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

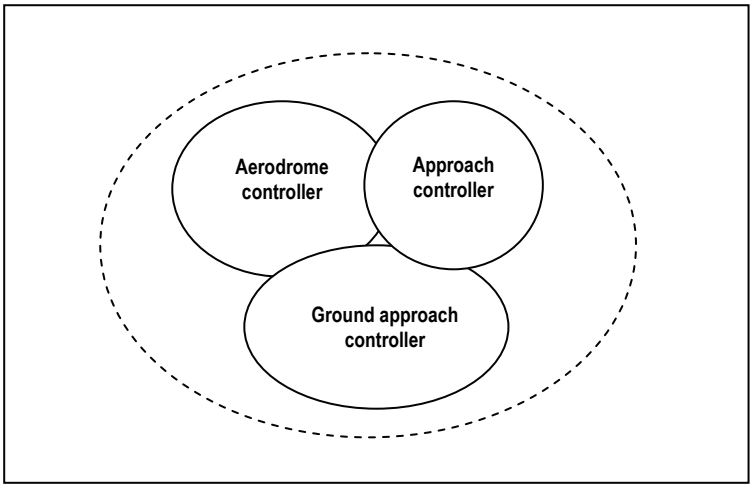
For the purpose of this research, the following terms and abbreviations are provided:

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

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	

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

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	

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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
		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**	

Compiled by the researcher

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

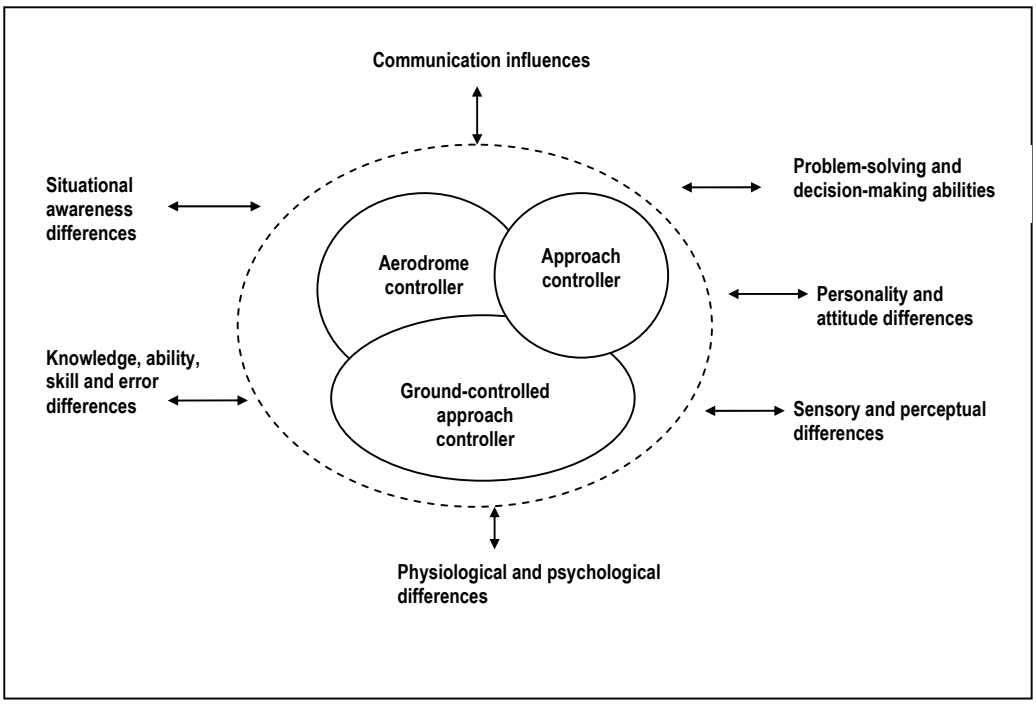
3.3 An overview of human factors

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.

