THE DEVELOPMENT OF A
ROOT CAUSE ANALYSIS PROCESS
FOR VARIATIONS IN HUMAN PERFORMANCE

by

ANERIE RADEMEYER

Submitted in fulfilment of the requirements for the degree

PHILOSOPHIAE DOCTOR
Human Resources Management

in the

FACULTY OF ECONOMIC AND MANAGEMENT SCIENCES

at the

UNIVERSITY OF PRETORIA

PRETORIA

PROMOTOR: DR YVONNE DU PLESSIS
CO-PROMOTOR: DR CHARLES H. KEPNER

August 2008

- My friends, Elanza and Rassie de Villiers, who are just the best. Elanza, thank you for always putting your own troubles aside to listen to mine. Rassie, thank you for all the phone calls and words of encouragement.

The companies

- Mr Scott Newton and the Master's degree students in Counselling Psychology at the Institute of Management and Business Analysis (CIMBA) in Asolo, Italy, for your participation in the study and valuable contributions.
- Mr Adriaan du Plessis and the consultants at Thinking Dimensions Group Pty Ltd for testing the process and contributing your experience to the study.

The language editor

Idette Noomé for the professional way in which the thesis has been proofread and edited.

"I asked for strength that I might achieve;
I was made weak that I might learn humbly to obey.
I asked for health that I might do greater things;
I was given infirmity that I might do better things.
I asked for riches that I might be happy;
I was given poverty that I might be wise.
I asked for power that I might have the praise of men;
I was given weakness that I might feel the need of God.
I asked for all things that I might enjoy life;
I was given life that I might enjoy all things.
I got nothing that I had asked for,
But everything I had hoped for.
Almost despite myself my unspoken prayers were answered;
I am, among all men, most richly blessed."

(Prayer of an unknown Confederate soldier, cited in Haddon, 2003:155)

DECLARATIONS

I, Anerie Rademeyer, declare that '*The development of a root cause analysis process for variations in human performance'* is my own unaided work both in content and execution. All the resources I used in this study are cited and referred to in the reference list by means of a comprehensive referencing system. Apart from the normal guidance from my supervisors, I have received no assistance, except as stated in the acknowledgements.

I declare that the content of this thesis has never before been used for any qualification at any tertiary institution.

I, Anerie Rademeyer, declare that this study was language edited by Idette Noomé (MA English, University of Pretoria).

_____
Anerie Rademeyer

ABSTRACT

**The development of a Root Cause Analysis process for variations in
human performance**

by

Anerie Rademeyer

Promotor	:	**Dr Yvonne du Plessis**
Co-promotor	:	**Dr Charles H Kepner**
Faculty	:	**Economic and Management Sciences**
Degree	:	**Philosophiae Doctor (Human Resources Management)**

Problem-solving ability is now the most sought-after trait in up-and-coming executives, according to a survey of 1 000 executives conducted by Caliper Associates, reported in the *Wall Street Journal* by Hal Lancaster (Hoenig, 2002:338). This trait would include the ability to solve human performance problems, something many people tend to steer clear of.

According to Piskurich (2002:57-58) and Rothwell, Hohne and King (2000:67-71), the most common problem-solving tools that are used when solving human performance problems are brainstorming, cause-and-effect analysis, and the five why's technique. Although techniques such as these have proven to be robust and useful, what is required to solve human performance problems is a logical and verifiable process that can establish a data point about which relevant information can be recognized and gathered, and against which the conclusion can be evaluated, to have confirmed knowledge of the root cause of the problems. Unfortunately, existing root cause analysis processes tend to focus on processes and systems, rather than on individual performance (Bowling, 2003).

The main objective of this study was to develop a root cause analysis process that would uncover the root cause(s) of uncontrolled variation(s) in human performance and prevent the recurrence of events causing the variation. In addition to addressing individual human performance incidents, it is also necessary continually to manage people's performance to detect and address

any occurrences (or recurrences) of performance variations. Therefore, in addition to the main objective, the study also aimed to develop a Human Performance Management Model that incorporated the root cause analysis process as a problem-solving tool.

Action research was used in this study, because of the cyclical iterative nature of this type of research, and because it is a rigorous, responsive and flexible process. The study consisted of three cycles. The end result was a structured root cause analysis process – the Human Performance Variation Analysis (HPVA) process – that enables the systematic collection of valid and reliable information, as is required to solve variation in human performance. The HPVA process is a three-part process that consists of 11 steps. The process is in turn a tool that forms part of a ten-step Human Performance Management Model.

The study contributes to the body of knowledge on human performance management by presenting the following:

- a systematic root cause analysis process that uncovers the root causes of human performance problems effectively and consistently and that controls these causes of problems in a way that prevents the problems from recurring; and
- a Human Performance Management Model that will help to sustain the new, improved performance; prevent the same or similar performance problem(s) in other areas of the organisation; and ultimately, create an environment and culture of continuous human performance improvement.

Key terms:

Human performance enhancement	Performance management model
Human performance technology	Performance problem-solving
Performance analysis	Problem-solving process
Performance deviations	Performance variations
Performance improvement	Root cause analysis
Performance management	Solving human performance problems

CONTENTS

CHAPTER 5 – RATIONALE FOR THE RESEARCH APPROACH

CHAPTER 6 – RESEARCH METHODOLOGY AND METHODS USED

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1

INTRODUCTION

1.1   BACKGROUND

Over the centuries, many have contributed to our understanding of the concept of performance excellence. Three leaders in the field of performance excellence are W.E. Deming, J.M. Juran, and P.B. Crosby (Vanderbilt University, n.d.). Historically, the lessons that these three "gurus" have learned and the methodologies that they investigated have, to a large extent, shaped the way in which performance as a concept is applied in organisations.

During the late 1920s, while working as a summer employee at the Western Electrical Company in Chicago, Dr W. Edwards Deming found that worker motivation systems were undignified and economically unproductive. In the 1930s Deming partnered with Walter A. Shewhart, a Bell Telephone Company statistician whose work persuaded Deming that statistical control techniques could be used to replace conventional management methods. Using Shewhart's theories, Deming developed a statistically controlled management process that provided managers with a way to determine when to intervene in an industrial process and when to leave it alone (*Encyclopedia of Small Business*, n.d.). Deming put Shewhart's statistical quality-control techniques and his own viewpoints of management to the test during World War II. Government managers found that these techniques could easily be taught to engineers and workers and quickly implemented them in over-burdened war production plants (*Encyclopedia of Small Business*, n.d.).

After World War II, Japan's economy suffered from the post-war economic depression. In 1950, Dr Deming was invited to visit Japan by the Japanese Union of Scientists and Engineers. Deming gave a series of lectures on quality control to Japan's top engineers and managers. Japan adopted Deming's principles and this strategy began to show positive results eighteen months

after his first lecture. In the mid-1950s, Japan began to display remarkable improvements in the quality of their products (Neave in Williams, 2001:38) and began to capture an increasingly large part of the international market share in the automotive and electronic industries – all this within four years of Deming's first visit (Aguavo, Deming & Walton in Williams, 2001:39).

Although Deming's former definition of quality concentrated on its statistical component, his later works considered quality from both a statistical and a management perspective. He argued that it was essential to transform management practices so that quality can be looked at from a systems perspective. Deming argued strongly that quality should be an organisation-wide effort and that it is everyone's duty, with management playing a primary role (CHI Publishers, n.d.:4). It is not surprising, then, that W. Edwards Deming is considered the father of Total Quality Management (TQM) (CHI Publishers, n.d.:4), which was the phrase applied to the quality initiatives offered by Deming and other management gurus, such as Joseph M. Juran and Philip B. Crosby, who were also major contributors to the TQM movement (*Encyclopedia of Small Business*, n.d.:5; CHI Publishers, n.d.:2).

"TQM is a holistic concept that considers the improvement in all organisational activities and processes" (CHI Publishers, n.d.:5). According to Andersen and Fagerhaug (2006:12), "TQM developed in different directions more or less simultaneously. One of these directions is the development of a number of problem analysis, problem-solving and improvement tools". Today, TQM possesses a large toolbox of such techniques, which are all overarching theories with the aim of continuous improvement in quality. Root cause analysis is part of this toolbox; and it plays an integral part in the continuous improvement process (Andersen & Fagerhaug, 2006:12; Neal *et al.*, 2004:75).

It can thus be said that the origins of root cause analysis can be traced to the broader field of TQM (Andersen & Fagerhaug, 2006:12).

