value of experts and role models within their air traffic control teams (Table 5.9 *team learning facilitation* and Figure 5.15). A mutual readiness and eagerness amongst team members to share and collect experienced based information was reported (Tables 5.9 & 5.12 *team learning facilitation* and Figures 5.7 & 5.8). These shared learning relationships described were synonymous with a self-directed leading learning approach (where individuals and teams are able to design and implement learning) described by Argyris' (1993(a): 5 & 6).

Air traffic controllers interviewed identified co-learning preferences that included observation of other controllers at work, questioning controllers and obtaining feedback from clients (Tables 5.9 & 5.12 *individual learning preferences* and Figure 5.7). Co-learning preferences mentioned in my study corresponded with Barnes, Ernst and Hyde (1999: 26-28) and Zimmerman and Lebeau's (2000: 309) observation that concerted efforts need to be employed by team members to permit the team's overall learning. Concerted efforts identified comprised individual and collective formal/intentional and informal/unintentional training and learning goals (Tables 5.9 & 5.12 *individual learning preferences and participative learning* and Figures 5.7 & 5.8). Individual and team learning goals were consistent with Dixon's (1994: 36-43) view that organisational meaning is probable when private, collective and accessible meaning structures are integrated.

I found that relationships between personal learning preferences and planned learning preferences had transpired as a result of individual learning agendas and team-based learning agendas (Tables 5.9 & 5.12 *individual learning preferences and participative learning* and Figures 5.7 & 5.8). The role, importance and impact of reflection employed to sustain meaning structures was stressed by team members (Tables 5.9 & 5.12 *individual learning preferences and participative learning*). Findings from my study with regard to the relationships between reflection and learning were consistent with views held by Rogers (2002: 108), Taylor, Marienau and Fiddler (2000: 318 & 322), Hammond and Collins (1991: 14) and Edwards, Hanson and Raggatt (1995: 33-40) that reflection deepens awareness and enhances understanding of behaviour, capabilities, beliefs, purpose, values and environment.

According to Sharry (2001: 2) and Dixon (1994: 120) effective relationships within teams rely upon dialogue that directs experiences, transfers information and challenges established opinions. In my study I found that the use of various communication strategies to enhance learning transmission relevant to individual and collective meta-cognitive competencies was encouraged and apparent in the three teams (Figure 5.12). Communication strategies employed within these self-directed teams encouraged effective teamwork and facilitated formal and informal learning initiatives (Table 5.9 *operational training characteristics*). These benefits associated with effective communication strategies were consistent with Kraiger and Wenzel's (1997: 2) shared mental model characteristics, which included shared task information, mutual expectations and complementary task behaviour.

Status differences within these air traffic control teams were considered by some team members as being a hindrance for effective teamwork (Table 5.9 *teamwork characteristics and operational training characteristics*). However, formal training design, implementation and evaluation responsibilities entrusted

to specific status figures was accepted by team members (Table 5.9 *training design, training implementation and training evaluation* and Figures 5.9, 5.10 & 5.11). I found that entrustment of training formal/intentional training design, training implementation and training evaluation resided with chief air traffic control officers, senior air traffic control officers and appointed training officers (Figures 5.9, 5.10 & 5.11). Teams reported that involvement in these imperatives by team members occurred rarely (Figures 5.9, 5.10 & 5.11). These findings are not congruent with team-centred learning design, implementation and evaluation practices associated with self-directed team learning as offered by Gibbons (2002: 11-13 & 69) and Argyris (1993(a): 1-3). However, I found that informal learning was designed, implemented and evaluated primarily by team members (Tables 5.9 & 5.12 *participative learning*). Use of discussions, experiences and observations suggested that individuals and teams designed, implemented and evaluated learning (Tables 5.9 & 5.12 *participative learning*). These informal/unintentional learning processes were congruent with self-directed team learning preferences (thus pointing out that responsibility for own learning resided mainly with team members) described by Gibbons (2002: 11-13), Dolmans and Schmidt, (2000: 252) and Spear and Mocker (1984: 1-10).

I found that self-directed learning was encouraged by a common aviation safety goal and a necessity work together as an effective team (Table 5.9 *operational training characteristics*). Training, however, rarely included stress coping strategies and human factors aspects (such as personal relations, team cohesion and fostering of mutual trust) (Table 5.9 *operational training characteristics*). It was reported that work-related discussions rarely took place at social gatherings (Figure 5.14). However, perceived value of social interaction as a learning source was acknowledged (Table 5.9 *learning environment*). According to team members opportunities to be sensitised in terms of personality difference influences (Figure 5.15) and to get to know team members at a personal level (Figure 5.12) also occurred rarely. Reasons for exclusion of these themes may be found in reports that not enough planned team-build training opportunities were available and that formal workplace learning was externally directed (Table 5.9 *operational training characteristics*). From my findings I concluded that team resource management and human factors training did not receive consistent attention. Team-build opportunities are considered to be beneficial for human factors training (including team resource management strategies) and self-directed team learning because it addresses individual mental factors, interpersonal factors and associated competencies (Thomas, 2004: 213, Amundson, 1995: 83-86, Isaac & Ruitenberg, 1999: 15 and Hamman, Seamster & Edens, 1995: 89-92).

2.2.3 Reported practices that influenced my understanding of self-directed team learning dynamics within self-managed air traffic control teams

In my study I found that an understanding of self-directed team learning dynamics by teams was influenced by individual learning and participative learning practices. Reported learning in this regard was aimed at meeting aviation safety requirements (Table 5.9 *operational training characteristics*) and directed by team member curiosity (Figure 5.7). I found that individual and participative learning was inspired by problem-based learning, experiential learning and reflective learning preferences (Figure 5.7). This finding corresponds with Dixon (1994: 39) and McCann's (2005: 2) assertion that action learning is fundamental to self-directed team performance. Morning meetings, on-the-job training periods, formal briefings, informal discussions, observations, critical reflections, posing of questions and lessons learned from other's mistakes were used by the teams to enhance learning transmission relevant to individual and collective meta-cognitive competencies (Tables 5.9 & 5.12 *individual learning preferences and participative learning* and Figures 5.7 & 5.8). My findings regarding individual and participative learning benefits were consistent with those of Barnes, Ernst and Hyde's (1991: 1) acknowledgement that self-directed teamwork helps team members to enhance their own performance by making use of observations and experiences.

I found that an attitude and willingness to assume responsibility for learning (mainly informal learning) encouraged team members to learn from workplace experiences and to stimulate learning by expressing concerns, suggestions and requests (Table 5.9 *operational training characteristics* and Figures 5.12 & 5.13). In this regard Rogers (2002: 107) states that learning is accomplished by critically analysing experiences and acting on the basis of that analysis. Formal/intentional training presented included lectures, presentations, briefings and structured discussions (Tables 5.9 & 5.12 *learning environment* and Figure 5.14). Informal workplace experiential training as well as design, implementation and evaluation of formal training were encouraged by air traffic control operational management (Figures 5.9, 5.10 & 5.11). These findings relating to learning responsibilities coincide with Brockett and Hiemstra's (1991: 10-17) outlook that self-directed learners accept responsibility and control over planning, implementation and evaluation of individual and collective learning experiences.

Blumberg (2000: 199) reports that team members, participating in problem-based learning, demonstrate self-directed learning skills. I found that individual learning experiences (often motivated by scenario-building, incidents, mistakes and emergencies) were shared within teams resulting in reports from team members of enhanced team performance (Table 5.9 *participative learning and operational training characteristics*).

2.2.4 Summary

This section presented my understanding of the impact self-directed team learning as applicable to this study and considered associated enablers, assessment criteria, inferred relationships and observed practices in this regard. I discovered that participants in my study employed self-directed learning in order to ensure aviation safety imperatives. Self-directed learning was apparent at individual level and relied mainly upon informal/unintentional learning. Self-directed team learning stemmed from all individual self-directed learning undertakings integrated by means of formal/intentional and informal/unintentional learning approaches. However, informal/unintentional approaches seemed to be a preferred primary mode of collaborative learning and were considered to be more beneficial. I found that self-directed air traffic control team learning impact indicators were apparent in air traffic control management's commitment with regard to training, team member's dedication towards self-regulated learning and teams' devotion concerning shared training and learning ownership (Tables 5.9 & 5.12 *participative learning and operational training characteristics* and Figures 5.8, 5.12 & 5.15).

I discovered that team members generated valid and useful information to solve problems (Tables 5.9 & 5.12 *participative learning and operational training characteristics* and Figures 5.8, 5.12 & 5.15). My understanding of the impact of self-directed air traffic control team learning that included sharing of valid information and vigilant monitoring of own and other's experiences in order to detect and correct error was aligned to Model 2 theory-in-use (Argyris, 1982: 101-103). Accordingly I identified self-regulated learning traits which corresponded with Zimmerman's (1990: 4) view that team members become metacognitively, motivationally and behaviourally active participants in self-directed learning. From my study I concluded that self-directed learning occurred in terms of Bruffee (1993: 3) and Argyris' (1992: 68) notion of double-loop learning. This conclusion is motivated in terms of reports where team members observed and reflected upon each other's actions, which in turn guided individual and/or collective actions (Tables 5.9 & 5.12 *participative learning and operational training characteristics* and Figures 5.8, 5.12 & 5.15).

2.3 Future/continued air traffic control team learning possibilities

Sustained competence of air traffic controllers contributes to self-directed team performance. According to IFATCA (2001(a): 1) air traffic controllers should participate in continuation training in order to ensure maintenance of desired performance standards. An important undertaking of continuation training is human factors training (including team resource management), which is required to cope with present and future

aviation safety workplace challenges (Fuller, Johnston & McDonald, 1995: 1 and CAST, 1999: 23). Creating understanding in this regard required an investigation of the nature of air traffic control teams' continuation training practices and the result of continuation training on service delivery. The impact of continuation training (also referred to as continued or future training) observed from an individual, collective and organisational perspective, is accordingly reported in this section[6].

Continuation training within a rapidly changing air traffic control environment should ultimately be aimed at achieving results that support aviation safety and self-directed teamwork (Smith-Jentsch, Kraiger, Salas & Cannon-Bowers, 1999: 42-49). Key questions driving an impact study (Readership Institute, 2005: 1) were adapted in order to facilitate this discussion of air traffic control continuation training. These questions are presented below and associated discussions of findings are offered in paragraphs 2.3.1, 2.3.2, 2.3.3 and 2.3.4.[7]

- What aspects were identified that advanced my understanding of future/continued air traffic control team learning possibilities within self-managed air traffic control teams?
- What relationships were inferred from an analysis of future/continued air traffic control team learning possibilities within self-managed air traffic control teams?
- How did reported practices influence my understanding of future/continued air traffic control team learning possibilities within self-managed air traffic control teams?

2.3.1 Aspects identified that advanced my understanding of future/continued air traffic control team learning possibilities

I found that continued learning was encouraged by air traffic control management (Figure 5.14). Continued learning was encouraged and managed mainly by means of formal cooperative continuation training events (Tables 5.11 & 5.14 *continued learning strategies* and Figure 5.14). Formal continuation training efforts frequently addressed task-related learning contents (Table 5.11 *continued learning strategies*). My findings in this regard included information exchange matters, team feedback skills and flexibility abilities as described by Meyer (1999: 90), Smith-Jentsch, Kraiger, Salas and Cannon-Bowers (1999: 1-3) and Salas, Bowers and Edens (2001: 36-42 & 243). Human factors elements such as stress coping and team resource

[6] With reference to Chapter 5 Tables 5.11 and 5.14 (Results: Impact of self-directed team learning in the air traffic control workplace continuation training scenario), Figure 5.13 (Continuation training characteristics) and Figure 5.14 (Workplace learning environment characteristics).
[7] Subcategories are included as part of references to Tables 5.11 and 5.14 (for example: Table 5.11 *continued learning strategies* – in this regard reference is made to Table 5.11 and specifically the subcategory titled "continued learning strategies").

management strategies were rarely addressed by air traffic control teams as part of continuation training (Figure 5.13). Learning content addressing team member competencies, team member attitudes, supporting behaviours and team situation awareness as described by Smith-Jentsch, Kraiger, Salas and Cannon-Bowers (1999: 1-3), Owen (2000: 333) and Salas, Bowers and Edens (2001: 36-42 & 243) were thus rarely covered during continuation training proceedings. This finding may also be related to reports that not enough planned team-build training opportunities were available (Table 5.9 *operational training characteristics*).