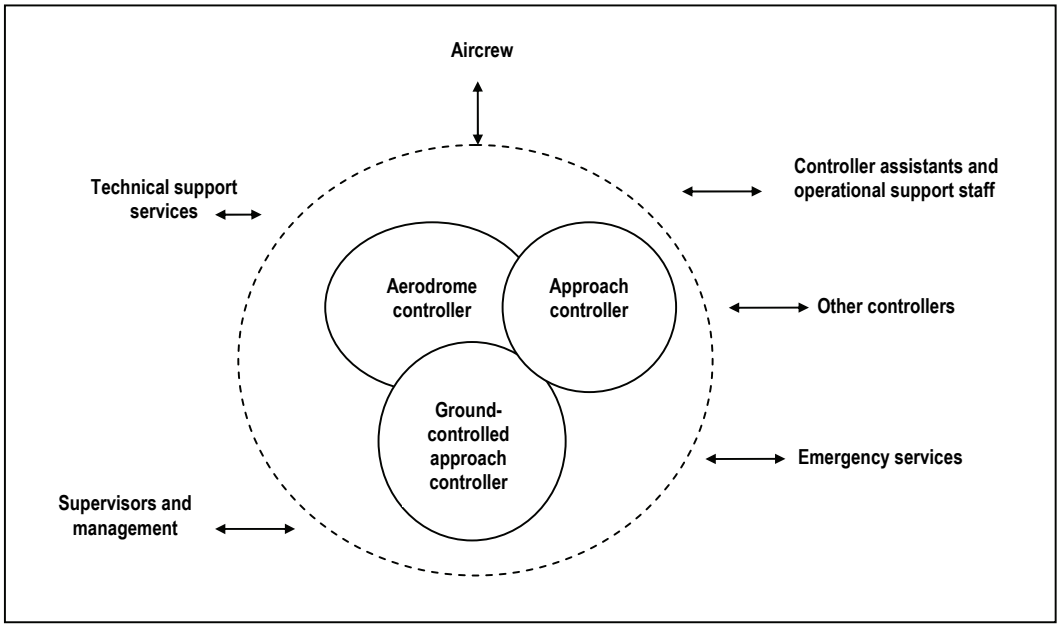
> *An air traffic control team comprises a small number of people with adequate knowledge and complementary skills who are committed to a common purpose and specific performance goals, following a common working approach, for which they hold themselves individually and collectively accountable* (ATNS,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