To gain a better understanding of the origin and concepts of root cause analysis, it is necessary to describe it briefly. *Root cause analysis* has been

defined as "a structured investigation that aims to identify the true cause of a problem and the actions necessary to eliminate it" (Neal *et al*. 2004:75). According to Mary A. Bowling (2003), root cause analysis focuses primarily on processes and systems, and not on individual performance.

Significant industries using root cause analysis include the manufacturing, construction, healthcare, transportation, chemical, petroleum and power generation industries (Wilson, n.d.). According to Wilson (n.d.), the possible fields of application include operations, project management, quality control, health and safety, business process improvement and change management. In a root cause analysis survey conducted by the Plant Maintenance Resource Center (2001), 59% of the respondents indicated that they use some form of root cause analysis and that the following people usually participate in the root cause analysis process:

- reliability/plant/maintenance engineers;
- maintenance managers/superintendents;
- maintenance foremen/supervisors/coordinators;
- maintenance planners/schedulers;
- maintenance trades people/craftspeople;
- production managers/superintendents;
- production foremen/supervisors/coordinators;
- production operators;
- safety officers; and
- environmental officers.

It is evident from the above list that the field of human resources management has not been a general area of application. It is from this gap that the focus of this study emerged.

The greatest challenge of this study was therefore to adapt the data fields that are commonly used in root cause analysis – for example, manufacturer, model number, failed component, maintenance start date/time, equipment type

(Latino & Latino, 2006:75) – to human performance factors in order to identify the latent conditions that underlie variations in human performance.

The aim of this study is to integrate root cause analysis in and apply it to the field of human performance management – more specifically, to apply a root cause analysis process to uncover the root cause(s) of uncontrolled variation(s) in human performance.

An explanation of the types of variation in performance implied here is set out below to clarify the concept.

1.2   VARIATIONS IN PERFORMANCE

Deming, Juran and Crosby all noted more than two decades ago that variability on critical performance metrics is evidence that a business is not being managed effectively (Adsit, n.d.). Variation in measures such as performance, quality and throughput poses a threat to the vitality of an organisation. The greater the range of variation, the more costly the business is to operate.

Motley's (2005) definition of a variation is most apt for the purposes of this study – variation is any unwanted condition, or is the difference between a current and a desired end state.

It can be accepted that there will always be variation between people, in output, in service and in product(s). However, it is a key element of performance excellence to manage and reduce variation, and when variation does occur, to identify the sources of that variation and then to earmark them for further scrutiny. However, this does not imply that we need to measure and investigate every possible source of variation – we only need to investigate the possible sources that probably contribute most significantly to the variation in the output.

All causes of performance variation fall into two categories, namely chronic or controlled variation and sporadic or uncontrolled variation, and any situation may display both these types of variation from time to time (4GM Consulting, n.d.).
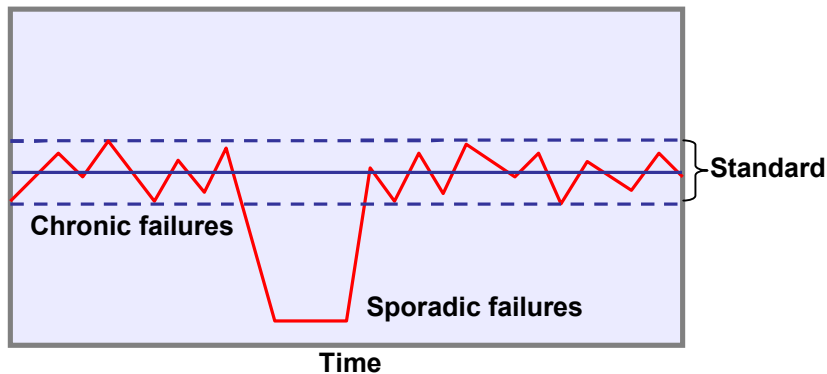
Figure 1.1 Types of variation

Source: Adapted from Latino and Latino (2006:46)

Small, individual causes of problems are inherent in all the possible sources of variation and they combine to produce a predictable degree of variation that remains reasonably constant over time, provided nothing arbitrarily changes in the process or job. These causes of variation are referred to as *controlled variation*, *common cause*, or *chronic failures/events* (4GM Consulting, n.d.; Latino & Latino, 2006:46). These variations happen so often that they become part of the *status quo*. If they can be eliminated, that would lead to an improvement.

Significant, assignable causes of variation are referred to as *uncontrolled variation*, *special cause*, or *sporadic failures/events* (4GM Consulting, n.d.; Latino & Latino, 2006:46). These are unnatural, inconsistent, unpredicted and unplanned, and they cause a significant shift or variation when they occur. Their occurrence can usually be ascribed to something special or specific that occurs. When they do occur, they cost a lot of money and require urgent and immediate attention.

According to Deming (quoted by Halliday, n.d.), confusion between controlled and uncontrolled variation could lead to frustration, greater variability and higher costs – the exact opposite of what an organisation needs. It is therefore important to distinguish between controlled and uncontrolled variation, as well as between performance management and performance improvement, because performance management and performance improvement as strategies generally follow different approaches. For the purposes of this study,

- *performance management* refers to actions taken to solve uncontrolled variation by eliminating the root causes and preventing a recurrence of the event that is causing the variation; and

- *performance improvement* refers to long-term strategies used to identify, understand and reduce or solve controlled variation, as well as to raise the level of performance by means of on-going management and improvement.

1.3 RATIONALE FOR THE STUDY AND ITS SIGNIFICANCE

1.3.1 The lack of shared understanding

When a variation in human performance occurs, it is usually the supervisor's responsibility to identify the deficiency and to respond to it promptly and consistently. However, if the manager/supervisor and the person who performs the task do not see the problem the same way, each will try to resolve a different issue and that will get them nowhere (Kepner & Iikubo, 1996:72). Tools are required that would allow organisations to create a common view or understanding of the problem (Gano, 1999:34). According to Gano (1999:34), sharing a common understanding made up of different people's perspectives would enable the organisation to escape from the illusion of "common sense" and thus avoid the usual type of disagreements.

1.3.2 The lack of proper analysis

In addition to a lack of shared understanding, ineffective problem-solving is often caused by people's tendency to focus on solutions

before clearly defining the problem and its causes (Gano, 1999:32). Jumping into a debate about possible solutions to a variation in human performance – for instance, job aids, coaching/mentoring, teaming, training or work group alignment (Rothwell, Hohne & King, 2000:99-100) – would focus only on the symptoms. As a result, the problem will recur again and again. According to the Center for Industrial Research and Services (n.d.), most organisations try to fix problems quickly, without ever finding out what caused the problems in the first place, making the problems reappear. "Only when the root cause is identified and eliminated can the problem be solved" (Center for Industrial Research and Services, n.d.).

1.3.3 Shortcomings of existing techniques and methodologies

According to Ammerman (1998:65), the most common root cause analysis techniques are Event and Causal Factor Charting, Control Barrier Analysis, and Fault Tree Analysis:

- *Event and Causal Factor Charting*
  The principles of using sequence diagrams was first adopted by the U.S. Atomic Energy Commission (Livingston, Jackson & Priestley, 2001:7). "Subsequently, many other root cause analysis programmes have included Events and Causal Factor diagrams in their armoury of methods" (Livingston *et al*., 2001:7). The purpose of Events and Causal Factors Charting is to identify and document the sequence of events from the beginning to the end of the incident, and to identify the factors, conditions, failed barriers, and energy flows that contributed to the incident (Livingston *et al*., 2001:7).

- *Control Barrier Analysis*
  The concepts used in barrier analysis were originally developed in Hienrich's domino theory in the 1930s (Livingston *et al*., 2001:13). Haddon and Gibson (in Livingston *et al*., 2001:13) developed the concept of an accident as an abnormal or unexpected release of energy. "Barrier analysis uses this idea in its approach to accident

prevention by suggesting that, in order to prevent an accident, a barrier must be erected between the energy source and the item or person that is to be protected" (Livingston *et al*., 2001:13).

- *Fault Tree Analysis*

  The theory of Fault Tree Analysis has been around at least since 1961 (Livingston *et al*., 2001:16). It is a deductive methodology – "it involves reasoning from the general to the specific, working backwards through time to examine preceding events leading to failure" (Livingston *et al*., 2001:16). Fault Tree Analysis is used to determine the potential causes of incidents or of system failures more generally (Livingston *et al*., 2001:16).