Mixed feelings were expressed by teams and team members in terms of the impact of continuation training benefits (Table 5.11 *continued learning strategies and continued learning value* and Table 5.14 *continued learning environment and continued learning value*). Reports from the three teams revealed that continuation training was centrally managed, time-bound and possibly not always well received by team members (Table 5.11 *continued learning strategies and continued learning expectations* and Table 5.14 *continued learning strategies, continued learning environment, continued learning expectations and continued learning value*). My findings were not congruent with effective continuation training requirements stated by Williams (2004: 1-5), Yancey (2005: 1) and Smith-Jentsch, Kraiger, Salas and Cannon-Bowers (1999: 1-3), which require that a sociable and favourable learning environment needs to exist that encourages concerted efforts by all team members.

2.3.2 Relationships inferred from an analysis of future/continued air traffic control team learning possibilities

No statistically significant differences existed between the three teams in terms of continuation training[8]. Air traffic management endeavoured to create an environment that supported workplace learning and continued learning (Figures 5.9, 5.10, 5.11 & 5.14). A potential relationship between formal self-directed team learning and formal air traffic control workplace continuation training was perceived (Table 5.11 *continued learning strategies* and Figures 5.13 & 5.14). This perceived relationship focused mainly on task specific content in pursuit of a common aviation safety goal.

[8] Reference: Chapter 5 paragraph 3.1.4.

2.3.3 Reported practices that influenced my understanding of future/continued air traffic control team learning possibilities

According to Smith-Jentsch, Kraiger, Salas and Cannon-Bowers (1999: 1-3), ATNS (2003: 22-24) and Salas, Bowers and Edens (2001: 36-42 & 243) air traffic control continuation training should incorporate individual and team knowledge, attitudes and skills. Continuation training practices need to include knowledge, attitude and skill contents made up of air traffic control task contents and human factors contents (Gibbons, 2002: 7, Smith-Jentsch, Kraiger, Salas and Cannon-Bowers, 1999: 1-3 and Salas, Bowers & Edens, 2001: 36-42 & 243). Continuation training practices identified in my study comprised a formal approach that incorporated planned lectures presentations, case studies, quizzes, exams, and directed discussions that focused primarily on air traffic control task contents (Table 5.11 *continued learning strategies* and Figures 5.13 & 5.14). According to Smith-Jentsch, Kraiger, Salas and Cannon-Bowers (1999: 42-45) successful continuation training is characterised by continuation training awareness, interactive learning and feedback, and reinforcement activities. My findings with regard to continuation training practices reported by the three teams were not consistent with Smith-Jentsch, Kraiger, Salas and Cannon-Bowers (1999: 42-45) requirements for successful continuation training efforts.

2.3.4 Summary

Continued learning expectations, characteristics, environments, strategies and value were addressed in this section. Findings presented supported an opinion that formal/intentional continuation training practices were used by air traffic control teams to address task-specific knowledge, skills and attitudes in a similar and cooperative manner. Impact indicators related to these formal air traffic control continuation training activities were traced in terms of contributions to continued aided learning and situational awareness in support of air traffic control knowledge, skills and attitudes (Table 5.11 *continued learning strategies and continued learning value*; Table 5.14 *continued learning value* and Figure 5.13).

These air traffic control continuation training results were found to be not fully aligned to the views of Smith-Jentsch, Kraiger, Salas and Cannon-Bowers (1999: 1-3) and Salas, Bowers and Edens (2001: 36-42 & 243) due to a perceived partial exclusion of human factors content from continuation training. It was also found that continuation training was managed generally in a formal/intentional manner, while informal continuation training practices and associated impact were less obvious (Table 5.11 *continued learning strategies and continued learning value*; Table 5.14 *continued learning value* and Figures 5.13 & 5.14).

3 Contextualising results

In this section findings presented in paragraphs 2.1, 2.2 and 2.3 were contextualised in order to present an integrated view and understanding of the impact of self-directed team learning in an air traffic control environment. My finding regarding the existence of a statistically significant relationship between self-directed team performance and learning and learning approaches is used as a point of departure in this discussion[9]. A broad-spectrum association from a statistical perspective was not claimed with reference to relationships between learning approaches (considering learning content and social orientations when learning) and self-directed team results (considering self-directed team performance and self-directed team learning). Statistical significant correlations between certain learning approaches (considering learning content and social orientations when learning) and certain self-directed team results (considering self-directed team performance and self-directed team learning) were, however, valuable and supportive of contextualised results presented below.

In an attempt to facilitate a deeper understanding regarding team performances and team learning I cross-checked insights with respect to team's performances and self-directed team learning relationships. Self-directed team learning within an air traffic control environment served as a central theme in this regard. Intra- and inter-team perspectives and team member's perspectives were utilised in creating understanding of the impact of self-directed team learning in an air traffic control environment. Understanding and appreciating individual and team learning, team performance and continued learning similarities and/or differences required a process of multilayered pattern-seeking by integrating individual, team and the air traffic control organisation experiences[10]. Results of this process of inductive data analysis and summary are presented below.

Air traffic controllers (considering individual, team and organisational perspectives) directed efforts towards achieving well defined, known and accepted aviation safety objectives. Achievement of these shared objectives relied primarily on task-specific team and team member generic attitudes, cognitive, knowledge and behavioural competencies. Self-directed teamwork and associated self-directed team learning inspired professional competence required to achieve air traffic control operational outcomes. In addition

[9] Reference: Chapter 5 paragraph 3.2.
[10] A crystallisation style permitted maximum experiences within the analytical style (McMillan and Schumacher, 2001: 463).

relationships found between teams' learning approaches and self-directed team performances were supportive of self-directed team learning[11].

Self-directed learning emerged as individual and integrated formal and informal learning events and experiences. Informal learning, described as a preferred mode of learning, allowed team members to observe and reflect upon own actions and other's actions, thus allowing them to become actively involved in self-directed learning. Informal learning at individual level facilitated both task-specific and human factors learning. Formal learning illustrated a reliance on planned collective learning events. Continued/future learning was formalised in terms of continuation training. Formal self-directed and continuation training initiatives focussed mainly on task competencies, whereas human factor competencies did not receive as much consideration. Training and learning initiatives identified in the air traffic control organisation supported self-directed learning theories and practices. Self-directed learning was described by participants in my study as a means to ensure compliance with individual and team competence/ performance requirements. Workplace performances in turn served as a self-directed learning input.

Statistically significant relationships between air traffic control self-directed team learning and operational performance outputs may have been evident in teams 1 and 3. However, such a relationship should be understood in terms of the potential success/impact thereof on aviation safety. These success/impact indicators may be revealed in organisational commitment and support for self-managed and empowered training and learning within air traffic control teams. Contextual results offered collective insight into three self-managed teams' self-directed learning approaches and contributions to aviation safety within an air traffic control community of practice.

4 Synthesis

Synthesis 

Discussion of findings and contextualising of results presented in this chapter suggest that self-directed team learning offered opportunities for individuals and teams within an organisation to influence air traffic control team performances in an air traffic control work environment. **This statement proposes a perceived relationship between self-directed team learning and air traffic control operational outputs.**

[11] Reference: Chapter 5 paragraph 3.2.

The nature of self-directed team learning's impact on the air traffic control work environment was illustrated by presenting identified and described individual and collective (team) views and dynamics. Impact of air traffic control team performances was traced in terms of identified teamwork characteristics, activities, dynamics, performance measures and focus areas and reflective practices.

A deeper understanding of modes of learning by self-directed teams and the impact of self-directed learning upon work performance was discovered from individual and participative learning perspectives. My research included descriptions of the impact of operational training practices with regard to training design, implementation, facilitation and evaluation.

A further understanding and appreciation of how these air traffic control teams sustained continued learning in the workplace was also probed. This inquiry uncovered continued learning expectations, environments, strategies, and benefits.

While considering this discussion of findings and contextualising of results I was able to conclude that self-directed learning within air traffic control teams had an impact on air traffic control operational outcomes, thus contributing towards a critical air traffic control goal – aviation safety[12].

[12] The aim of this research was to discover multiple realities that were assumed to be present in the air traffic control self-directed team learning environment. Accordingly research constraints listed in Chapter 4, paragraph 2 were respected. My discussion of research findings and contextualising of results is only relevant to my study. Generalisations were not a research objective and were not intended.

CHAPTER 7

CONCLUSIONS AND RECOMMENDATIONS

Figure 7.1 Chapter 7 orientation

Introduction	
Overview of this study	
Limitations of this study	
Ethical aspects	
Summary of findings	
Answering the research questions	
Possible contributions	
Recommendations	Recommendations for practice
	Recommendations for training
	Recommendations for research
Concluding comments	

Compiled by the researcher

1 Introduction

Introduction

In Chapter 6 the results of this study were presented according to the following secondary research questions, as formulated in Chapter 1:

- Do air traffic controllers perceive a relationship between self-directed team learning and the air traffic control operational output?
- What is the nature of perceived relationships between self-directed team learning and the air traffic control operational output?
- What are the self-directed team learning dynamics within self-managed air traffic control work teams?
- Do air traffic controllers perceive a relationship between self-directed team learning and air traffic control workplace continuation training?
- What is the nature of perceived relationships between self-directed team learning in the air traffic control workplace continuation training scenario?

Responses to these questions helped to answer the following primary research questions:

- **Does self-directed team learning impact on the air traffic control work environment?**
- **What is the nature of self-directed team learning impact on the air traffic control work environment?**

This chapter offers a final synopsis to this study by providing an overview of the study and a summary of conclusions and recommendations.

2 Overview of this study

Overview of this study

This impact study provided a picture of perceived current reality as presented by 25 respondents. Essential focus areas of this impact study including aspects of relevance are presented below.

- Aspects identified that advanced understanding of self-directed team performance results.
- Relationships inferred between aspects/elements that resulted from an analysis of self-directed team performance results.
- Practices that influenced my understanding of self-directed team performance results.
- Aspects identified that advanced my understanding of self-directed team learning dynamics within self-managed air traffic control teams.
- Relationships inferred from an analysis of self-directed team learning dynamics within self-managed air traffic control teams.
- Practices that influenced my understanding of self-directed team learning dynamics within self-managed air traffic control teams.
- Aspects identified that advanced my understanding of future/continued air traffic control team learning possibilities within self-managed air traffic control teams.
- Relationships inferred from an analysis of future/continued air traffic control team learning possibilities within self-managed air traffic control teams.
- Practices that influenced my understanding of future/continued air traffic control team learning possibilities within self-managed air traffic control teams.

An outline and summary of each of the chapters is provided below.

Chapter 1. In this chapter an overview of the study was provided. This chapter offered an introduction to the study and the rationale for this research. The research problem was described in terms of the impact that self-directed team learning in an air traffic control environment may have. Relevant concepts and terminology were explained in order to serve as an introduction to the specific "world of air traffic control". A brief orientation and discussion was provided in the form of an outline of the research strategy and process.