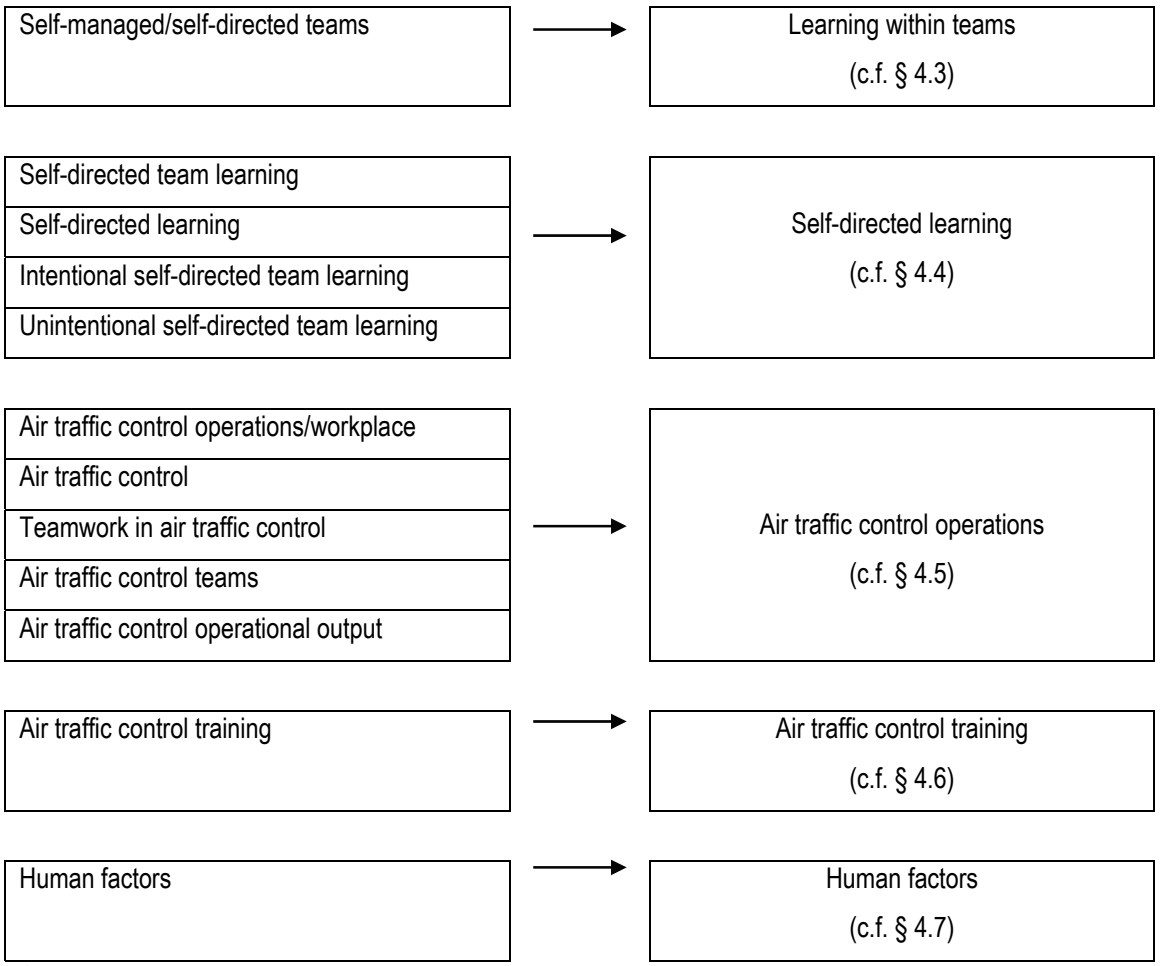
4.1 Point of departure

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)



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

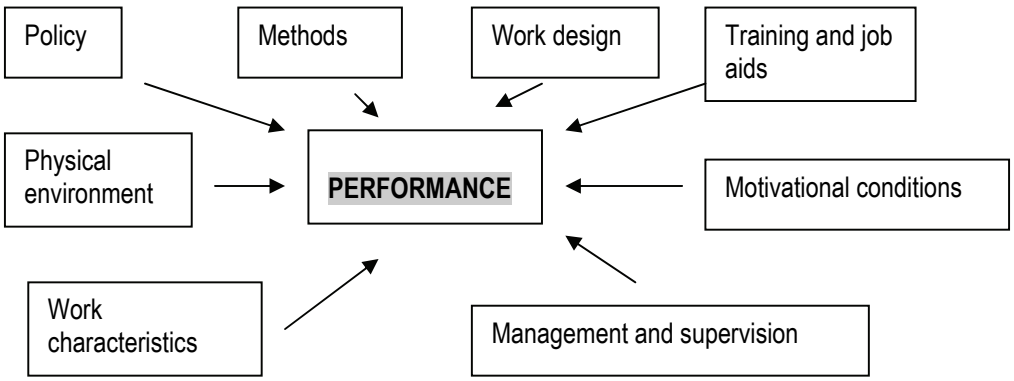
Teamwork describes the activities and associated dynamics that are present within a team at work.

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;

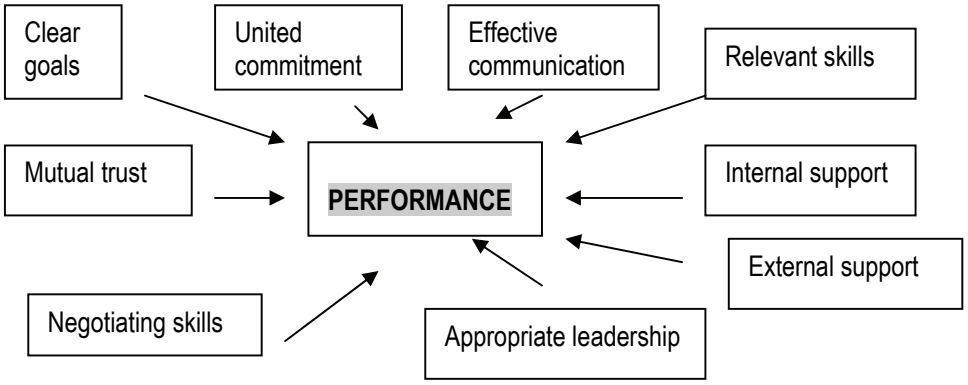
- skills;
- support;
- communication; and
- trust.