The principles and concepts that the above techniques employ have provided the foundation for almost every root cause analysis technique (Livingston *et al*., 2001:13) to date. According to Piskurich (2002:57-58) and Rothwell *et al*. (2000:67-71), the most common cause analysis tools used when analysing human performance are brainstorming, cause-and-effect analysis (also known as the fishbone or Ishikawa diagram), and the five why's technique.

Although techniques such as brainstorming, the fishbone diagram, and the five why's have proved to be robust and useful, it may be argued that, for the following reasons, they are not necessarily geared for and apposite in analysing uncontrolled variations in human performance and would therefore have only limited success in identifying the root causes of human performance problems:

- There is no evidence of an objective, finite data point or base performance from which to proceed or against which a comparison can be made, or a logical structure by which to be guided (Kepner, 2006b:1).

- According to Latino and Latino (2006:21), techniques such as these allow ignorance and assumptions (hearsay) to be treated as fact and then not enough time is spent on collecting data or evidence to

support the hearsay hypothesis. As a result, objective analysis is not possible. The only conclusions that can be reached are judgements based on partial and superficial experience, intuition and opinion. In such circumstances, the root cause that is selected is the one that feels good and seems to explain the performance variation, but it may have no analytic veracity (Kepner, 2006b:1).

The author's own experience in root cause analysis over the past 13 years concurs with Dr Kepner's (2006b:2) findings, namely that the methods and tools currently used to identify the root cause(s) of uncontrolled variations in human performance

- lack a precise, agreed-upon definition of the required or desired performance;
- lack a means of identifying what information is relevant;
- cannot identify sources of relevant, needed information, or those who can best judge the degree to which the conclusion explains the variation; and
- does not give enough guidance as to the remedial or corrective action that should be taken, which leads to much insecurity and trial-and-error adaptation of the action. The result is confusion, mistrust, resentment, and erosion of loyalty to the manager.

1.3.4 The need for a tool that fits the means

If attention is not paid to the uncontrolled variation in human performance and its root causes, it may have a damaging effect on performance and could ultimately have a negative and unfair impact on employees' careers and organisations' missions. What is needed to analyse uncontrolled variations in human performance is a logical and verifiable process that will establish a data point about which relevant information can be recognized and gathered, and against which the conclusion can be evaluated, to have confirmed knowledge of the root

cause of the uncontrolled variation from the data point. *The lack of such a root cause analysis process necessitates this research*.

A proper root cause analysis process for uncontrolled variations in human performance will

- provide a precise definition of the required or desired performance;
- provide a blueprint of the relevant information, as well as of who has the required information and knows enough about the situation to be able to help to identify an adequate explanation for the observed uncontrolled variation in human performance;
- demonstrate how well the explanation fits the uncontrolled variation in human performance; and
- identify and avoid the consequences of an action – this will lead to stability, acceptance of the action taken, loyalty to the manager and organisation, and trust in the humanity and justice of the entire system.

A root cause analysis process for uncontrolled variations in human performance should make successful corrective action a real possibility, whereas a superficial analysis which leads to an incorrect or inadequate understanding of the cause can only create chaos, waste and confusion (Kepner, 2006a:1). Knowing the root cause of an uncontrolled variation in human performance would be a huge step forward for all stakeholders.

In summary, a root cause analysis process would assist managers and supervisors because it could

- provide them with a strategy and a set of guidelines that would help them make sense of all the information coming their way regarding the uncontrolled variation in human performance;
- make them proactive by helping them to call for, and seek out, the specific information that they need in order to address the source of uncontrolled variation in human performance;

- assist them in determining the root cause of the uncontrolled variation in human performance, by providing them with a process for diagnosing, analysing and assessing the variation in the performance;

- help them in their efforts to determine what could be done to solve or prevent the source(s) of uncontrolled variation in human performance;

- assist them in making appropriate referrals, which would in turn enable them to enhance overall performance and, in some instances, even salvage careers; and

- give them added credibility for fairness, increase loyalty and commitment to both manager and company, and lead to positive future collaboration.

The study contributes to the body of knowledge on human performance management by presenting a systematic root cause analysis process that uncovers the root causes of human performance problems effectively and consistently; and controls these causes in a way that prevents the problems from recurring. The process will also facilitate the sharing of information between the manager/supervisor and performer – they become partners in formulating ideas and conclusions based on the facts and their combined knowledge and experience. To solve performance problems today, it is vital that managers/supervisors and performers pool their best knowledge and ideas to find the causes and develop the best solutions.

1.4   RESEARCH OBJECTIVES

The main objective of this study is to *develop a root cause analysis process that will uncover the root cause(s) of uncontrolled variation in human performance and prevent the recurrence of events causing the variation*.

In addition to the main objective, the study aims to use the root cause analysis process to *develop a Human Performance Management Model*. The purpose

of this model is to expand the boundaries of traditional performance management also to include

- actions that will sustain the new, improved performance;
- actions that will prevent the same or a similar performance problem in other areas of the organisation; and
- a process that will ultimately create an environment and culture of continuous performance improvement.

1.5   SCOPE OF THE STUDY

This study's main focus is the management of human performance by uncovering and preventing the root causes of uncontrolled variation by means of the application of a root cause analysis process. A secondary component of this study illustrates how the root cause analysis process can be incorporated into a larger performance management model as a cause analysis tool.

For the purposes of this study, as already mentioned earlier in this chapter, *performance management* refers to actions taken to keep the performance at the expected level of performance and to eliminate any event that causes unwanted variations from the performance norm, or uncontrolled variation.

Human performance management originated in the behavioural sciences, while quality improvement originated in engineering and statistics. Despite these differences, there are significant similarities between human performance management and quality improvement (JHPIEGO Corporation, 2003, *verbatim*)[1] – both

- are cyclical problem-solving processes;
- advocate the establishment of standards and the continual quest to meet those standards;
- seek to establish the root causes of identified problems; and

---

[1].Throughout this thesis, on a few occasions, items in a bulleted list are cited *verbatim* because that is the simplest and most concise way of making those points. Wherever this has been done, such citations are indicated as *verbatim* citations in the brackets after the page number.

- identify and select appropriate actions that are intended to address performance problems.

Notwithstanding these similarities, this study does not include an investigation of quality or performance improvement, or performance improvement methods, such as Six Sigma and innovation. For the purposes of this study, as mentioned previously in this chapter, *performance improvement* refers to actions taken, first, to obtain consistency and precision by minimizing or eliminating controlled variation, and/or, second, to raise the expected level of performance to a new standard.

1.6 OVERVIEW OF THE RESEARCH DESIGN AND METHODOLOGY

The objectives of this study could best be achieved by means of a qualitative research approach, applying action research as the research method. According to Hopkins (quoted by Gabel, 1995), the action research framework is most appropriate for recognizing the existence of shortcomings and for adopting some initial stance with regard to the problem, formulating a plan, carrying out an investigation, evaluating the outcomes and developing further strategies in an iterative fashion. The basic action research cycle, as displayed in Figure 1.2 (O'Brien, 1998:1), was used in this study. It is explained in greater detail in Chapters 5 and 6.
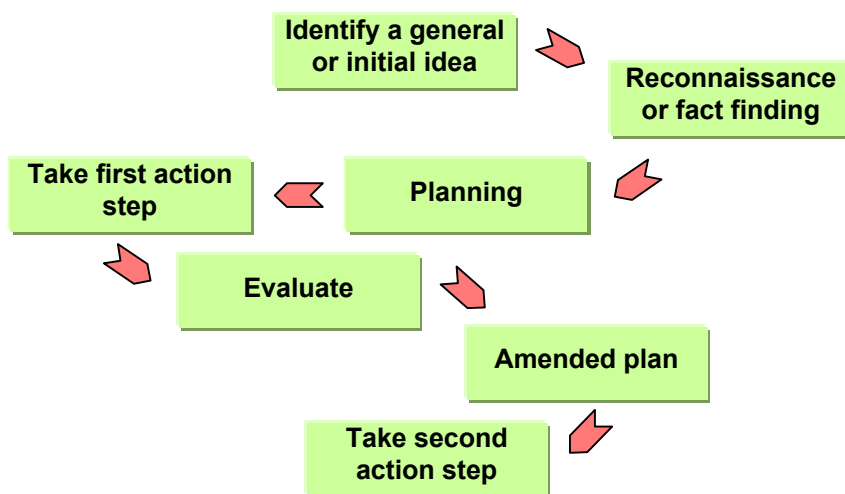
Figure 1.2 Basic action research cycle

Source: O'Brien (1998:1)

This study primarily involves the analysis of data in the form of words (more specifically literature studies) and gathering feedback after a practical application of the root cause analysis process. Most of the data analysis was carried out alongside data collection.