Chapter 2. In Chapter 2 a theoretical framework was presented as a platform for this study. Literature relevant to this research problem was offered to provide understanding regarding adult learning, learning within teams, self-directed learning, air traffic control operations, air traffic control training and human factors.

Chapter 3. Chapter 3 offered a conceptual orientation that was deemed appropriate. A philosophical departure point and learning conceptualisation were presented in support of the research paradigms of inquiry.

Chapter 4. Chapter 4 offered an in-depth research design and methodology discussion and explanation. This study followed a mixed methods approach (QUALITATIVE - quantitative). Data collection techniques incorporated individual interviews, focus group interviews, self-directed team learning questionnaires (SDTLQ) and learning approach questionnaires (LAQ). An explanation of data analysis and data validation strategies followed after a discussion of my role as researcher.

Chapter 5. In Chapter 5 results obtained were analysed. This analysis focus was placed on both qualitative results and quantitative results.

Chapter 6. In Chapter 6 results obtained from the two phases of this study were presented. A discussion of findings and contextualising of results of this study with information from the literature review ensued. Triangulation was central in this process and ensured a synthesis of findings.

Chapter 7. This chapter presents a final overview of this study with reference to the entire research process. Essentially this chapter therefore focuses on conclusions drawn from this study, as well as recommendations for practice and further research.

3 Limitations of this study

Limitations of this study ←

The following listed limitations to this study (from a qualitative perspective) existed and are acknowledged.

- Research was restricted to three air traffic control centres.
- Only one person performed data collection and interpretation.
- The Hawthorne[1] effect could influence team dynamics, environmental influences and learning dynamics.
- Findings could be criticised in terms of the Hawthorne effect and personal bias.
- Continuous changes in the teams being investigated occurred due to shift and staff rostering requirements.
- This study had a narrow focus, being self-directed team learning.

[1] Hawthorne effect: the tendency of people to act differently because they realise that they are subjects in a study (McMillan & Schumacher, 2001: 591).

- Several respondents had worked and/or trained with the researcher in the past. The researcher role of the researcher may have been strange to individuals and/or teams and thus influenced behaviour.

The following listed limitations to this study (from a quantitative perspective) existed and are acknowledged.

- Respondents may have perceived the researcher's non-participative approach as "cold and distant", which may have influenced responses.
- The Hawthorne effect may have influenced feedback from respondents.
- Respondents may have been oversensitive to certain aspects of the research environment and may have directed their responses accordingly.
- All air traffic controllers did not have an equal chance of being included in the sample because a non-probability convenient sample was used. The sample consisted of 25 respondents. This sample size did not meet the minimum number of 26 respondents[2].

I acknowledge that different data collection instruments and different research paradigms could be used to enhance understanding of this topic. I also acknowledge that different researchers may or may not arrive at different findings by means of a re-analysis of collected data.

4 Ethical aspects[3]

Ethical aspects 

In accordance with ethical requirements I acknowledge the following:

- I obtained written permission from the South African Air Force to conduct the research on 18 February 2005 (Appendix K).
- I informed all respondents during meetings at each air traffic control centre regarding the aim, objectives, nature and ethical requirements of this research project. Participation was voluntary and informed consent from participants was obtained. Confidence was ensured by not disclosing the identity of respondents and research sites.

[2] According to Stoker (1981: 13) a sample size of 26 was considered to be adequate for this study.
[3] The ethical clearance certificate provided by the Faculty of Education at the University of Pretoria is attached as Appendix I.

- I ensured that participants were not exposed to any undue physical or psychological harm.
- Raw data obtained will be available for at least one year after completion of this project and coded data were stored on CD.

5 Summary of findings

Summary of findings ←

Based on my findings discussed in this study an understanding regarding the impact of self-directed team learning in an air traffic control environment emerged.

The impact of self-directed team learning from explanations, discussions, occurrences and initiatives presented by respondents was evaluated at individual, team/collective and organisational levels. My summarised findings are presented below.

- Self-directed teamwork and associated self-directed team learning inspired professional competence required to achieve air traffic control operational outcomes.
- Relationships found between teams' learning approaches and self-directed team performances were supportive of self-directed team learning.
- Self-directed learning emerged as individual and integrated formal and informal learning events and experiences.
- Continued/future learning was formalised in terms of continuation training.
- Training and learning initiatives identified in the air traffic control organisation supported self-directed learning theories and practices.

My discussions of research findings and contextualising of results are only relevant to my study. Generalisations were not a research objective and were not intended. Considering these conditions I concluded that the quality of team performance was influenced by self-directed team learning initiatives. Furthermore it transpired that the quality of self-directed team learning also relied upon the effectiveness of air traffic control team performances.

6 Answering the research questions

Answering the research questions ←

In response to the two primary research questions I concluded that:

- self-directed team learning impacted constructively on the air traffic control work environment; and
- the nature of self-directed team learning impact on the air traffic control work environment could be traced in terms of contributions towards aviation safety, individual and participative learning practices and operational training practices with regard to training design, implementation, facilitation and evaluation.

In response to the secondary research questions I concluded that air traffic controllers perceived:

- a relationship between self-directed team learning and the air traffic control operational output, mainly in terms of aviation safety[4];
- that self-directed team learning dynamics within self-managed air traffic control work teams consisted of individual and integrated formal and informal learning events and experiences; and
- a relationship between self-directed team learning and air traffic control workplace continuation training, albeit mainly a formal/intentional training approach[5].

7 Possible contributions

Possible contributions ←

I am of the opinion that this study should make a positive contribution to understanding the impact of self-directed team learning within an air traffic control environment.

On the whole this study's perceived significance may be found in its contribution towards aviation safety. Findings of this study may encourage awareness from air traffic control service providers to stimulate, implement, manage and evaluate self-directed team learning within teams. Such self-directed team learning

[4] A statistically significant relationship (at the 5% level of significance) for teams 1 and 3 was found in this respect.
[5] No statistically significant differences (at the 5% level of significance) existed between the three teams in terms of continuation training.

may also contribute towards improved teamwork and team performances. Again, a need may be identified to monitor and evaluate teamwork and team performances as a result of self-directed team learning investments.

A self-directed team learning approach may thus contribute to aviation safety within the air traffic control community of practice.

8 Recommendations

Recommendations	Recommendations for practice
	Recommendations for training
	Recommendations for research

Recommendations with regard to practice, training and further research are presented in this section. It must be noted that the intention is not to restrict the implications of this study to these presented recommendations.

8.1 Recommendations for practice

Findings obtained from this study may be used as a basis for helping to understand, prepare and manage air traffic controllers to perform in a collaborative manner within effective air traffic control teams. These different operational training characteristics may be useful, not only for air traffic control teams but for other institutions implementing teamwork activities and team performances. Information and guidance required in this regard may consist of initial and continued training and development strategies that are purposefully designed, developed, implemented and evaluated to encourage effective team performance and ensure overall aviation safety.

8.2 Recommendations for training

In this study self-directed learning was described by participants as an effective means to ensure compliance with individual and team competence/ performance requirements.

Informal learning initiatives may be considered by team members to observe and reflect upon own actions and other's actions thus allowing them to become actively involved in self-directed learning. Informal learning at individual level can facilitate both task-specific and human factors learning.

Formal learning initiatives may also be considered when planning collective learning events. Formal self-directed and continuation training initiatives are used mainly to address task competencies.

8.3 Recommendations for research

Findings of this study suggest that self-directed team learning may be an appropriate training and learning approach for air traffic controllers and air traffic control teams to follow. Therefore a complete and suitable self-directed team learning guide for use by air traffic controllers, air traffic control teams and air traffic control service organisations (possibly as part of human factors training) possibly needs to be designed, developed, implemented and evaluated. Such an initiative could use information obtained in this study to address these training and learning needs, although additional related studies might also need to be consulted.

9 Concluding comments

Concluding comments 

This chapter provided an overview of the results and findings of the study. Quantitative and qualitative data were analysed and interpreted in order to explore and determine whether or not self-directed team learning impacted upon a specific air traffic control environment.

Air traffic controllers are arguably a vital link in support of international aviation safety. This study revealed that air traffic controllers and air traffic control teams do indeed function within self-directed working, training and learning environments. Air traffic controllers who participated in this study, affirmed their need for effective teamwork and continued learning, which in turn, served as essential performance requisites.

In summary, air traffic controllers require the support and guidance from their fellow team members to fulfil their roles adequately. Understanding self-directed air traffic control team performance and the impact of self-directed team learning on such performance should not only benefit air traffic controllers, air traffic control teams and air traffic control organisations, but also the public that makes use of air transport.

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Appendix A Researcher-respondent agreement

RESEARCHER-RESPONDENT AGREEMENT

Allow me to introduce myself: My name is C.G. (Ian) Joubert. I am conducting a post-graduate research project as a student of the University of Pretoria. Your assistance is requested in this regard.

As the **Researcher** I wish to inform you, the **Respondent**, that I intend to establish whether self-directed learning principles and strategies are present and applicable in the air traffic control team-based learning context, to differentiate between intentional and unintentional levels of self-directed team learning, and to describe the role and contribution of self-directed team learning in the air traffic control workplace.

The problem statement for this proposed study is: **What impact does self-directed team learning have within the South African Air Force air traffic control work environment?**

The research project will examine the nature, characteristics and impact of self-directed team learning in the South African Air Force air traffic control workplace. The primary focus of the study will be on tracing the impact of self-directed team learning in an air traffic control environment.

During the investigation of the research problem stated above I intend to:

- trace the impact of self-directed team learning strategies in the air traffic control workplace;
- identify, describe and analyse self-directed team learning strategies in the air traffic control workplace;
- challenge the boundaries of theory, research, practice and assumptions associated with self-directed team learning within the air traffic control workplace;
- generate knowledge that will be useful to other disciplines that rely on effective teamwork, both within and outside of the aviation environment; and
- contribute to local and international literature on self-directed team learning within the air traffic control work environment.

I undertake to focus on the research questions and will not interfere in any manner that may jeopardize the integrity of data and the study as a whole. I acknowledge that your participation is voluntarily. There will be no unpleasant or damaging effects on the individual, the team and the setting (workplace). I will communicate the aim, objectives, nature and future use of findings to you and all other participants prior to commencement of data collection activities. I acknowledge and respect your participation as being voluntary.

I will comply with the listed ethical issues.

- Protection of the rights of human subjects by not causing emotional harm, by not infringing their right to maintain self-respect and human dignity.
- Provide all the facts without distortion or misrepresentation.
- Avoid being biased in the interpretation and presentation of data.
- Only use measurements that are suited to the research problem.
- To not knowingly ascribe greater confidence than the measurements warrant.
- Reporting of conflicting evidence.
- Reporting of any flaws or limitations in the research.

No reasons can be cited as necessary for disclosing the identity of participants, therefore:

- I will ensure confidence by not disclosing your identity and the identity of other respondents; and
- research sites will receive random numbers in order to protect sites and individuals.

RESEARCHER-RESPONDENT AGREEMENT

My visit to this SA Air Force Air Traffic Control centre has been authorized by corporate and unit management. The importance of air traffic control safety needs and requirements are fully realized by me – these will be respected at all times and it is accepted that no infringement will be tolerated. No unprofessional behaviour will be required from you as respondent.

I will provide all participants with an opportunity to learn from their participation, therefore the outcome of my study will be made available to all participants and will be communicated by means of internal organizational means.

Data collection will be performed by means of:

- an interview with you;
- a focus group interview in which you may participate;
- a Learning Approach Questionnaire (LAQ) completed by you; and
- a questionnaire completed by you.