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

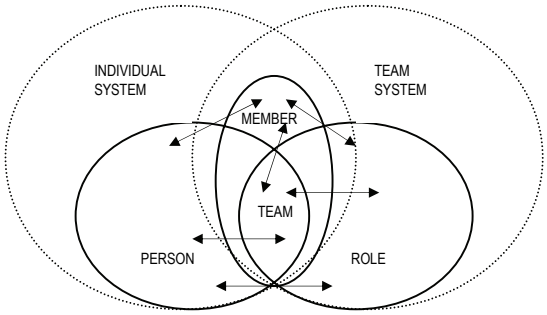


Adapted by the researcher from Gee's (2002: 3)

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.

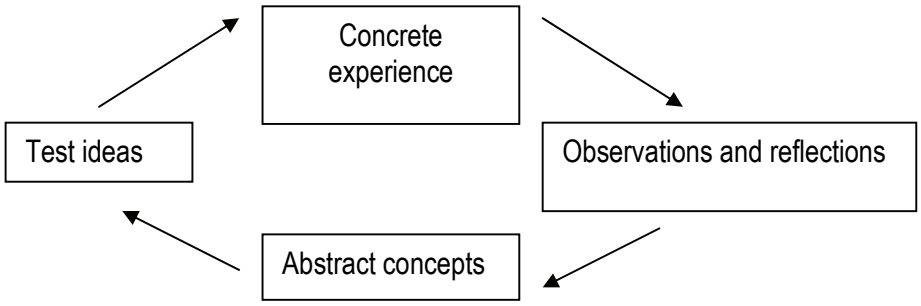
The following problems or megatraps (Rayner, 1996: 5) may also contribute to ineffective team performance and team learning within a self-directed team context:

- **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:

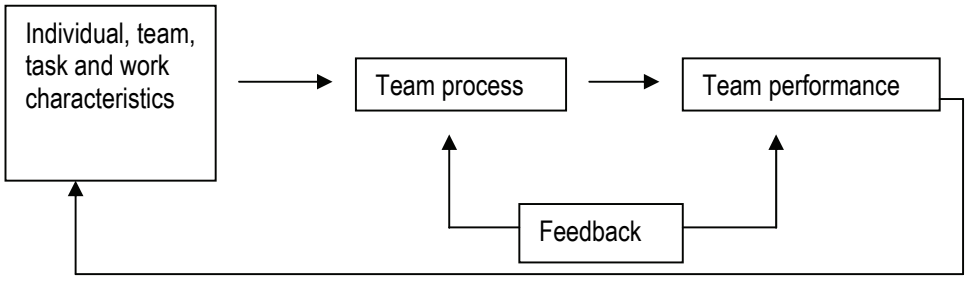
- Accent is on the "whole person" learning; learning that involves thinking, feeling and behaviour.
- There must be practice of behaviour and skills — practice that is informed by guided experience and constructive feedback.
- There should be a strong focus on the present because it helps in the learning 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		

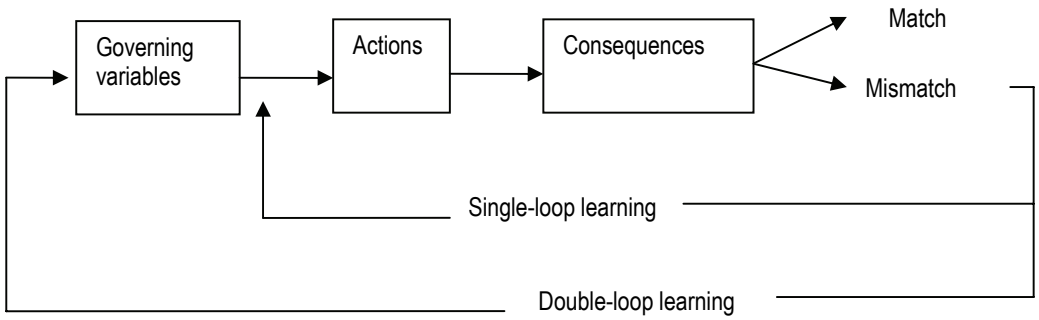
Argyris (1982: 102)