The study was conducted in three phases and nine steps (see Figure 1.3 – Research methodology overview):

Phase 1: Development of the root cause analysis process

- Step 1: Conduct a literature review
- Step 2: Develop a root cause analysis process for uncontrolled variations in human performance

Phase 2: Testing and refinement of the root cause analysis process

- Step 3: Design a feedback guide to gather opinions and suggestions
- Step 4: Apply the root cause analysis process to real life human performance variations
- Step 5: Gather, interpret and incorporate feedback data into process
- Step 6: Develop a case study
- Step 7: Apply the root cause analysis process to the case study
- Step 8: Interpret feedback data and refine the process

Phase 3: Development of a Human Performance Management Model

- Step 9: Develop a model for human performance management

The research process and steps are described in more detail in Chapters 5 and 6, which also explain the purpose of the process and its application to this study.

1.7   OUTLINE OF THE STUDY

This thesis consists of eight chapters.

Chapter 1 has highlighted the following:

- Current tools and methodologies used in root cause analysis have been developed with safety, quality, risk and reliability in mind. They are therefore not necessarily geared or appropriate to analysing uncontrolled variations in human performance.

- The lack of an appropriate tool increases the likelihood that people would fall into the trap of jumping ahead to solutions, instead of analysing the problem properly.

- There is a need for an appropriate tool that can be used to analyse and uncover the root causes of uncontrolled variations in human performance – it needs to establish a data point about which relevant information can be recognized, gathered, and against which the conclusion can be evaluated.

- The objective of this study is to develop a root cause analysis process that can uncover the root causes of uncontrolled variations in human performance, as well as to use the newly developed root cause analysis process to develop a human performance management model.

- The newly developed root cause analysis process and human performance management model will benefit any manager or supervisor who faces uncontrolled variations in human performance and who wishes to find the root cause of the variation, to improve performance, and to prevent any recurrence of the events that caused the variation.

Chapter 2 describes the fundamentals of human performance and the variables and trends that influence the level of work performance. **Chapter 3** describes methods and tools that could help manage human performance, as well as the role that human error plays as a potential cause of variation in human performance. The concept of root cause analysis is discussed in detail in **Chapter 4**. The research approach, methodology and methods used in this study are discussed in **Chapters 5 and 6**. The details of the research results and findings are outlined and discussed in **Chapter 7**. **Chapter 8** concludes this thesis by discussing the conclusions and recommendations.
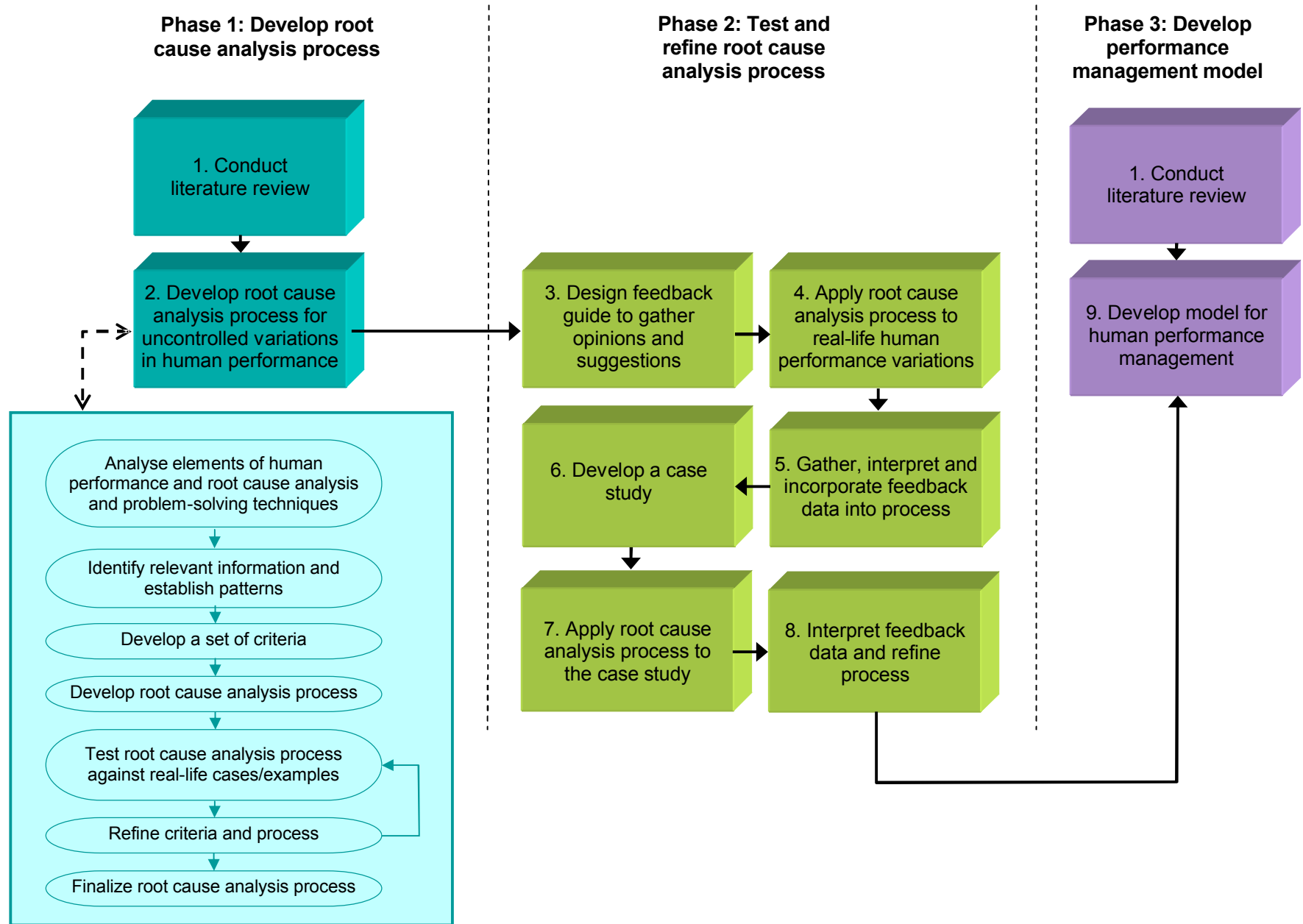
Figure 1.3 Research methodology overview

CHAPTER 2

THE FUNDAMENTALS OF HUMAN PERFORMANCE

2.1   INTRODUCTION

This chapter is the first of three that documents a literature review on the central concepts of this study. The purpose of this chapter is to introduce human performance as the foundation of people's accomplishments, and of outcomes and results in the world of work. This chapter is divided into three sections, discussing the following:

- a definition of human performance;
- human performance models; and
- variables and trends that affect human performance.

2.2   DEFINING THE TERM "HUMAN PERFORMANCE"

The word "performance" denotes a quantified result or a set of results that are obtained. It also refers to the accomplishment, execution or carrying out of anything that has been ordered or undertaken, to something performed or done, to a deed, achievement, or exploit, and to the execution or accomplishment of work (Stolovitch & Keeps, 1992:4). Nickols (quoted by Stolovitch & Keeps, 1992:4) defines "performance" as "the outcomes of behaviour". The adjective "human" is used to qualify the term "performance" to make it clear that the term refers specifically to the performance of people, rather than the performance of machines or other forms of equipment or technology. In short, human performance refers to people's accomplishments, outcomes and results.

2.3   HUMAN PERFORMANCE MODELS

The founders of human performance technology have observed that improved performance was often a consequence of a combination of interventions that

responded to a valid and reliable analysis of a problem or an opportunity. Furthermore, they realized that any single discipline – for example, training, organisational development, or feedback systems – by itself is no longer sufficient to address situations effectively and efficiently. Several models have therefore been developed to help communicate these conclusions (Rosenberg, Coscarelli & Hutchison, 1992:26-27).

In this section, the following seven human performance models are discussed from the perspectives of the different theorists and practitioners:

- Rummler and Brache's model;
- the ACORN model and the BEM developed by Thomas F. Gilbert;
- James H. Harless's model;
- Robert F. Mager and Peter Pipe's Situational Model;
- Rothwell's model for human performance enhancement;
- the TIME performance model; and
- the ASTD's Human Performance Improvement Process Model.