*This agreement is entered into by the **Researcher**, Christiaan Gerhardus Joubert, being a University of Pretoria post-graduate student, student number 24218783 at the _____ Air Traffic Control Centre on _____; and the **Respondent**,_____ (name& surname), force number _____ military rank _____ as an acknowledgement of providing my (respondent) informed consent to voluntary participate in this research project in accordance with the conditions and requirements presented and contained in this agreement.*

*Signed by the **Researcher**:* _____

*Signed by the **Respondent**:* _____

*Witnessed by:*_____ *Signature:* _____

Date: _____

Appendix B Researcher task/activity guide - individual interviews

RESEARCHER TASK/ACTIVITY GUIDE

INDIVIDUAL INTERVIEWS

PRE-INTERVIEW ACTIVITIES

Ensure that the respondent have voluntary provided his/her consent by means of a completed Researcher-Respondent Agreement.
Have note paper and a pen ready for the respondent.
Have the questions ready for the respondent.
Arrange not to be disturbed during the interview.
Check that the tape recorder is serviceable and load an audio cassette that will record the interview.
Open a page in the journal and register:

- date & time; and
- respondent number

INTERVIEW

Thank the respondent for his/her attendance.
Provide the following information to the respondent:

> This is an in-depth, face-to-face interview that will enable me to gather self-directed team information from you, as an air traffic controller. I will conduct a one-to-one interview with every participating air traffic controller from this Air Traffic Control Centre. I am making use of three open-ended questions, thus allowing for limitless response from you. I will also ask the same questions during each interview. This will allow for reliability, consistency and ease of data analysis. This individual interview will allow me to gain a deeper understanding of the role of the individual in the team learning initiative, levels of intentional and unintentional learning, the contribution from other team members with reference to learning, and the impact/value of self-directed team learning. I will use interview results (qualitative data) to assist in the creation of deeper understanding. This interview should not exceed one hour. All interviews will be audio taped and I will prepare transcripts of these confidential interviews.

Emphasise to the respondent that:

> There are no correct answers to the three questions.

RESEARCHER TASK/ACTIVITY GUIDE

You are welcome to make notes on the paper provided to guide your thought and conversation, prior to and during the discussion.

You will receive a written version of the question posed and you will be allowed to study the question prior to providing a response.

Your honest responses are requested.

Identity of respondents and the centre will remain confidential.

Transcribed information will be made available to the respondent for validation purposes.

Determine the need for a warm-up question (when required ask: "What do you enjoy about air traffic control?").

Activate the tape recorder.

Ask the first question and hand the question to the respondent.

Note all own prompts and notes in the journal.

Do not interrupt (unless necessary).

Seek clarity when required and probe for depth when required.

Continue with the next two questions, conduct to be similar to question 1.

Note all own prompts and notes in the journal.

Thank the respondent.

Deactivate the tape recorder.

Obtain contact details from respondents to which transcribed info can be forwarded and note in the journal.

Collect the question cards.

QUESTIONS

1. **Explain with the aid of examples how teamwork influences the outcome of the air traffic control service provided by your centre?**
2. **Explain with the aid of examples how learning from air traffic control teamwork experiences influences your own performance?**
3. **Explain with the aid of examples how learning from experience influences air traffic control teamwork?**

RESEARCHER TASK/ACTIVITY GUIDE

Each respondent will be handed a card, similar to the examples below, containing the question that will receive attention. This question card is handed to the respondent when the specific question is asked by the researcher.

1. Explain with the aid of examples how teamwork influences the outcome of the air traffic control service provided by your centre?

2. Explain with the aid of examples how learning from air traffic control teamwork experiences influences your own performance?

3. Explain with the aid of examples how learning from experience influences air traffic control teamwork?

Appendix C Researcher task/activity guide – focus group interviews

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

RESEARCHER TASK/ACTIVITY GUIDE

FOCUS GROUP INTERVIEWS

PRE-FOCUS GROUP INTERVIEW ACTIVITIES

Ensure that the respondents have voluntary provided their consent by means of a completed Researcher-Respondent Agreement.

Have the questions ready for the respondents.

Arrange not to be disturbed during the interview.

Ensure familiarity of respondents with their respondent numbers.

Check that the tape recorder is serviceable and load an audio cassette that will record the interview.

Open a page in the journal and register:

- date & time; and
- respondent numbers

INTERVIEW

Thank the respondents for their attendance.

Provide the following information to the respondent:

> I have identified the need to obtain learner information in terms of preferences, dislikes, and processes during a relatively free discussion. Focus groups are suggested as a means to create a social environment in which individual members are stimulated by the perceptions, opinions and ideas of each other, which in turn, increase the richness of data. I have decided to use the focus-group technique to gather qualitative data and to gain deeper understanding of learner behaviour, to test preliminary information, and to test ideas. The use of focus groups will enable me to capitalize on the group interaction around a topic.
>
> Each focus group interview should not exceed one hour. Focus group interviews will be audio taped and I will prepare transcripts of these confidential interviews.
>
> I expect focus groups to share individual and team learning experiences, techniques used to learn, comments relating to the role of the team in terms of intentional and unintentional learning, value and contributions from different team members and team roles, and the perceived value of the learning focus. I will use focus group results to assist in the creation of deeper understanding.
>
> I will assume the role of facilitator, in order to maintain a supportive and non-evaluative environment.

RESEARCHER TASK/ACTIVITY GUIDE

Emphasise to the respondents that:

There are no correct answers to the three questions.
Only one person at a time should talk.
When responding state your unique number first in order to assist with the transcription.
Each respondent will receive a written version of the question posed and they will be allowed to study the question prior to providing a response.
Their honest responses are requested.
Identity of respondents and the centre will remain confidential.
Transcribed information will be made available to respondents for validation purposes.

Ensure respondents know their unique numbers.
Determine the need for a warm-up question (when required ask: “What satisfaction does air traffic controlling provide to you as a team?”).

Activate the tape recorder.
Ask the first question and hand the question to the respondents.
Note all own prompts and notes in the journal.
Do not interrupt (unless necessary).
Seek clarity when required and probe for depth when required.
Continue with the next two questions, conduct to be similar to question 1.
Note all own prompts and notes in the journal.

Upon completion of the interview invite last comments and thank the audience for their participation.
Thank the respondents.
Deactivate the tape recorder.
Obtain contact details from respondents to which transcribed info can be forwarded and note in the journal.
Collect question cards.

RESEARCHER TASK/ACTIVITY GUIDE

QUESTIONS

1. **What can a team member, joining the air traffic control team, expect from the team?**
2. **How is individual and collective learning planned and executed at your air traffic control centre?**
3. **How can air traffic control team learning at your centre be improved?**

Each respondent will be handed a card, similar to the examples below, containing the question that will receive attention. This question card is handed to the respondent when the specific question is asked by the researcher.

1. What can a team member, joining the air traffic control team, expect from the team?

2. How is individual and collective learning planned and executed at your air traffic control centre?

3. How can air traffic control team learning at your centre be improved?

Appendix D Transcript cover letters

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

9 Tieroogpark
Hoewe Street
Elarduspark
0181
03 Jan 2006

Dear Respondent

TRANSCRIPT: SELF-DIRECTED TEAM LEARNING RESEARCH PROJECT

Attached please find your transcript copy of the individual interview conducted by Ian Joubert in which you participated.

You are requested to check this transcript and ensure that the transcript content is an accurate reflection of your thoughts, perceptions, opinions and observations as expressed during said individual interview. Grammar and spelling corrections are not required.

This individual interview data will be categorized and analysed and patterns of similarity and differences will be explored by me in order to explain the impact of self-directed team learning in an ATC environment. I wish to reiterate that your identity will remain known only to me, and will not be disclosed in any form in the final research report. Actual individual interview text will most probably not be used in the final report, however, when included all attempts will be made to ensure protection of your identity and that of the ATSU that you represent.

You are most welcome to provide me with further information and/or comments in response to the individual interview questions stated if you wish. Any changes/amendments to the transcript and/or further information/comments must reach me by **31 January 2006**. Fax and/or e-mail responses are preferred.

Contact information:

- Fax: 011 390 1209 (clearly indicate: For attention Ian Joubert)
- Telephone: 011 570 0400
- Mobile: 083 231 6246
- e-mail: ianj@atns.co.za

A no-return action by 31 January 2006 will be regarded as an indication of agreement with the attached transcript content.

Your assistance is greatly appreciated.

Kind regards

Ian Joubert

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

9 Tieroogpark
Hoewe Street
Elarduspark
0181
03 Jan 2006

Dear Respondent

TRANSCRIPTS: SELF-DIRECTED TEAM LEARNING RESEARCH PROJECT

Attached please find your transcript copies of the individual interview and focus-group interview conducted by Ian Joubert in which you participated.

You are requested to check these transcripts and ensure that the transcript contents are an accurate reflection of your thoughts, perceptions, opinions and observations as expressed during said interviews. Grammar and spelling corrections are not required.

This individual interview and focus group interview data will be categorized and analysed and patterns of similarity and differences will be explored by me in order to explain the impact of self-directed team learning in an ATC environment. I wish to reiterate that your identity will remain known only to me, and will not be disclosed in any form in the final research report. Actual interview text will most probably not be used in the final report, however, when included all attempts will be made to ensure protection of your identity and that of the ATSU that you represent.

You are most welcome to provide me with further information and/or comments in response to the individual interview and focus group interview questions stated if you wish. Any changes/amendments to these transcripts and/or further information/comments must reach me by **31 January 2006**. Fax and/or e-mail responses are preferred.

Contact information:

- Fax: 011 390 1209 (clearly indicate: For attention Ian Joubert)
- Telephone: 011 570 0400
- Mobile: 083 231 6246
- e-mail: ianj@atns.co.za

A no-return action by 31 January 2006 will be regarded as an indication of agreement with the attached transcript contents.

Your assistance is greatly appreciated.

Kind regards

Ian Joubert

Appendix E Self-directed Team Learning Questionnaire (SDTLQ)

UNIVERSITEIT VAN PRETORIA
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SELF-DIRECTED TEAM LEARNING QUESTIONNAIRE

THANK YOU FOR YOUR WILLINGNESS TO COMPLETE THIS QUESTIONNAIRE.

The purpose of this questionnaire is to trace the impact of self-directed team learning within the South African Air Force air traffic control environment. It is important that you answer all the questions as honestly as possible. Your answers to this questionnaire will be treated as confidential.

Read each question carefully and mark your answers by **circling** the appropriate **shaded** number in the box. For example:

Example 1

Please use the following code to answer this question
1 – Always
2 – Frequently
3 - Rarely
4 - Never

I share my ideas with other people	①	2	3	4

Example 2

	ATC	ATSA
Training received by me	①	2

If you make a **mistake**, simply **blacken** in the box where the error is and then circle the appropriate shaded number in the alternate box. For example:

Example 1

Please use the following code to answer this question
1 – Always
2 – Frequently
3 - Rarely
4 - Never

I share my ideas with other people	①	2	■	4

Example 2

	ATC	ATSA
Training received by me	■	②

SELF-DIRECTED TEAM LEARNING QUESTIONNAIRE

SECTION A:	PERSONAL DETAIL

Respondent number V1 [ ][ ] 1

Question 1

What is your gender?

Male	1	V2 [ ] 3
Female	2	

Question 2

At which air traffic control centre are you stationed?

FALW	1	V3 [ ] 4
FALT	2	
FAHS	3	

Question 3

What is your military rank?

Non-Commissioned Officer	Candidate Officer	Second Lieutenant	Lieutenant	Captain	Major	Lieutenant-Colonel
1	2	3	4	5	6	7

V4 [ ] 5

Question 4

Which of the following **validations** do you hold at this air traffic control centre?

Flight information service	1	V5 [ ] 6
Ground control	2	V6 [ ] 7
Aerodrome control	3	V7 [ ] 8
Approach control	4	V8 [ ] 9
Ground controlled approach	5	V9 [ ] 10

Question 5

How many years have you been employed at this centre?