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

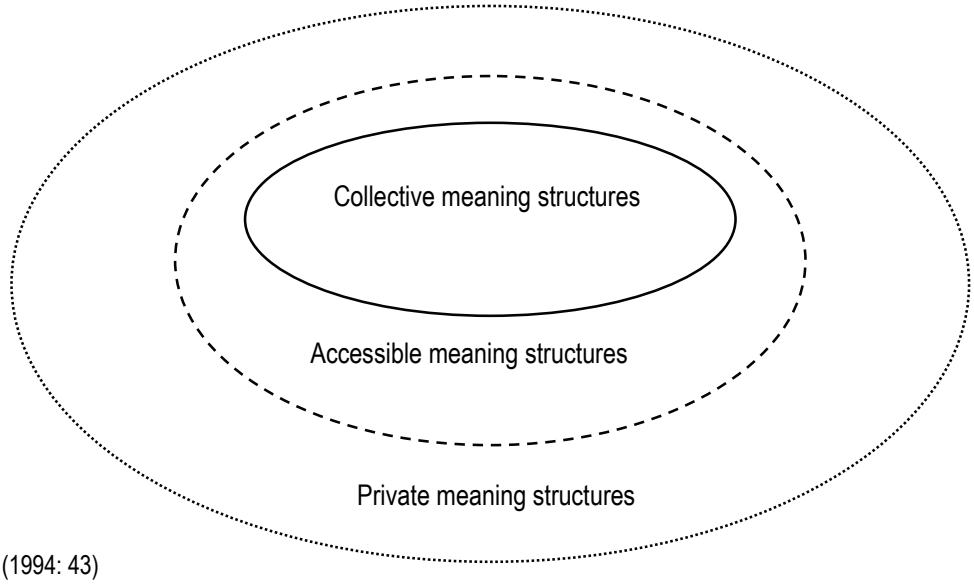
Extended and complex work environments have made it difficult for individuals to single-handedly conceptualise and solve all workplace problems and challenges. Johnson and Johnson (1991: 17) state:

> *"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).

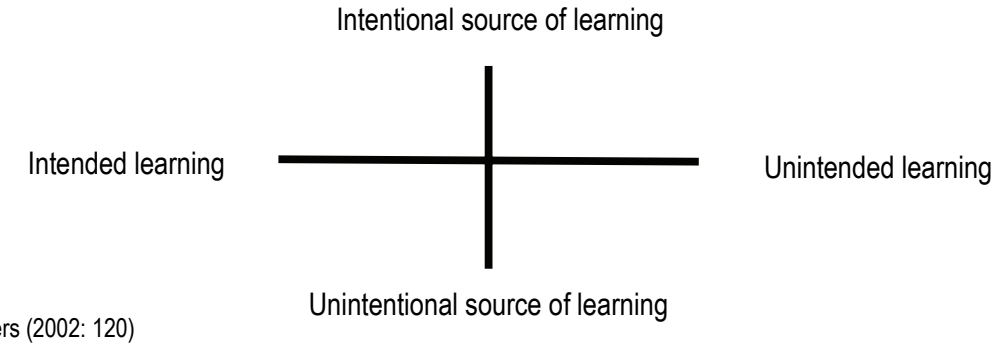
- Most learning episodes are directed towards specific goals, however there is little interest in overall principles. Few attempts are usually made to draw general conclusions from the particular instance learned. The team member normally brings the process of investigation to a close, storing away the 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.

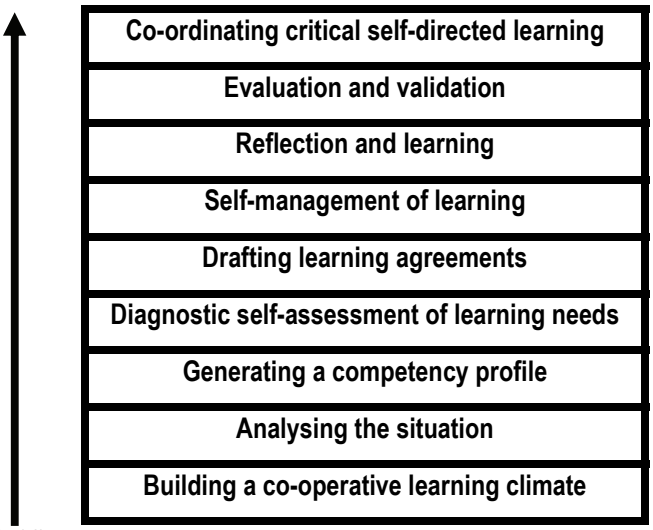
Table 2.20 Major classes of self-directed learning processes

	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.