2.3.1 Rummler and Brache's model

One of the cornerstones of human performance is the notion of systems thinking (Piskurich, 2002:7). Authors such as Geary A. Rummler and Alan P. Brache have popularized and operationalized the idea of looking holistically and strategically at organisational problems (in Piskurich, 2002:7). Rummler and Brache (in Piskurich, 2002:8) have labelled and described three distinct parts of an organisation's performance system:

- *The organisation level of performance*
  This level encompasses the relationship between the organisation and its market; and it describes the main functions of the organisation, as depicted in its organisational chart of reporting relationships and departmental functions (Piskurich, 2002:8).
- *The process level of performance*
  This level considers the work flow across departments. It also

includes the job design, required input and desired outputs, and outlying processes required to support the performance that is being analysed (Piskurich, 2002:8).

- *The job/performer level of performance*

  This level focuses on things such as hiring and promotion, individual performance goals, and past levels of performance (Piskurich, 2002:8).

Combined, the above three levels make up the operational fabric of an organisation (Piskurich, 2002:8).

Based on Rummler and Brache's model, Figure 2.1 sets out the organisational performance system.

The three levels of performance	The three performance needs		
	Goals	**Design**	**Management**
Organisation level	Organisation goals	Organisation design	Organisation management
Process level	Process goals	Process design	Process management
Job/performer level	Job/performer goals	Job design	Job/performer management

Figure 2.1 Rummler and Brache's nine performance variables
Source: Rothwell *et al*. (2000:54)

One clear strength of Rummler and Brache's framework is that it is based on a systems perspective of the organisation and illustrates the relationship between the three performance levels and the three performance needs (Rothwell *et al*., 2000:54-55). Probing questions can be asked for each of the nine performance variables to diagnose the current state of affairs. Where there is a lack of congruence or alignment among the levels, or where there are problems or inefficiencies within the matrix, interventions may be recommended to bridge these performance gaps (Rothwell *et al*., 2000:55).

2.3.2 Models developed by Thomas F. Gilbert

Thomas F. Gilbert developed a classic holistic model for performance and reached several conceptual milestones in describing human performance and how it is analysed. He believed that performance is a function of behaviour (a process or what can be observed as an activity) and accomplishment (what is seen after people stop working). Gilbert differentiated between deficiencies of knowledge, deficiencies of execution, and a combination of these two kinds of deficiency (Rothwell, 2005:150). For Gilbert, any performance system can be analysed from the following six vantage points (Rothwell, 2005:42):

- *the philosophical level* – the beliefs according to which the organisation functions;
- *the cultural level* – the larger environment within which the organisation operates;
- *the policy level* – the missions that define the organisation's purpose;
- *the strategic level* – the plans the organisation has established to accomplish its mission;
- *the tactical level* – specific duties carried out to realize plans; and
- *the logistic level* – all the support activities that help people to perform their duties.

Gilbert developed several important models to describe his ideas – one is the ACORN model, and another the "Behavior Engineering Model" (BEM).

The ACORN model was intended to bring clarity to the mission level and focuses on the following (Rothwell, 2005:42):

- *Accomplishment*:
  Is the stated accomplishment a result, not a behaviour?
- *Control*:
  Does the performer possess the necessary authority to carry out the accomplishment?

- *Overall objective*:

  Does the accomplishment represent the real reason for the job's existence, or is it merely one of several tasks?

- *Reconcilable*:

  Is this accomplishment reconciled with, or congruent with, the mission of the organisation and the goals for carrying it out, or is it inconsistent with them?

- *Numbers*:

  Can the accomplishment be measured to determine practicality and cost-effectiveness?

Gilbert's other model, the "Behavior Engineering Model" (BEM), is a holistic model that intends to bring a comprehensive perspective to troubleshooting human performance problems or identifying possible human performance improvement opportunities. The model identifies six general aspects of behaviour that can be influenced to improve performance, namely data, instruments, incentives, knowledge, capacity, and motives (Rothwell *et al*., 2000:61). These six elements can be classified on two levels: those elements possessed by the individual performer that affect performance and those in the work environment that support and affect performance (Rothwell *et al*., 2000:59-62).

	Information	**Instrumentation**	**Motivation**
Environment supports	Data	Instruments	Incentives
Person's repertory of behaviour	Knowledge	Capacity	Motives

Figure 2.2 Gilbert's "Behavior Engineering Model"

Adapted from: Rothwell *et al*. (2000:61)

The BEM is comprehensive and provides a broad perspective to diagnose human performance (Rothwell *et al*., 2000:59). The goal of the model is to examine all the variables influencing performance – both

in the work environment and at the individual level – and to structure them in such a manner that the desired performance is achieved (Rothwell *et al*., 2000:63).

2.3.3 James H. Harless's model

James H. Harless focused on the context of an organisation and directed his focus towards human performance on the job. Rather than dividing performance into six areas, as Gilbert did, Harless identified the following three categories that influence human performance on the job (Rosenberg *et al*. 1992:26):

- skill or knowledge;
- the environment; and
- motivation.

Harless's model indicates that all three these areas should be in alignment with the organisation's goals. It also implies that, in addition to analysing influences on performance, it is important to consider who the performers are, what the specific performance is, and how well it is being done. Harless's model presents generic areas of intervention relevant to the influence categories, and it depicts interrelationships among the three areas (Rosenberg *et al*., 1992:26-27).

2.3.4 Robert F. Mager and Peter Pipe's Situational Model

Robert F. Mager and Peter Pipe's Situational Model differentiates between skill deficiencies, management deficiencies, and a combination of these deficiencies (Rothwell, 2005:150). As depicted by Figure 2.3, Mager and Pipe's model is designed as a flowchart with alternative branches, decision points, and suggested action steps. Thus it provides a systematic process for addressing performance.
Although Mager and Pipe's model has been criticized for its simplicity, it is very effective when troubleshooting a difference between what is and what should be happening.

2.3.5 Rothwell's model for human performance enhancement

By combining the classic elements found in Mager and Pipe's and Gilbert's models, William J. Rothwell (2005:48-49) developed a model for human performance enhancement that can be applied both situational and comprehensively. The model focuses attention both outside the organisation (from customers, suppliers, distributors, and other stakeholders) and inside the organisation, thus considering the different environments that influence human performance.

Rothwell's model offers a systematic approach to identifying or anticipating human performance problems and human performance improvement opportunities. The model consists of the following steps (Rothwell, 2005:48-50):

- Step 1: Analyse what is happening.
- Step 2: Envision what should be happening.
- Step 3: Clarify present and future gaps.
- Step 4: Determine the present and future importance of the gaps.
- Step 5: Identify the underlying cause(s) of the gap(s).
- Step 6: Select human performance enhancement strategies, individually or collectively, that close the gaps by addressing their root cause(s).
- Step 7: Assess the likely outcomes of implementation to minimize negative side effects and maximize positive results.
- Step 8: Establish an action plan for implementation of the human performance enhancement strategies.
- Step 9: Implement the human performance enhancement strategies.
- Step 10: Evaluate results during and after implementation, feeding information back into Step 1 to prompt continuous improvement and organisational learning.

```
┌─────────────────────────────┐
│  Describe the performance   │
│        discrepancy          │
└─────────────────────────────┘
              │
              ▼
┌─────────────────────────────┐    No    ┌─────────────────────────────┐
│ Is the discrepancy important?│ ──────▶ │ No further action is required│
└─────────────────────────────┘          └─────────────────────────────┘
              │
             Yes
              │
              ▼
┌─────────────────────────────┐
│  Determine the cause of the │
│         discrepancy         │
└─────────────────────────────┘
```

Caused by a skill deficiency   Not caused by a skill deficiency

Ask the following:
- Are employees used to performing? *If not, arrange formal training*
- Are employees used to performing often? *If not, arrange practice; if yes, arrange feedback*
- Is there a simpler way to address the skill deficiency? *E.g. job redesign, on-the-job training*
- Does the employee have the potential to perform? *If not, take action with employee, e.g. transfer him/her, or terminate*

As the following:
- Does the performance lead to punishment? *If so, remove the punishment*
- Is the non-performance rewarded? *If so, arrange positive consequences*
- Does performance matter? *If not, arrange consequences or improve feedback that performers receive about their work results*
- Do obstacles stand in the way of performance? *If yes, remove the obstacles*

```
┌─────────────────────────────┐
│   Select the best solution(s)│
└─────────────────────────────┘
              │
              ▼
┌─────────────────────────────┐
│   Implement the solution(s) │
└─────────────────────────────┘
```

Figure 2.3 Situational model for human performance

Source: Rothwell *et al*. (2000:64)

2.3.6 The TIME performance model

This model analyses a performance problem by focusing on the following four key interrelated components (Main, 2002:109):

- *Training*: The purpose of training is to provide workers with the knowledge, skills and abilities to perform their work.