Less than one year	1	V10 [ ] 11
More than one year but less than three years	2	
More than three years	3	

Question 6

What is your current position?

Command & Control Assistant	Air traffic controller	Senior air traffic controller	Chief air traffic controller
1	2	3	4

V11 [ ] 12

SECTION B:	SELF-DIRECTED TEAM PERFORMANCE

Question 7

Please use the following code to answer this question
1 – Always
2 – Frequently
3 - Rarely
4 - Never

Team work characteristics
When involved in air traffic control teamwork at this air traffic control centre I have noticed that (respond to all the options provided):

conflict occurs between team members	1	2	3	4	V12	13
pressures to conform are common	1	2	3	4	V13	14
power is shared amongst team members	1	2	3	4	V14	15
certain air traffic control roles are considered more important than others	1	2	3	4	V15	16
the team is more important than team members	1	2	3	4	V16	17
individual contributions are encouraged	1	2	3	4	V17	18
the team covers up blunders/mistakes	1	2	3	4	V18	19
the team is willing to learn as a result of experience	1	2	3	4	V19	20
internal commitment amongst members is present	1	2	3	4	V20	21
team members handle criticism well	1	2	3	4	V21	22
misunderstandings prevail	1	2	3	4	V22	23
team members act defensively when confronted	1	2	3	4	V23	24
team members attempt to understand why people behave in certain ways	1	2	3	4	V24	25
the pace set by the team meets the needs of all team members	1	2	3	4	V25	26

Question 8

Self-efficacy
Which one of the following statements accurately describes your air traffic control team's performance during difficult controlling periods/tasks?
(select only **one** option)

Team performance is characterised by setting goals and involvement by all team members in pursuit of these goals	1			
Team performance is characterised by setting goals, however, not all team members pursue these goals	2	V26		27

Question 9

Please use the following code to answer this question
1 – Always
2 – Frequently
3 - Rarely
4 - Never

Team performance activities
How often do the following air traffic control team performance activities take place at this centre? (respond to all the options provided):

gathering of information	1	2	3	4	V27		28
reporting of information	1	2	3	4	V28		29
creating new ideas	1	2	3	4	V29		30
experimenting with new ideas	1	2	3	4	V30		31
exploring new opportunities	1	2	3	4	V31		32
assessing the applicability of new work processes	1	2	3	4	V32		33
establishing new ways of making things work	1	2	3	4	V33		34
implementing new ways of making things work	1	2	3	4	V34		35
delivering safety focused outputs	1	2	3	4	V35		36
continuously checking the working of the air traffic control system	1	2	3	4	V36		37
upholding air traffic control standards and processes	1	2	3	4	V37		38
safeguarding air traffic control standards and processes	1	2	3	4	V38		39
coordinating the work of others	1	2	3	4	V39		40
integrating the work of others	1	2	3	4	V40		41

Question 10

Please use the following code to answer this question
1 – Always
2 – Frequently
3 - Rarely
4 - Never

Individual reflection
How often do you:

revisit an air traffic control shift in your mind and think about what actually happened during the shift?	1	2	3	4	V41		42
think about ways to improve your air traffic control skills as a result of **your** opinion concerning your present performance?	1	2	3	4	V42		43
think about ways to improve your air traffic control skills as a result of inputs received from **others** concerning your present performance?	1	2	3	4	V43		44
think about the social relationships that you encounter in your work team?	1	2	3	4	V44		45
think about your contribution to aviation safety?	1	2	3	4	V45		46
think about your own personal values and their role in your work life?	1	2	3	4	V46		47
think about the expectations of the aviation industry, your organisation, your centre and your team?	1	2	3	4	V47		48

Question 11

Please use the following code to answer this question
1 – Always
2 – Frequently
3 - Rarely
4 - Never

Teamwork performance measures
How often do air traffic control teams at this centre use the following indicators to measure air traffic control teamwork performance (respond to all the options provided):

incident occurrences	1	2	3	4	V48		49
accident occurrences	1	2	3	4	V49		50
application of traffic separation standards	1	2	3	4	V50		51
number of flight delays	1	2	3	4	V51		52
efficient airspace utilisation	1	2	3	4	V52		53
managing traffic capacity	1	2	3	4	V53		54

Please use the following code to answer this question
1 – Always
2 – Frequently
3 - Rarely
4 - Never

Teamwork performance measures *(continued)*
How often do air traffic control teams at this centre use the following indicators to measure air traffic control teamwork performance (respond to all the options provided):

traffic sequencing abilities of the controllers	1	2	3	4	V54		55
compliance with unit operational rules	1	2	3	4	V55		56
quality of team support provided	1	2	3	4	V56		57
individual contributions by team members	1	2	3	4	V57		58
work overload occurrences	1	2	3	4	V58		59
number of unnecessary requests made to pilots	1	2	3	4	V59		60
handling of emergency situations	1	2	3	4	V60		61
quality of radio-telephony practices	1	2	3	4	V61		62
effectiveness of information (coordination) sharing	1	2	3	4	V62		63
number of interpersonal conflict situations	1	2	3	4	V63		64

Question 12

Please use the following code to answer this question
1 – Always
2 – Frequently
3 - Rarely
4 - Never

Team performance dynamics
How often is air traffic control team performance at this centre directed/facilitated/guided by (respond to all the options provided):

shared judgement calls	1	2	3	4	V64		65
shared problem solving actions	1	2	3	4	V65		66
shared decision-making abilities	1	2	3	4	V66		67
shared situational awareness	1	2	3	4	V67		68
similar skill levels	1	2	3	4	V68		69
shared positive attitudes	1	2	3	4	V69		70
trust amongst team members	1	2	3	4	V70		71
shared information amongst team members	1	2	3	4	V71		72

SECTION C: SELF-DIRECTED TEAM LEARNING

Question 13

Please use the following code to answer this question
1 – Always
2 – Frequently
3 - Rarely
4 - Never

Individual learning preferences
To what extent do you prefer to learn as a result of (respond to all the options provided):

novel, difficult and unfamiliar ATC problem situations	1	2	3	4	V72		73
routine and expected ATC situations	1	2	3	4	V73		74
familiar and trained-for ATC problem situations	1	2	3	4	V74		75
curiosity	1	2	3	4	V75		76
feedback received from others	1	2	3	4	V76		77
your own diagnosis of your learning needs	1	2	3	4	V77		78
a systematic and sequential learning plan that is provided to you	1	2	3	4	V78		79

Question 14

Please use the following code to answer this question
1 – Always
2 – Frequently
3 - Rarely
4 - Never

Learning participation
How often do you participate in the following initiatives at this air traffic control centre (respond to all the options provided):

formal team discussion sessions	1	2	3	4	V79		80
informal team discussions	1	2	3	4	V80		81
formal individual feedback sessions (example: a structured one-to-one discussion)	1	2	3	4	V81		82
informal individual feedback sessions (example: a semi-structured or unstructured one-to-one discussion)	1	2	3	4	V82		83
setting of learning contracts/agreements	1	2	3	4	V83		84
critically analysing and reflecting upon your own performance	1	2	3	4	V84		85

Question 15

Individual workplace learning orientation
My own workplace learning experience is (select only **one** option):

inner-directed focused (relying only on myself to learn)	1	V85	86
external directed focused (relying on others to assist with my learning)	2		

Question 16

Please use the following code to answer this question
1 – Always
2 – Frequently
3 - Rarely
4 - Never

Workplace training design
To what extent is air traffic control **training objectives** for the air traffic control team at this centre decided upon by the (respond to all the options provided):

chief air traffic control officer	1	2	3	4	V86		87
senior air traffic control officer	1	2	3	4	V87		88
air traffic control training officer	1	2	3	4	V88		89
air traffic control team	1	2	3	4	V89		90
individual air traffic controller	1	2	3	4	V90		91

Question 17

Please use the following code to answer this question
1 – Always
2 – Frequently
3 - Rarely
4 - Never

Workplace training implementation
How often do the following members present air traffic control **training initiatives** to the air traffic control team at this centre (respond to all the options provided):

chief air traffic control officer	1	2	3	4	V91		92
senior air traffic control officers	1	2	3	4	V92		93
air traffic control training officers	1	2	3	4	V93		94
all air traffic control team members	1	2	3	4	V94		95
individual air traffic controllers	1	2	3	4	V95		96

Question 18

Please use the following code to answer this question
1 – Always
2 – Frequently
3 - Rarely
4 - Never

Workplace training evaluation
How often do the following members **evaluate** air traffic control training initiatives presented to the air traffic control team at this centre (respond to all the options provided):

chief air traffic control officer	1	2	3	4	V96		97
senior air traffic control officers	1	2	3	4	V97		98
air traffic control training officers	1	2	3	4	V98		99
all air traffic control team members	1	2	3	4	V99		100
individual air traffic controllers	1	2	3	4	V100		101

Question 19

Please use the following code to answer this question
1 – Always
2 – Frequently
3 - Rarely
4 - Never

Operational training characteristics
To what extent does air traffic control operational training at this centre, **excluding continuation training**, focus on (respond to all the options provided):

passing information to team members who need it, before they need it (a proactive approach)	1	2	3	4	V101		102
identifying the need to assist other team members	1	2	3	4	V102		103
encouraging team members to communicate their observations	1	2	3	4	V103		104
encouraging team members to communicate their concerns	1	2	3	4	V104		105
encouraging team members to communicate their suggestions	1	2	3	4	V105		106
encouraging team members to communicate their requests	1	2	3	4	V106		107
learning to adapt performance strategies quickly as a result of changing demands	1	2	3	4	V107		108
learning to adapt performance strategies appropriately to changing task demands	1	2	3	4	V108		109

Please use the following code to answer this question
1 – Always
2 – Frequently
3 - Rarely
4 - Never

Operational training characteristics *(continued)*
To what extent does air traffic control operational training at this centre, **excluding continuation training**, focus on (respond to all the options provided):

knowledge of tasks performed by all air traffic control positions at this centre	1	2	3	4	V109		110
team situation awareness skills	1	2	3	4	V110		111
stress coping strategies	1	2	3	4	V111		112
getting to know my team members at a personal level	1	2	3	4	V112		113
coordination activities and processes	1	2	3	4	V113		114
fostering mutual trust	1	2	3	4	V114		115
creating team cohesion	1	2	3	4	V115		116

Question 20

Please use the following code to answer this question
1 – Always
2 – Frequently
3 - Rarely
4 - Never

Continuation training characteristics
To what extent does air traffic control continuation training at this centre, **excluding operational training**, focus on (respond to all the options provided):

passing information to team members who need it, before they need it (a proactive approach)	1	2	3	4	V116		117
identifying the need to assist other team members	1	2	3	4	V117		118
encouraging team members to communicate their observations	1	2	3	4	V118		119
encouraging team members to communicate their concerns	1	2	3	4	V119		120
encouraging team members to communicate their suggestions	1	2	3	4	V120		121
encouraging team members to communicate their requests	1	2	3	4	V121		122
learning to adapt performance strategies quickly as a result of changing demands	1	2	3	4	V122		123
learning to adapt performance strategies appropriately to changing task demands	1	2	3	4	V123		124

Please use the following code to answer this question
1 – Always
2 – Frequently
3 - Rarely
4 - Never

Continuation training characteristics *(continued)*
To what extent does air traffic control continuation training at this centre, **excluding operational training**, focus on (respond to all the options provided):

knowledge of tasks performed by all air traffic control positions at this centre	1	2	3	4	V124		125
team situation awareness skills	1	2	3	4	V125		126
stress coping strategies	1	2	3	4	V126		127
getting to know my team members at a personal level	1	2	3	4	V127		128
coordination activities and processes	1	2	3	4	V128		129
fostering mutual trust	1	2	3	4	V129		130
creating team cohesion	1	2	3	4	V130		131