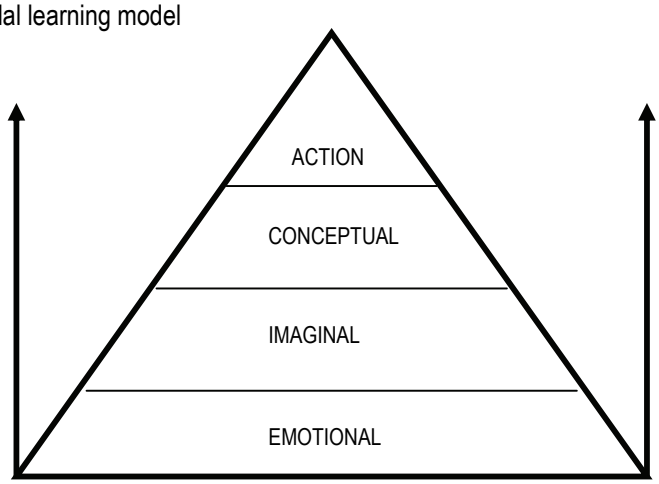
Heron (Postle, 1993: 33-35) identifies four modes of learning from experience, each dependent on the other and arranged as an “up-hierarchy”; known as multimodal learning. The four modes of learning from experience are described below and depicted in Figure 2.14.

- **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

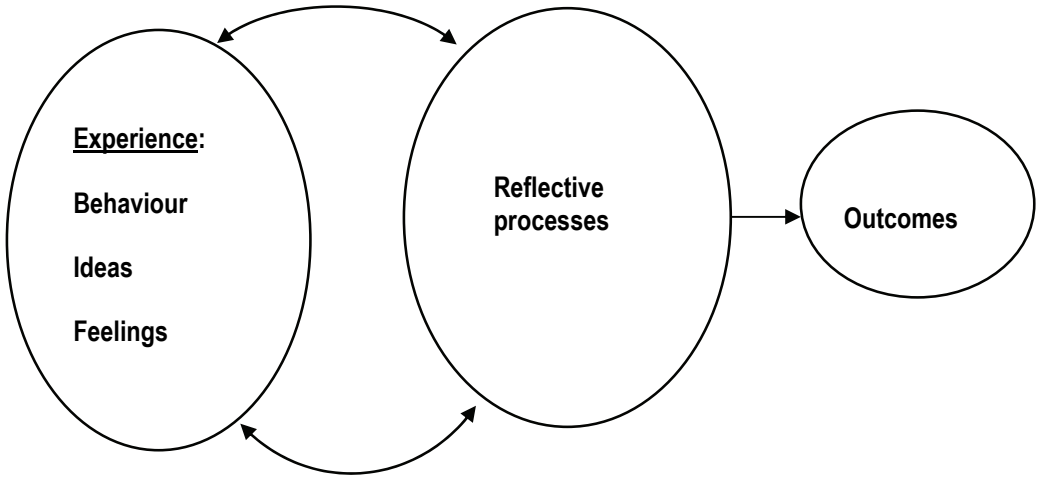
(Edwards, Hanson & Raggatt, 1995: 33). Reflection may take place in isolation or in association with others (Edwards, Hanson & Raggatt, 1995: 33). Reflection is an important activity in which people recapture their experience, think about it, mull over it and evaluate it (Edwards, Hanson & Raggatt, 1995: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