- *Incentives and motivation*: These include intrinsic and extrinsic factors that may influence a person's will to perform.

- *Environment*: These are the extrinsic environmental factors that influence a person's work and working environment.

- *TIME support mechanisms*: These factors represent the cultural environment and the association of work, worker, and workplace. They all need to be aligned correctly to support the performance system.

The model's four components depend on each other – for performance to run smoothly, all four components must be in harmony. If one component in the model fails, the entire performance system becomes unstable. The centre of the performance model is the point where all of the elements unite to form the point of optimal job performance. At this point, everything is in place for a performer to perform the job at the maximum level of proficiency (Main, 2002:108-109). The model is depicted in Figure 2.4 (next page).
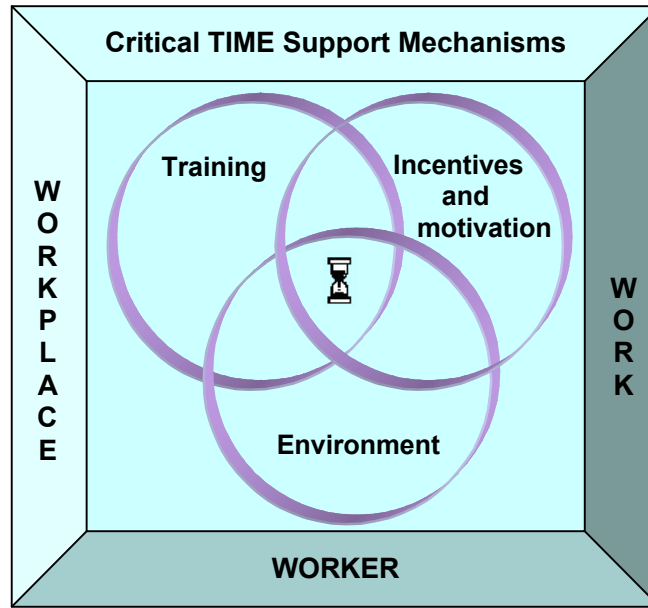
Figure 2.4 The TIME performance model

Source: Main (2002:108)

The TIME performance model can be an effective tool for intervention selection and grouping. Table 2.1 presents Roger E. Main's (2002:111) list of intervention groups in relation to the TIME performance model's components.

Table 2.1 The TIME performance model intervention grouping

Component	Intervention group
Training	Interventions that support the acquisition of knowledge, skills and abilities
Incentives and Motivation	Interventions designed to motivate the desired human performance
Environment	Interventions designed to adjust or modify the work environment
TIME Support Mechanisms	Interventions designed to align the key organisational structure components of work, worker, and workplace

Adapted from: Main (2002:111)

2.3.7 The ASTD's Human Performance Improvement Process Model

In 1996, the American Society for Training and Development (ASTD) subsidised research to identify the roles, competencies and outputs associated with human performance improvement. The result was the *ASTD Model for Human Performance Improvement*. It represents the most recent and most formal attempt to identify competencies associated with human performance improvement work (Rothwell *et al*., 2000:13).

The human performance improvement process model was derived from many sources and was confirmed by means of an expert-based study. Figure 2.5 represents Eduardo Saleh's (2004:2) presentation of the ASTD's Human Performance Improvement Process Model.
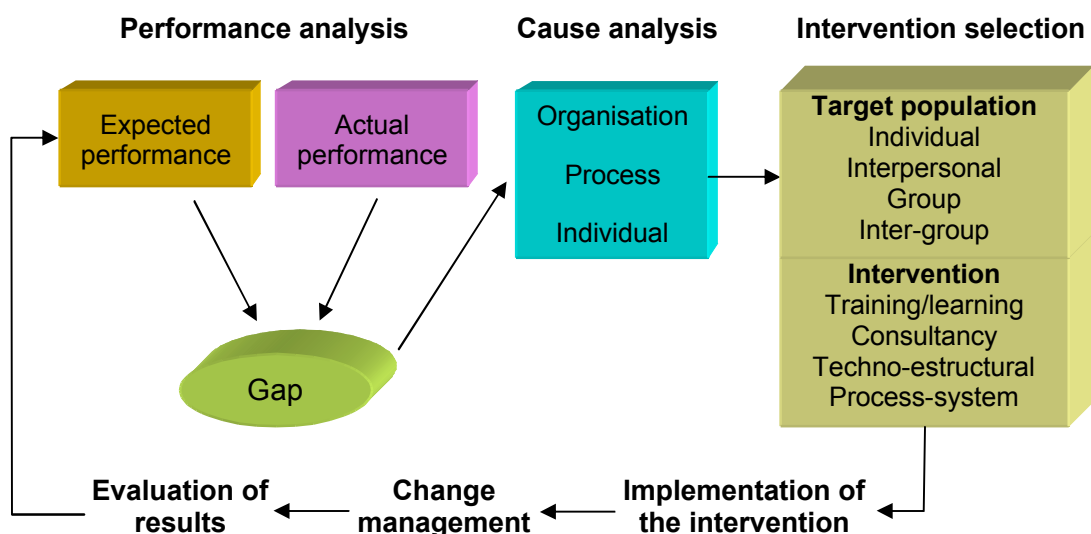
Figure 2.5 The Human Performance Improvement Model
Source: Saleh (2004:2)

The ASTD's Human Performance Improvement Process Model consists of the following six steps, which represent the primary components that are found in most comprehensive performance improvement

frameworks, and that will be discussed in greater detail below (Rothwell *et al*., 2000:14-15):

- Step 1:   Performance analysis
- Step 2:   Cause analysis
- Step 3:   Selection of appropriate intervention
- Step 4:   Implementation
- Step 5:   Change management
- Step 6:   Evaluation and measurement

2.3.7.1   Step 1: Performance analysis

Performance analysis involves the identification of gaps, or discrepancies in performance (Rothwell *et al*., 2000:45). The performance gap or discrepancy is the difference between the desired performance and the current performance:

- The *current performance* explains the existing conditions and present level of performance.

- The *desired performance* explains the ideal, or most-wanted, end-results, in other words, what performance will look like when the organisation serves its customers and other stakeholders optimally, is optimally organised internally to promote a high-performance work organisation, and is optimally positioned to encourage efficient and effective work and workers.

- William J. Rothwell (2005:125) defines the *performance gap* as the "difference between what is happening and what should be happening", or the "difference between the way things are and the way they are desired to be". In short, performance gaps focus on any deficiency or proficiency that may affect human performance.

Once a performance gap has been identified, it is important also to assess the impact, results, or consequences of the

discrepancy. The following questions should be asked in forecasting the importance of the performance gap (Boyd, 2002:45; Rothwell, 2005:143-144):

- How often does the gap occur?
- What consequences stem from the performance gap?
- What costs and benefits can be estimated for the gap?
- What costs and benefits can be pinpointed for taking action to close the performance gap?
- How do the costs and benefits compare?
- What non-financial measures may be important?
- What is the importance of the identified performance gap?

2.3.7.2   Step 2: Cause analysis

"Cause analysis involves examining the discrepancies identified through performance analysis and determining their root cause(s). In other words, cause analysis attempts to determine the reason for the discrepancy" (Rothwell *et al.*, 2000:46).

The result of the cause analysis should be a clear description of what is causing the performance gaps. The most frequently used techniques for analysing human performance problems are brainstorming, the fishbone diagram, and the five why's technique (Piskurich, 2002:57-58; Rothwell *et al.*, 2000:67-71). Tools used from root cause analysis methodologies include affinity diagrams, Pareto charts, and scatter diagrams. The following analytical methods can also be used (Piskurich, 2002:58):

- telephonic, written or Internet surveys;
- interviews with key workers with follow-up observation;
- simulated demonstrations and/or live observations;
- panels;
- reviews of performance data;

- interviews of deficient performers and their supervisors or managers; and

- reviews of records such as performance appraisals, Human Resources records, disciplinary actions, lost time histories, or maintenance records.

In addition to the above mentioned tools and techniques, George M. Piskurich (2002:63-64) has also developed a list of "look for" statements that could be helpful during the cause analysis process (see Table 2.2). These statements help the user to gather the data needed to isolate the correct cause(s) of the performance gap.

2.3.7.3   Step 3: Select appropriate interventions

The purpose of this step is to formulate a solution that will solve the performance problem by removing its cause(s). One should resist the urge to jump ahead to an immediate solution to a performance problem, or to select the one that simply feels good at the time. The possible interventions should be carefully analysed, so that the most appropriate and effective intervention can be selected (Rothwell *et al*., 2000:84).