Question 21

Please use the following code to answer this question
1 – Always
2 – Frequently
3 - Rarely
4 - Never

Workplace learning environment
To what extent is the air traffic control workplace learning environment at this centre characterised by (respond to all the options provided):

weekly planned learning sessions	1	2	3	4	V131		132
team members that ensure that learning does take place within the team	1	2	3	4	V132		133
the use of learning contracts/agreements	1	2	3	4	V133		134
planned continuation training events	1	2	3	4	V134		135
ad hoc lectures/presentations	1	2	3	4	V135		136
social gatherings where work related matters are discussed in an informal manner	1	2	3	4	V136		137
social gatherings where work related matters are discussed in a formal manner	1	2	3	4	V137		138
support from management to encourage team members to learn from workplace experiences	1	2	3	4	V138		139

Please use the following code to answer this question
1 – Always
2 – Frequently
3 - Rarely
4 - Never

Workplace learning environment *(continued)*
To what extent is the air traffic control workplace learning environment at this centre characterised by (respond to all the options provided):

adequate resources to facilitate learning	1	2	3	4	V139		140
an open forum that encourages discussion and sharing of experiences amongst team members	1	2	3	4	V140		141
team members that will plan their own learning when the need arises	1	2	3	4	V141		142

Question 22

Please use the following code to answer this question
1 – Always
2 – Frequently
3 - Rarely
4 - Never

Team learning facilitation
How often is air traffic control team learning at this centre facilitated by (respond to all the options provided):

a supportive team learning atmosphere	1	2	3	4	V142		143
known team roles and responsibilities	1	2	3	4	V143		144
a sensitivity towards personality differences	1	2	3	4	V144		145
a shared motivation to learn	1	2	3	4	V145		146
pre-planning for learning	1	2	3	4	V146		147
guiding leadership support	1	2	3	4	V147		148
adequate resource availability	1	2	3	4	V148		149
participation from experienced team members	1	2	3	4	V149		150

Question 23

You are invited to include any additional information that you consider to be important and/or relevant to this study.

V150			151
V151			153
V152			155
V153			157

THANK YOU VERY MUCH FOR COMPLETING THIS QUESTIONNAIRE

Appendix F Learning Approaches Questionnaire (LAQ)[1]

[1] LAQ inclusion authorised by the LAQ author (reference: Appendix H).

LEARNING APPROACHES QUESTIONNAIRE (LAQ)

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Instructions:

At this SA Air Force Air Traffic Control Centre, there are opportunities to learn something almost every day - this means the **learning opportunities** you have in formal or informal learning situations (i.e. courses you attend, when studying information, material you read, in discussions and other learning experiences you have). This questionnaire examines your approach to the task of learning, in other words, the way you go about it to learn something and your relationship with other people in learning situations. The main concern here is on how you approach what you have to learn, and why you use a specific approach. Use the scale from 1 to 7 to indicate to what extent the approach indicated by the question is applicable to you. A scale of **1** means that you do **not** use the approach **at all**. A value of **7** means that you use the approach **to a very large extent**. If the values 1 to 7 are not applicable, choose any value between 1 and 7 which is applicable, depending on the extent to which you use the approach. The descriptions at the sides of the scale serve as guideline for the values you can choose. Indicate your choice by **circling** the most applicable **shaded** value on this answer sheet.

Not at all	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**To a very large extent**

Example:

In the learning opportunities you have *at this SA Air Force Air Traffic Control Centre,* to what extent....

01 do you share your ideas with other people?

Not at all	**1**	②	**3**	**4**	**5**	**6**	**7**	**To a very large extent**

If you make a **mistake**, simply **blacken** in the box where the error is and then circle the appropriate shaded number in the alternate box. For example:

01 do you share your ideas with other people?

Not at all	**1**	②	**3**	**4**	**5**	■	**7**	**To a very large extent**

Do not skip any questions. Make sure that you circle your answer on this answer sheet. Remember there are no right or wrong answers because everyone has the right to his own views. To be able to get the most out of the results you will have to be as truthful to yourself as possible when answering the questionnaire. Do not ponder too long over a question. Preferably mark the first answer that comes to your mind. **Remember to answer as honestly as possible what is true of you.** Do not merely mark what seems to be in general a more acceptable way of responding to impress other people.

Please begin

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LEARNING APPROACHES QUESTIONNAIRE (LAQ)

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Respondent number V1 [ ][ ] 1

This section is about **your approach to learning tasks**

In the learning opportunities at this SA Air Traffic Control Centre, to what extent …

01 do you see a learning opportunity primarily as a way of ensuring a safe and rewarding job and not as something to be enjoyed?

Not at all	1	2	3	4	5	6	7	To a very large extent

V2 [ ] 3

02 is it important to you to prove your abilities to friends and colleagues by doing very well in a learning situation?

Not at all	1	2	3	4	5	6	7	To a very large extent

V3 [ ] 4

03 do you find learning opportunities where you are introduced to new information as exciting as your favourite hobby?

Not at all	1	2	3	4	5	6	7	To a very large extent

V4 [ ] 5

04 do you try to remember as much information as accurately as possible, rather than to try to understand the information?

Not at all	1	2	3	4	5	6	7	To a very large extent

V5 [ ] 6

05 do you prioritise work in order to achieve your learning objectives?

Not at all	1	2	3	4	5	6	7	To a very large extent

V6 [ ] 7

06 when you are reading something, do you try to think of anything similar that you have experienced?

Not at all	1	2	3	4	5	6	7	To a very large extent

V7 [ ] 8

07 are you sure that you will be able to understand difficult topics?

Not at all	1	2	3	4	5	6	7	To a very large extent

V8 [ ] 9

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In the learning opportunities at this SA Air Traffic Control Centre, to what extent …

08 do you become tense because of a fear of failure when you have to learn something?

Not at all	1	2	3	4	5	6	7	To a very large extent	V9		10

09 are you driven by your need for success, even if it means having less time to socialise?

Not at all	1	2	3	4	5	6	7	To a very large extent	V10		11

10 do you find personal satisfaction in searching for new meanings in existing knowledge?

Not at all	1	2	3	4	5	6	7	To a very large extent	V11		12

11 do you tend to stick to memorising factual information without searching for meaning?

Not at all	1	2	3	4	5	6	7	To a very large extent	V12		13

12 do you ensure that you do all the required learning in time?

Not at all	1	2	3	4	5	6	7	To a very large extent	V13		14

13 do you tend to test new ideas by trying to imagine situations in which you will find them?

Not at all	1	2	3	4	5	6	7	To a very large extent	V14		15

14 do you try to learn for career purposes only, with as little effort and bother as possible?

Not at all	1	2	3	4	5	6	7	To a very large extent	V15		16

15 is it important to you to achieve an exceptional performance?

Not at all	1	2	3	4	5	6	7	To a very large extent	V16		17

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In the learning opportunities at this SA Air Traffic Control Centre, to what extent …

16 do you get personal satisfaction from studying new information to supplement your own ideas?

Not at all	1	2	3	4	5	6	7	To a very large extent	V17		18

17 are you confident of your ability to gain insight into something which others find difficult to understand?

Not at all	1	2	3	4	5	6	7	To a very large extent	V18		19

18 do you follow a set of rules or procedures, without thinking much about their purpose?

Not at all	1	2	3	4	5	6	7	To a very large extent	V19		20

19 do you tend to plan your learning programme long ahead of time?

Not at all	1	2	3	4	5	6	7	To a very large extent	V20		21

20 do you try to find links between different learning experiences?

Not at all	1	2	3	4	5	6	7	To a very large extent	V21		22

21 do you think it is an appealing idea to meet the minimum requirements in learning situations with as little effort as possible?

Not at all	1	2	3	4	5	6	7	To a very large extent	V22		23

22 do you tend to set high achievement standards for yourself?

Not at all	1	2	3	4	5	6	7	To a very large extent	V23		24

23 do you get personal satisfaction from studying new information?

Not at all	1	2	3	4	5	6	7	To a very large extent	V24		25

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In the learning opportunities at this SA Air Traffic Control Centre, to what extent …

24 do you tend to memorise parts of what you learn without knowing how they are linked to other parts?

Not at all	1	2	3	4	5	6	7	To a very large extent	V25		26

25 do you ensure that every minute during learning situations is productively utilised?

Not at all	1	2	3	4	5	6	7	To a very large extent	V26		27

26 do you try to find the underlying relations between different aspects?

Not at all	1	2	3	4	5	6	7	To a very large extent	V27		28

27 do you tend to focus on the obvious aspects of a problem rather than on the underlying aspects?

Not at all	1	2	3	4	5	6	7	To a very large extent	V28		29

28 do you believe in your ability to make a success of a learning opportunity?

Not at all	1	2	3	4	5	6	7	To a very large extent	V29		30

29 do you prefer not to be exposed to learning opportunities because you find them stressful?

Not at all	1	2	3	4	5	6	7	To a very large extent	V30		31

30 do you concentrate on always performing well, even if other people think that you are slightly losing your sense of balance in life?

Not at all	1	2	3	4	5	6	7	To a very large extent	V31		32

31 do you seek satisfaction by discovering a new way of understanding existing knowledge even if it requires much effort and insight?

Not at all	1	2	3	4	5	6	7	To a very large extent	V32		33

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In the learning opportunities at this SA Air Traffic Control Centre, to what extent …

32 do you tend to learn something off by heart by repeating the material until you can reproduce it?

Not at all	1	2	3	4	5	6	7	To a very large extent	V33		34

33 do you try to use every available minute of the day to achieve your learning objectives?

Not at all	1	2	3	4	5	6	7	To a very large extent	V34		35

34 do you try to relate what you learn to your own experiences?

Not at all	1	2	3	4	5	6	7	To a very large extent	V35		36

35 are you confident of your ability to understand the most important parts of what you have to learn?

Not at all	1	2	3	4	5	6	7	To a very large extent	V36		37

36 do you feel satisfied and relieved when you have at least met the minimum requirements in terms of what you should have learnt?

Not at all	1	2	3	4	5	6	7	To a very large extent	V37		38

37 do you try always to perform well in a learning task, even if you do not enjoy it?

Not at all	1	2	3	4	5	6	7	To a very large extent	V38		39

38 are learning opportunities important because they offer you an opportunity to see things from a different point of view?

Not at all	1	2	3	4	5	6	7	To a very large extent	V39		40

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In the learning opportunities at this SA Air Traffic Control Centre, to what extent …

39 do you focus on simple facts instead of trying to understand complex issues?

Not at all	1	2	3	4	5	6	7	To a very large extent	V40		41

40 do you like to set up a time schedule for the completion of your learning tasks?

Not at all	1	2	3	4	5	6	7	To a very large extent	V41		42

41 do you tend to develop a framework to see how certain ideas are related to each other?

Not at all	1	2	3	4	5	6	7	To a very large extent	V42		43

42 is your concentration in learning situations negatively affected because you are afraid of performing poorly?

Not at all	1	2	3	4	5	6	7	To a very large extent	V43		44

43 is the discovery of new perspectives according to which you can live your life, your main aim during a learning opportunity?

Not at all	1	2	3	4	5	6	7	To a very large extent	V44		45

44 do you use learning opportunities more for financial gain than for the value of learning the content itself?

Not at all	1	2	3	4	5	6	7	To a very large extent	V45		46

45 do you try to determine if what you learn can be applied to various kinds of situations?

Not at all	1	2	3	4	5	6	7	To a very large extent	V46		47

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In the learning opportunities at this SA Air Traffic Control Centre, to what extent …

46 are you confident of your ability to complete learning tasks successfully?

Not at all	1	2	3	4	5	6	7	To a very large extent	V47		48

47 do you tend to prepare for a learning opportunity long beforehand?