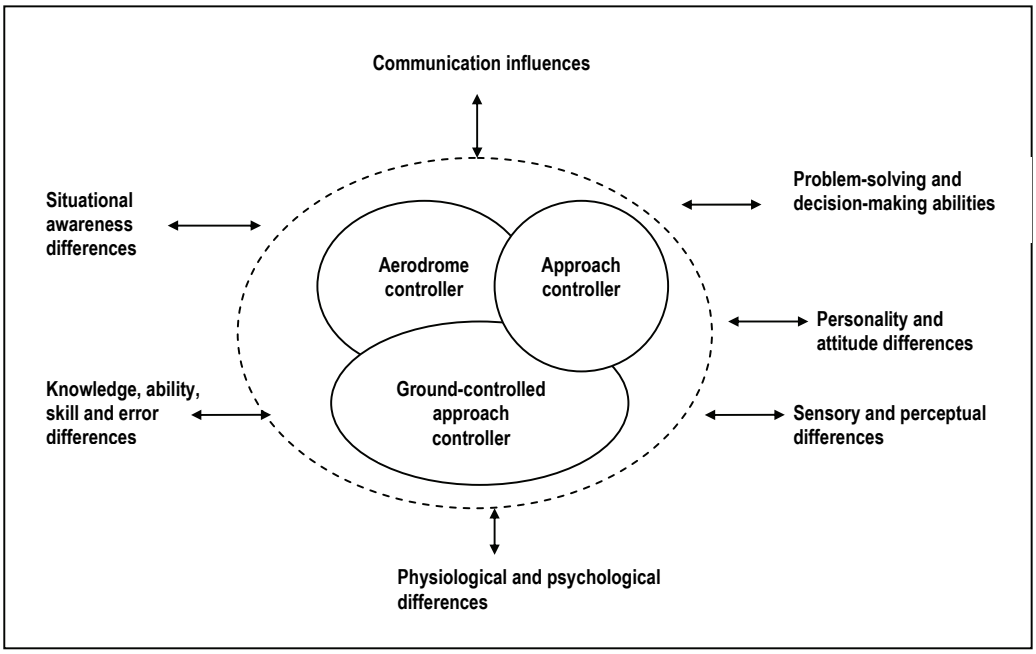
A study of human factors allows for the assessment (Thomas, 2004: 213, Amundson, 1995: 83-86 and Hamman, Seamster & Edens, 1995: 89-92) of the following:

- **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):

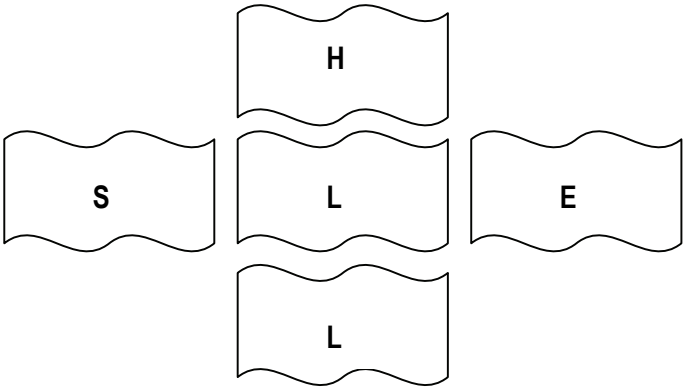
- **S** — Software. The rules, procedures, spoken words, which are part and parcel of the standard operating procedures.
- **H** — Hardware. The air traffic control suites, their configuration, controls and surfaces, displays and functional systems.

- **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.**

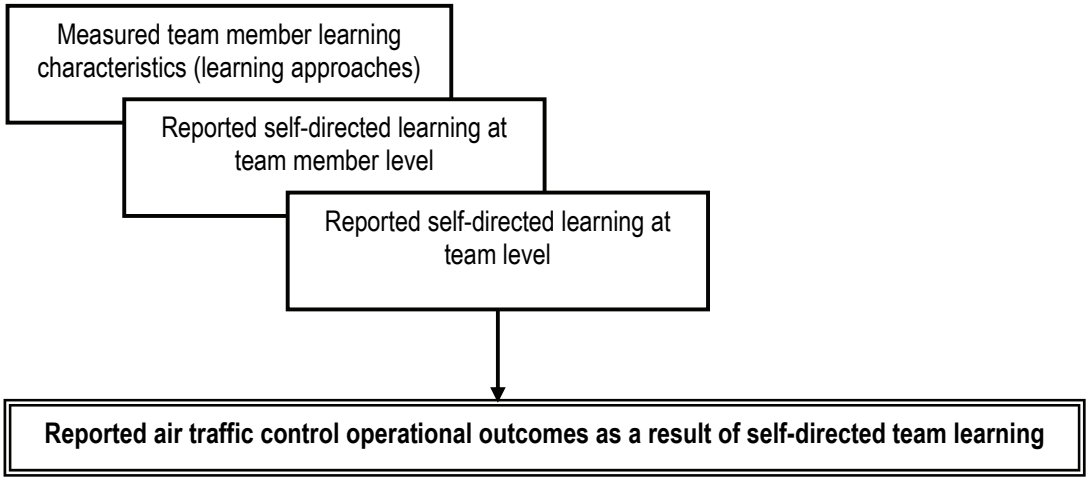
- I required a thorough understanding of learning practices and strategies utilised by both team members and teams and reported and perceived impact/outcome/effectiveness results. These learning practices, strategies and results are reliant upon individual learning approaches. **I had to understand, 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