A systematic process should be followed when evaluating and selecting appropriate interventions (Rothwell *et al*., 2000:91). Rothwell *et al*. (2000:91-107) suggest the following four-step process because they argue that it contains the primary components of a good decision-making system:

- Establish selection criteria, namely the standards, measures or constraints by which potential interventions are evaluated and ultimately chosen.

- Consider alternative interventions, by scanning the list of potential interventions, generating additional interventions, and weighing the alternatives.

- Evaluate each potential intervention against each criterion.
- Select the appropriate intervention(s) and determine its viability.

2.3.7.4 Step 4: Implementation

In this step, the intervention(s) is implemented in a way that is consistent with the desired results and that will help individuals and groups achieve the results they desire (Rothwell *et al*., 2000:116).

An implementation plan should cover the following elements (Andersen & Fagerhaug, 2006:158, *verbatim*):

- *required activities* – activities that need to be carried out to implement the improvement proposals generated in the problem-solving process;
- *activity sequence* – the order in which the activities must be carried out;
- *organisation and responsibility* – an indication of who is responsible for both carrying out and monitoring the progress of each activity;
- *schedule* – a more detailed plan for when the activities should be carried out, including milestones for key results expected throughout the project; and
- *costs* – estimates of the costs involved in the implementation.

Table 2.2 "Look for" statements to consider in cause analysis

Market/Organisational Level	Management Level	Process/Function Level	Job Performer Level
• Look for recent changes in the company. • Look for trends in the company. • Look to see if the gap is isolated within one group or is common throughout the organisation. • Look for new products or services that have been recently implemented. • Look at the current business environment. • Look for reorganisation, consolidation, or mergers. • Look to see if the organisation's mission or vision has changed. • Look to see if the organisational structure has recently changed. • Look to see if cultural values or norms are changing in the organisation or workforce. • Look for restrictive policies that inhibit worker or organisational performance. • Look at the organisational climate. • Look for linkage between performance and organisational goals.	• Look for distinctive elements that affect achieving the proper performance. • Look for a lack of confidence in the worker's ability to do the job on the part of managers. • Look for disagreements between managers and workers as to job values. • Look at where authority resides compared to where responsibility is placed. • Look at management's responsiveness to workers' needs and complaints. • Look to see if the right people are being recruited and hired. • Look to see if feedback is timely and sufficient. • Look for goals being communicated to all levels. • Look at regular versus special incentives. • Look for compensation commensurate with performance. • Look at how management perceives training programmes. • Look at management's expectations for training.	• Look for new procedures recently put in place. • Look for new systems or equipment. • Look to see if work processes are optimally organised. • Look to see if the physical environment is conducive to high level performance. • Look at work group priorities and their consistency with performance measures. • Look at communication both up and down the line. • Look for job aids. • Look at materials consumed during performance, their availability and quality. • Look at staffing levels and staffing requirements. • Look for tasks that interfere with each other. • Look for tasks that are boring or socially negative. • Look for safety issues that affect performance. • Look at how training is matched to performance. • Look at what is covered in training programmes.	• Look for trends in work quality. • Look to see if all performers doing the same task have the same problem. • Look for job function changes. • Look for changes in the behaviour of workers or groups. • Look for a lack of confidence in their ability to do the job on the part of the workers. • Look to see if the workers are given enough data and information to do the job properly. • Look for conflicting job demands. • Look to see if performers have sufficient time to do the job properly. • Look for barriers to performance and their sources. • Compare high and low performers. • Look at master/exemplary performers. • Look at job standards and their reasonableness. • Look for clear, personal consequences of poor performance.

Table 2.2 "Look for" statements to consider in cause analysis (continued)

Market/Organisational Level	Management Level	Process/Function Level	Job Performer Level
• Look at and listen to corporate history.		• Look at the tools and equipment needed to do the job. • Look at job instructions for clarity and completeness. • Look to see if job instructions are followed.	• Look to see if incentives are appropriate. • Look to see if the workers want to achieve the expected results. • Look to see what the workers expect for top performance. • Look to see if performers agree with the way the task is supposed to be done. • Look for tools and materials that are not ergonomically sound. • Look for links to another performer's deficient output. • Look for high turnover and find out why it exists. • Look at turnover and promotion histories. • Look at how learners perceive training. • Look for adequate time for training.

Source: Piskurich (2002:63-64)

33

Most performance improvement interventions begin when a senior manager approves the use of the organisation's resources. Once the proposal has been accepted, the performance improvement strategy is implemented. There are three general ways by means of which a performance improvement strategy can be implemented (Rothwell *et al*., 2000:136-140):

- implementing a performance improvement intervention with one leader who receives specific instructions from senior executives about how to implement the intervention;

- implementing a performance improvement intervention with a team, committee, or task force who work together to achieve the performance improvement results; and/or

- implementing a performance improvement intervention with objectives, by clarifying the role that each manager and worker in the organisation is expected to play during implementation.

The following additional thoughts about the implementation of a performance improvement strategy are offered by Andersen and Fagerhaug (2006:168, *verbatim*):

- Involve everyone responsible for results to ensure full support for the changes.

- Try to elicit involvement and inspiration from those involved in the project.

- Follow a clearly communicated plan.

- Keep the affected persons constantly informed about progress and achieved results.

- Emphasize the importance of patience – changes do not happen overnight.

- Put the process under pressure – delays are common.

- Pick low-hanging fruit and celebrate wins.

2.3.7.5   Step 5: Change management

During this step, the implementation process of the intervention is monitored. Feedback is important to establish whether the performance improvement strategy is successful. Information about progress toward the objectives of the performance improvement strategy can be collected in the following ways (Rothwell *et al.*, 2000:142):

- Clarify from stakeholders what results are sought from the performance improvement intervention.

- Ensure that the outcomes can be made specific and measurable.

- Identify who should receive feedback about performance to ensure that progress is being achieved toward the goals.

- Work with stakeholders and performers to identify the most effective methods by which to convey feedback.

- Start a tracking system to collect feedback and give it to performers.

It is important that the above measures occur and that the data are fed back to the key stakeholders.

2.3.7.6   Step 6: Evaluation and measurement

Managers and other stakeholders of performance improvement interventions want to know what business requirements have been satisfied and what return on investment has been received from the resources invested in the performance improvement interventions. An evaluation must be made of how well the performance improvement interventions were implemented, their impact, any changes that were made, actions taken, the results achieved, and the benefits that were received from the performance improvement intervention(s). Evaluation is a way of

connecting business performance outcomes with the inputs, outputs, and processes of a human performance improvement intervention, along with showing the benefits of the results in comparison to the costs of the intervention (Burkett, 2002:155).

Holly Burkett (2002:157) gives the following additional and compelling reasons why evaluation is important:

- It helps the users to understand the business and what measures management uses.
- It makes good economic sense and should be required for any activity that represents a significant expenditure of funds.
- It provides solid measurements of a past programme's success to secure additional funds for the future.
- There is increased pressure from management to ensure accountability and show that value-added contributions have been made.
- The performance evaluation standards keep rising.
- Satisfaction is gained when the bottom-line contribution is known and clearly articulated and it can be demonstrated that the efforts people have put in have indeed made a difference in the organisation.
- Evaluation skills sets are a core competency with the evaluator role in human performance improvement work.
- It shows the worth of the human performance improvement function in the organisation.

According to Burkett (2002:155), Donald Kirkpatrick's model for assessing the results of training can be used to evaluate performance improvement interventions; it can occur at any time and with any frequency – it can occur before an intervention, during development, or after implementation. However, it is important that evaluation be integrated into the human performance improvement process. This requires a framework

that links evaluation strategies throughout the various stages of the performance improvement intervention (Burkett, 2002:157).

Burkett (2002:159-163) suggests the following guidelines to help plan an evaluation:

- Establish an evaluation framework that provides the roadmap for conducting evaluation and allows one to begin with the end in mind.
- Develop a data collection plan that includes a variety of methods to collect data and integrates the data into the performance improvement objectives that have been set.
- Establish an evaluation purpose that includes the following (Burkett, 2002:161-162):
  o determining if the intervention is accomplishing its objectives;
  o finding out if the human performance gap has been closed or narrowed;
  o gauging the extent of transfer to the job and identifying barriers and enablers to transfer;
  o assessing improvement areas in the needs assessment and the intervention;
  o calculating the benefit-cost ratio of a performance improvement or Human Resources development programme; and
  o providing data for decision-making about expanding or discontinuing programmes.
- Set evaluation levels or targets that provide a compass with which to set direction and maintain focus.
- Develop instruments to collect evaluation data. The seven most common instruments are surveys, questionnaires, interviews, focus groups, tests, observations and performance records (Burkett, 2002:162).