Not at all	1	2	3	4	5	6	7	To a very large extent	V48		49

48 does the pressure of a learning situation make you feel tense and depressed?

Not at all	1	2	3	4	5	6	7	To a very large extent	V49		50

49 do you try to understand ideas better by relating them to actual situations in everyday life?

Not at all	1	2	3	4	5	6	7	To a very large extent	V50		51

50 do you try to improve on previous achievements?

Not at all	1	2	3	4	5	6	7	To a very large extent	V51		52

51 do you tend to learn something by memorising the exact presentation used step-by-step?

Not at all	1	2	3	4	5	6	7	To a very large extent	V52		53

52 do you seek personal satisfaction in discovering new insights?

Not at all	1	2	3	4	5	6	7	To a very large extent	V53		54

53 do you try to get away with a minimum effort in performing a learning task as long as you don't fail?

Not at all	1	2	3	4	5	6	7	To a very large extent	V54		55

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In the learning opportunities at this SA Air Traffic Control Centre, to what extent …

54 when you take your abilities and circumstances into consideration, do you think that you will be successful in a learning situation?

Not at all	1	2	3	4	5	6	7	To a very large extent	V55		56

55 do you concentrate on optimally utilising every possible learning opportunity?

Not at all	1	2	3	4	5	6	7	To a very large extent	V56		57

56 do you become panicky and anxious when you have given a wrong answer to a question in a learning situation?

Not at all	1	2	3	4	5	6	7	To a very large extent	V57		58

57 do you try to relate ideas about a topic under discussion to other topics?

Not at all	1	2	3	4	5	6	7	To a very large extent	V58		59

58 do you regard yourself as an ambitious person, in the sense that you always want to perform exceptionally well as a learner?

Not at all	1	2	3	4	5	6	7	To a very large extent	V59		60

59 do you concentrate on remembering as much information as possible instead of trying to understand how everything fits together?

Not at all	1	2	3	4	5	6	7	To a very large extent	V60		61

60 do you use your free time to learn?

Not at all	1	2	3	4	5	6	7	To a very large extent	V61		62

61 do you try to decide whether there is sufficient evidence to support another person's conclusions?

Not at all	1	2	3	4	5	6	7	To a very large extent	V62		63

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The following section is about **your relationship with other people in learning situations**

In the learning opportunities at this SA Air Traffic Control Centre, to what extent …

62 are you willing to work with other people when searching for solutions to problems?

Not at all	1	2	3	4	5	6	7	To a very large extent	V63		64

63 do you experience negative feelings if you are not pointed out as one of the best candidates in a course?

Not at all	1	2	3	4	5	6	7	To a very large extent	V64		65

64 are you inclined to follow other people's ways of doing things?

Not at all	1	2	3	4	5	6	7	To a very large extent	V65		66

65 do you like to decide for yourself which learning opportunities to utilise?

Not at all	1	2	3	4	5	6	7	To a very large extent	V66		67

66 do you test your understanding of something by discussing it with other people?

Not at all	1	2	3	4	5	6	7	To a very large extent	V67		68

67 is it important to you to answer questions better than other people do?

Not at all	1	2	3	4	5	6	7	To a very large extent	V68		69

68 do you stick only to existing and well-known ideas and procedures?

Not at all	1	2	3	4	5	6	7	To a very large extent	V69		70

69 do you take control over your own learning programme without the help of other people?

Not at all	1	2	3	4	5	6	7	To a very large extent	V70		71

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In the learning opportunities at this SA Air Traffic Control Centre, to what extent …

70 do you share your knowledge with other people during a learning session?

Not at all	1	2	3	4	5	6	7	To a very large extent	V71		72

71 is it important to you to compare your achievements with those of other people?

Not at all	1	2	3	4	5	6	7	To a very large extent	V72		73

72 do you prefer to accept an expert's view of something without thinking much about it yourself?

Not at all	1	2	3	4	5	6	7	To a very large extent	V73		74

73 would you confidently interpret something differently from most other people?

Not at all	1	2	3	4	5	6	7	To a very large extent	V74		75

74 do you provide support and encouragement to others in a learning situation?

Not at all	1	2	3	4	5	6	7	To a very large extent	V75		76

75 is it important to you to have better ideas than other people?

Not at all	1	2	3	4	5	6	7	To a very large extent	V76		77

76 do you prefer that others create learning experiences for you rather than having to create them yourself?

Not at all	1	2	3	4	5	6	7	To a very large extent	V77		78

77 do you act according to your own convictions?

Not at all	1	2	3	4	5	6	7	To a very large extent	V78		79

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In the learning opportunities at this SA Air Traffic Control Centre, to what extent …

78 are personal contact and discussions with others during a learning opportunity important to you?

Not at all	1	2	3	4	5	6	7	To a very large extent	V79		80

79 do you rely on other people's instructions, down to the faintest details, as to what you should learn and not learn?

Not at all	1	2	3	4	5	6	7	To a very large extent	V80		81

80 do you stick to your own ideas, irrespective of other people's acceptance or rejection of your ideas?

Not at all	1	2	3	4	5	6	7	To a very large extent	V81		82

81 are you willing to exchange information with others during a learning session?

Not at all	1	2	3	4	5	6	7	To a very large extent	V82		83

82 is it important to you to be the best achiever on a course?

Not at all	1	2	3	4	5	6	7	To a very large extent	V83		84

83 do you readily do your own thing without the input of other people during learning opportunities?

Not at all	1	2	3	4	5	6	7	To a very large extent	V84		85

84 are you willing, with others in a group, to learn together about new things?

Not at all	1	2	3	4	5	6	7	To a very large extent	V85		86

85 do you prefer someone else to take the lead when difficult problems have to be dealt with?

Not at all	1	2	3	4	5	6	7	To a very large extent	V86		87

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In the learning opportunities at this SA Air Traffic Control Centre, to what extent …

86 are you at ease with the fact that your ideas might be different from other people's ideas?

Not at all	1	2	3	4	5	6	7	To a very large extent	V87		88

87 is it more important to you to be an achiever in what you do than just to enjoy doing it?

Not at all	1	2	3	4	5	6	7	To a very large extent	V88		89

88 do you openly discuss your experiences with other people so that every one can learn from these experiences?

Not at all	1	2	3	4	5	6	7	To a very large extent	V89		90

89 do you prefer to be told exactly how a learning assignment should be done?

Not at all	1	2	3	4	5	6	7	To a very large extent	V90		91

90 are you at ease with the idea of making your point of view known, even if it proves to be unpopular?

Not at all	1	2	3	4	5	6	7	To a very large extent	V91		92

91 do you agree that it is always important to be the best?

Not at all	1	2	3	4	5	6	7	To a very large extent	V92		93

92 do you inform other members of the group during a group discussion that you appreciate their contributions?

Not at all	1	2	3	4	5	6	7	To a very large extent	V93		94

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In the learning opportunities at this SA Air Traffic Control Centre, to what extent …

93 do you learn only that which other people expect of you to learn and nothing more?

Not at all	1	2	3	4	5	6	7	To a very large extent	V94		95

94 will other people hear from you if you do not agree with their ideas?

Not at all	1	2	3	4	5	6	7	To a very large extent	V95		96

95 do you encourage other people to take part in an exchange of ideas?

Not at all	1	2	3	4	5	6	7	To a very large extent	V96		97

96 do you follow your own ideas even if others do not agree with you?

Not at all	1	2	3	4	5	6	7	To a very large extent	V97		98

PLEASE ENSURE THAT YOU HAVE ANSWERED ALL THE QUESTIONS.

THANK YOU FOR COMPLETING THIS QUESTIONNAIRE

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Appendix G All Spearman correlation coefficients between LAQc and SDPM and SDLM; and LAQs and SDPM and SDLM (only considering LAQ S-variables) for teams 1, 2 and 3

All Spearman correlation coefficients between LAQc and SDPM and SDLM; and LAQs and SDPM and SDLM (only considering LAQ S-variables) for teams 1, 2 and 3

		Team 1		Team 2		Team 3	
LAQ (S-variables)	**LAQ description**	**SDPM**	**SDLM**	**SDPM**	**SDLM**	**SDPM**	**SDLM**
SDS	Strategy (DS) – deep approach	r = 0.26	r = 0.24	r = 0.43	r = 0.77	r = 0.26	r = 0.56
SDM	Motive (DM) – deep approach	r = 0.13	r = 0.16	r = -0.02	r = 0.87	r = 0.74	r = 0.50
SDA	SDA Deep approach (DA)	r = 0.31	r = 0.31	r = 0.19	r = 0.78	r = 0.69	r = 0.81
SAS	Strategy (AS) – achievement approach	r = 0.26	r = 0.36	r = 0.35	r = 0.35	r = -0.18	r = -0.31
SAM	Motive (AM) – achievement approach	r = -0.02	r = 0.30	r = 0.26	r = 0.37	r = 0.45	r = 0.72
SAA	Achievement approach (AA)	r = 0.18	r = 0.40	r = 0.30	r = 0.40	r = 0.24	r = 0.37
SSE	Self-efficacy (SE)	r = 0.54	r = 0.32	r = -0.19	r = 0.94	r = 0.35	r = 0.42
SSS	Strategy (SS) – surface approach	r = -0.41	r = -0.52	r = -0.07	r = -0.40	r = 0.46	r = 0.45
SSM	Motive (SM) – surface approach	r = -0.03	r = -0.51	r = -0.18	r = -0.72	r = 0.48	r = 0.10
SFF	Fear of failure (FF) – surface approach	r = -0.35	r = -0.31	r = -0.22	r = -0.09	r = -0.91	r = -0.68
SSA	Surface approach (SA)	r = -0.43	r = -0.53	r = -0.30	r = -0.48	r = 0.14	r = 0.11
SDAAASE	Deep-achieving approach to learning	r = 0.21	r = 0.31	r = 0.02	r = 0.81	r = 0.45	r = 0.58
SDEPEN	Dependent (DEPEN)	r = 0.36	r = -0.18	r = -0.12	r = -0.34	r = -0.03	r = -0.27
SINDEPEN	Independent (INDEPEN)	r = 0.56	r = 0.31	r = -0.22	r = -0.27	r = 0.83	r = 0.76
SCOMP	Competitive (COMP)	r = -0.33	r = -0.17	r = -0.32	r = -0.30	r = 0.26	r = 0.45
SCOOP	Cooperative (COOP)	r = 0.96	r = 0.74	r = 0.11	r = 0.90	r = 0.29	r = 0.67

Appendix H Verification of LAQ statistical analysis and results by the author of the LAQ

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

From: Prof. P. Schaap
University of Pretoria

To: Mr. C.G. Joubert
Student: University of Pretoria

Date: 21 September 2006

Use of the Learning Approaches Questionnaire (LAQ)

I, Prof. P. Schaap, author of the Learning Approaches Questionnaire (LAQ) hereby confirm that formal approval was granted to Mr. C.G. Joubert (student number: 24218783) in response to his request to use this questionnaire for research purposes.

I furthermore approve that a re-formatted version of this questionnaire may be included in Mr. C.G. Joubert's PhD theses titled: *Tracing the impact of self-directed team learning within an air traffic control environment*.

I, Prof. P. Schaap acknowledge that I did review the analysis and reporting of LAQ data as presented in this theses and approve thereof.

PSchaap

Prof. P. Schaap
University of Pretoria

Appendix I Ethical clearance certificate

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UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

ANNEXURE D

UNIVERSITY OF PRETORIA

FACULTY OF EDUCATION

RESEARCH ETHICS COMMITTEE

CLEARANCE CERTIFICATE	**CLEARANCE NUMBER : CS06/08/03**
DEGREE AND PROJECT	PhD Curriculum Studies Tracing the impact of self-directed team learning in an air traffic control environment
INVESTIGATOR(S)	Mnr C G Joubert
DEPARTMENT	Curriculum Studies
DATE CONSIDERED	30 September 2004
DECISION OF THE COMMITTEE	APPROVED

This ethical clearance is valid for 3 years from the date of consideration and may be renewed upon application

CHAIRPERSON OF ETHICS COMMITTEE Dr S Human-Vogel

DATE 18 August 2006

CC Prof J G Maree
Prof W J Fraser
Me J Beukes

This ethical clearance certificate is issued subject to the following conditions:

1. A signed personal declaration of responsibility
2. If the research question changes significantly so as to alter the nature of the study, a new application for ethical clearance must be submitted
3. It remains the students' responsibility to ensure that all the necessary forms for informed consent are kept for future queries.

Please quote the clearance number in all enquiries.

Appendix J Declaration by external coder

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DECLARATION

I, Cecilia Jacomina Louw, identity number 591006 0060 089, hereby declare that I acted in the capacity of external codifier for Mr Christiaan Gerhardus Joubert in the data analysis phase of his thesis.

In making the analysis, possible categories and subcategories were identified and based on scientific principles. Furthermore, tendencies in die data were presented as accurately as possible and based on qualitative analysis principles.

THUS SIGNED at Centurion on this 6 day of October 2006.

.....

Appendix K Approval received from the South African Air Force

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Directorate Command and Control Systems

Air Command Private Bag X199, Pretoria 0001 / Air Command South African Air Force Headquarters, Dequar Road, Pretoria, 0002

Telephone: (012) 312 2257
Facsimile: (012) 312 2076
Signal: AIR COMD 343A
Enquiries: Col E. Zimmer

Air Command
Directorate Command &
Control Systems
Private Bag X199
Pretoria
18 February 2005

Mr Ian Joubert,

REQUEST FOR RESEARCH WITHIN THE SA AIR FORCE

1. Conversation dated 16 February 2005 refers.

2. DC&CS, Brig Gen L. Lombard and SSO ATM, Col T. Jacobs have in concept approved your request to conduct research within the SA Air Force (Air Traffic Management Environment). The following actions need to be communicated and documented:

   a. Myself, to ensure the necessary authorities and liaison for yourself to in person, at the specific Control Towers conduct your research. This I will confirm.

   b. Yourself, to forward to my office your **detailed** plan of action/activities to meet your requirements. This must include for example dates, places and specific requirements.

3. With all the above in place, a meeting with Brig Gen Lombard will be arranged to update himself on the way forward. On conclusion of your research, Brig Gen Lombard, Col Jacobs and myself will need to have visibility into your final product.

4. I look forward to be off assistance as well as to what benefit the result of your research could be to SAAF ATC.

(E. ZIMMER)
SSO HR FUNCTIONAL DEVELOPMENT AND CAREER MANAGEMENT: COL

ez/ez

Appendix L Extracts of interviews conducted

Extracts from individual interviews

Respondent number	Questions posed and responses recorded
06	Explain with the aid of examples how teamwork influences the outcome of the air traffic control service provided by your centre? *Teamwork in the ATC environment is very important. A simple thing like animals which is especially a problem at our ATC centre on and around the runway poses a great threat. With more eyes looking around for and seeing animals crossing or near the runway while you are busy you may have missed as well as vultures and other birds that is already great proof of how teamwork can change the outcome of things. The same with the coordination between approach, ground and tower and how they influence each other in the actual flow of air traffic as it may be. It has a great influence on the outcome of the whole, call it, flying safety as well as the actual flow of air traffic et cetera. Around here, especially lately with all the (aircraft type) being here that has really come to the point where it makes a big difference; there is not a thing of dumping aircraft on the aerodrome controller and yours that cannot take place. Plain and simple - the better the coordination and the better the teamwork the better the flow of air traffic; especially with a lot of student pilots being here at the moment and you have got (approach types), in between IF patterns, in between normal circuit training and you have got to fit everyone in (example stated). Coordination and the whole team effort makes it a much safer environment and much easier to really keep the traffic flowing without impending on a student's learning ability or his chance of learning because of … (controlling action) because of a lack of coordination or a lack of team effort then actually you are taking the chance of learning away from that student – it is very important!*

08	Explain with the aid of examples how learning from air traffic control teamwork experiences influences your own performance? *It happens constantly in the tower. Everybody experiences something different or out of the ordinary. When they come up to the tower everybody is taught about it and they always share the experience with everybody – so you know basically what they experienced. And you will remember it and next time when you work and you have perhaps the same situation or the same person and he is giving you trouble just because he can – because that happens as well – then you know, oh well, its this situation and what is the options available. Discussions about incidents is quite frequent in the tower. How to handle them, different options for different types of situations happens quite frequently. It just starts, … as a casual conversation between two people – "I had this situation" – and they start talking and telling what happened and then one or two other people start join in and eventually everybody is talking and giving options, discussing the situation and giving alternatives, asking questions; maybe it wont be relevant but it leads from the situation.* *Learning differs from people, I know some of the people will, from my experience, go and write it down; we have a controller like that in the tower, and use it for his next period. Me, personally I just file it somewhere in my head and next time I'm confronted with a situation you remember that one thing that you were taught in the tower and you try and see if it is applicable, is it something that changed?, how can I solve this problem?, is that information relevant or not? It is definitely helpful – without it I don't think our service would be as professional as it is.* *Interest in the way that we deliver a service and also interest in you as a person helps you achieve the best that you can be. You need to ensure that the service that you as part of the team provide is at the same level as the rest of the team.*
15	Explain with the aid of examples how learning from experience influences air traffic control teamwork? *Yes, I believe there is an interesting saying that experience is a very hard teacher, it first gives you the test and then the lesson. Experience is something that you cannot disregard it. As stated earlier, when there is certain situations we feel that we could have done better … we then sit*

	around, sit upstairs and we discuss what can we do. We are not, we do not try to hide our mistakes, we discuss it with each other. If I feel I've made a mistake or there is a certain situation that I could have done better with, I sound-board it to the rest of the members to ask them "how would you manage that situation?" So, by picking up experience not only by myself I explain it to the rest of the members and vice versa. Other members even the seniors and the juniors they usually come and ask for, … not advice, but "what would you do in a situation like that?" So, yes, it's a very integral part of teamwork to improve the service. So the experience one picks up is not to be kept for yourself. We do share situations with each other and that is how we learn. Then other members pick up the experience that you pick up and then the teamwork reaches consensus about certain things to be done to improve the service of the team. *I think at this stage … I cannot speak for the rest of the tower's team or (organization) we must, not improve, we must endeavour to have more teamwork sessions, be it formally or informally to ensure that this team is running smoothly. I would not say that we are lacking but we can definitely have more sessions where we as a team can have teambuilding exercises for instance or even social events. One would not like to have individuals; … individual participation; one would like to have at least two in a group, give them certain situations, ATC situations, or even other problematic situations where one has to think fast, react fast … so yes, exercises in the sense of problem solving in group format.*

Extracts from focus group interviews

Respondent numbers	Questions posed and responses recorded
01,02, 04 & 07	What can a team member, joining the air traffic control team, expect from the team? *In my opinion, somebody from outside the team can expect a lot of assistance, a lot of suggestions and a lot of help from the team. When they begin to fit in with the group given the circumstances they will be able to do the job at the end of the day (emphasizing the task focus). He*

	would be drawn into the group socially, most definitely, actually. We get close to each other, we don't only work together, we also live together, so – it is easier in our context, when you arrive, you are part of the group. More than you would be at (ATSU) where you have a 9 to 5 job and you are totally anonymous after hours. I think you are immediately in the group from a social aspect as well. OK, what you should not expect, you should not expect the team to adapt around you. You should maybe then realize that the team was there before you came there. So you can't expect them now to all go out of their way to make you feel, … OK, they will make you feel welcome, but you must work from your side as well, because you must become part of the team. *I would like to maybe add that the team would at assess you at first and see what type of person you are and how you can contribute to the team as well. And then from there try, lets call it, … develop you and make you part of the team. That the team, … I find I like to see what I can learn from that person; he is coming from a different team joining my team and what we can learn from each other. It is important that they be open or willing to in what you are trying to teach them.* *I think that touches on what we have done in some of our earlier sessions, where the team will immediately also draw that person's expertise out because each person is a specialist and he doesn't necessary realize it. So, there is a mutual, … information will be shared, knowledge will be shared; there will be a two-way street. Also another thing is that it won't be necessary all formal, maybe this is the next question. When somebody arrives here the training officer will take him and obviously you have your standard training profile that you will go through with the person; you will see very regularly the person taking that person off to the side and showing them something totally different and some of that is not even in the curriculum, necessarily. But, stuff that needs to be shown and it happens almost out of its own; not necessarily triggered by any specific piece of paper work.*
10, 11, 12 & 16	How is individual and collective learning planned and executed at your air traffic control centre? *Planned learning is the validation, when you get here there is a plan, you will start at zero hours and you will work through. You have to write your exams, you have to pass your exams you are under continued evaluation during validation; that's the plan. So, I think … and your*

	continuation training; as well as … I think we have realized that every time something happens we debrief about it immediately. An incident occurs and sometimes it is not based on something that … sometimes it is something that has gone well … it gets put into the occurrence log and that is briefed very comprehensively in as far as possible whoever were involved and not involved … what did we learn out of that? … especially positive. So I think that is the planned part. It is not planned that tomorrow afternoon we are going to have an emergency and then discuss it but it is planned that whenever something happens it will be debriefed directly afterwards. It is true what he says, it is not planned, it just happens automatically. Everybody knows about it and everybody is talking about it, especially (person); he likes talking so everyone is drawn into the conversation as I said – people aren't scattered, it is a strange magnet, they are drawn upstairs. Everyone wants to see what is going on, again I think because of the group dynamics. If there were really conflict between people it would really affect this. So, it is planned unplanned. It is a known fact that this is going to happen, although there are training days when things are planned. What I also see is people who have a certain extent of knowledge about the subject … relevant or irrelevant … it is sort of a challenge to note something that somebody else don't know (example provided). And then they share it. *A large percentage of ATCs become ATCs because of an inherent need to help people, they want to do something. This is a case of you want to get your knowledge to help. You actually feel good, a sense of accomplishment, by knowing something that your colleagues don't know and you can assist them because they want to know that. And you get a positive response out of that. I think that is what drives it, rather than the idea that I am better than you. I think that is the prime drive for everything. You will not find an "I've got it you must get it" attitude. If I know something or anybody in the team knows something which another guy now has to look up and search for it would be shared.*
18, 20, 23 & 24	How can air traffic control team learning at your centre be improved? *First of all team learning … if the team doesn't operate well together, then the team learning part will be very difficult. I definitely think that from the towers side, but it is difficult considering the hours that we work and stuff, … to do more social team things together … work-related but away from work; like … the ATMS things that we do, … there is always three people that need to work and stay behind … because we have to*

	always accommodate the pilots. If you make it interesting, … there is such a whole wide world out there with regards to what you can learn and what other people can learn. I think if you start to do it more on a social basis you won't have to feel like you are at school. We start getting more "vrymoedigheid" … where the people can feel that they can ask questions … because I know there is a lot of people that just sit back in the tower … and I think if you also do that, they will feel more part of the team. And the questions that they ask … you think that more than one person in the tower doesn't know it … then she will make it part of the continuation training for instance, by asking questions related to that situation or scenario. Then people will feel more free to ask questions and do things like that. *I also think we must create a culture … like an open door policy, where every person, even a junior must feel free to make suggestions and identify needs from bottom up to the top and top to bottom. I think by encouraging everyone in the team to … I use the example of the internet – go to the internet aviation sites, and you will identify something that might be new to the team and identify such needs and do some research on it.*