- Consider and communicate the timing for follow-up evaluation.

Almost anything can be the object or the focus of evaluation. George L. Geis and Martin E. Smith (1992:141-144) present the following detailed list of possible objects for evaluation:

- *people*, for example, quality of performance;

- *products*, for example, quality and/or number of products produced;

- *processes*, for example, the frequency and types of interactions between different divisions of the organisation;

- *purposes*, for example, the objectives of a programme;

- *facilities and resources*, for example, the number of books and journals in the library;

- *rates*, for example, number of students processed through a course;

- *costs/profits*, for example, the cost of an intervention, as well as any addition to profits as a result of an intervention;

- *outcomes*, for example, the amount learned from a demonstration of new skills as a result of an instructional unit; and

- *impacts*, for example, long-term customer satisfaction.

Many factors can influence a performance measure. Hence, a sound and rigorous evaluation plan should include a method to isolate the effects of the programme from other influences. The following are six proven methods for doing this (Burkett, 2002:170-171):

- Use a control group that is demographically similar to the experimental group and is subjected to the same environmental influences, but does not receive the performance improvement intervention. As a result, measures taken after the intervention show the disparity

between the two groups that can be directly ascribed to the intervention.

- Do a trend line analysis by drawing a line from the current performance to the future performance. After the performance improvement intervention, the post-intervention performance can be compared to the performance predicted on the trend line.

- When a mathematical relationship between input and output variables is known, then the value of the performance improvement intervention can be forecast by using an equation to isolate the effects.

- Use customer input to determine the extent to which the performance improvement intervention influences the customer's decision to use a product or service.

- Use participants' and supervisors' estimates of the extent to which improvements are directly related to the performance improvement intervention.

- Use experts' estimates of the extent to which improvements are directly related to the performance improvement intervention.

2.3.8 Summary

The seven models that were discussed in this section are summarized in Table 2.3 (see next page).

Table 2.3 Summary of human performance models

Human Performance Model	Central Theme
Rummler and Brache's model (Piskurich, 2002:7-8; Rothwell *et al*., 2000:54-55)	This model is based on a systems perspective of the organisation and illustrates the relationship between three performance levels and three performance needs.
Models developed by Thomas F. Gilbert (Rothwell, 2005:42,150; Rothwell *et al*., 2000:59-63)	The ACORN model clarifies the mission level, while the BEM identifies six behavioural aspects that can be manipulated to improve performance.
James H. Harless's model (Rosenberg *et al*. 1992:26-27)	This model identifies three categories – skill/knowledge, the environment, and motivation – that should be aligned with the organisation's goal to improve performance.
Robert F. Mager and Peter Pipe's Situational Model (Rothwell, 2005:150; Rothwell *et al*., 2000:64)	This model distinguishes between skill deficiencies, management deficiencies, and a combination of these two aspects as influencers of human performance.
Rothwell's model for human performance enhancement (Rothwell, 2005:48-50)	This model focuses on different environments inside and outside the organisation that affect human performance.
The TIME performance model (Main, 2002:108,111)	This model analyses performance problems by focusing on four interrelated components of human performance, namely training, incentives and motivation, environment, and the cultural environment and the relationship of work, the worker and workplace.
ASTD's Human Performance Improvement Process Model (Andersen & Fagerhaug, 2006:158, 168; Boyd, 2002:45; Burkett, 2002:155, 157, 159-163, 170-171; Geis & Smith, 1992:141-144; Piskurich, 2002:57-58, 63-64; Rothwell *et al*., 2000:13-15, 45-46, 67-71, 84, 91-107, 116, 136-140, 142; Rothwell, 2005:125, 143-144; Saleh, 2004:2)	This model represents a six-step process consisting of the primary components associated with human performance improvement.

The above models contributed and added the following value to this study:

- These models assist us to understand the theories and what is involved in human performance better.

- They help us identify and understand the different variables that could influence human performance.

- They help us identify and understand the different components that must be in harmony for human performance to run smoothly.

- A model such as that of Rothwell (2005:48-50) offers a ten-step process for identifying or anticipating problems and human performance improvement opportunities.

- A model such as that of Robert F. Mager and Peter Pipe (Rothwell *et al*., 2000:64) provides a systematic process in a form of a flowchart for addressing human performance problems.

The researcher regards all the above contributions as valuable in developing a root cause analysis process that aims to uncover the root causes of uncontrolled variations in human performance.

2.4   VARIABLES AND TRENDS THAT AFFECT HUMAN PERFORMANCE

According the Rummler and Brache (1992:37-38), every performer operates in what they refer to as the Human Performance System. In the Human Performance System (see Figure 2.6 on next page), the performer is required to process a variety of inputs. For each input, there is a required output, and for every output produced, as well as for the action required to deliver an output, there is a resultant set of consequences – an event that influences the performer and is uniquely interpreted by the performer as either positive or negative (Rummler and Brache, 1992:37). The last component of the Human Performance System is feedback.
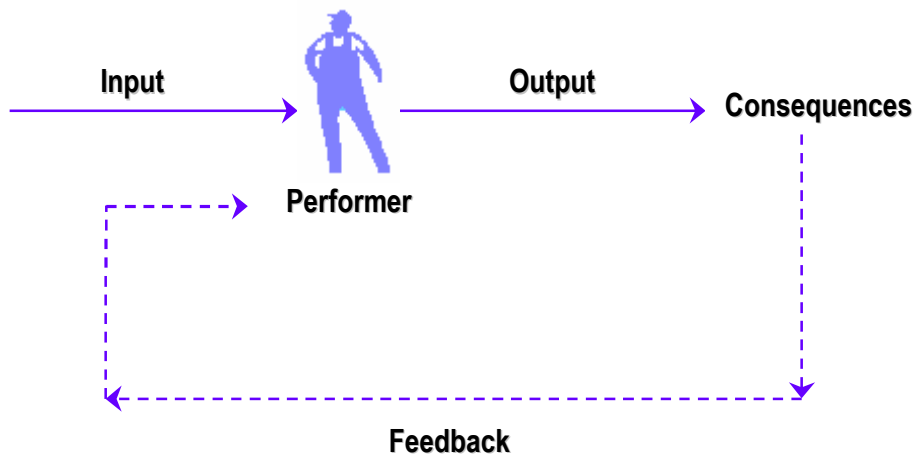
Figure 2.6 The human performance system

Source: Rummler and Brache (1992:38)

The significance of the Human Performance System is that human performance in an organisation is always a function of a number of variables or factors. In other words, people tend to perform at the desired levels if the criteria for optimal performance are met.

2.4.1 Variables that affect human performance

In order to understand human performance fully, one needs to recognize the variables that affect performance. Table 2.4 (see next page) summarizes several researchers' findings on variables that affect human performance, namely the findings of

- Peter Pipe (1992:356-359)
- John M. Keller (1992:278)
- Robert F. Mager and Peter Pipe (1997:3)
- Robert Bacal (n.d.:2-3)
- Dean L. Gano (1999:145)
- William J. Rothwell (2005:156-157)
- The U.S. Department of Labor (Rothwell, 2005:14-16)
- James Reason and Alan Hobbs (2003:63)
- George M. Piskurich (2002:55)
- Thomas F. Gilbert (Rothwell *et al*., 2000:6-8)
- Geary A. Rummler and Alan P. Brache (Rothwell *et al*., 2000:5-6)
- Maren Franklin (2006:9)
- EQE International Inc. (1999:A9-A10)

Table 2.4 Summary of research findings on variables that affect human performance

Findings by Peter Pipe (1992:356-359)	Findings by John M. Keller (1992:278)	Findings by Robert F. Mager and Peter Pipe (1997:3)	Findings by Dean L. Gano (1999:145)
All inputs may be candidates for change that may potentially affect performance. The following are inputs to task performance that need to be considered: 1. Relevant inputs by the job performer – mental (skills of remembering, analysis, synthesis, and problem solving) and physical skills directly linked to task accomplishment 2. Irrelevant inputs by the job performer – irrelevant or counterproductive behaviour 3. Other relevant inputs – raw materials, data, the efforts of others, and conditions in the environment where work is done, the quality of information 4. Other irrelevant inputs – any external factor that distracts from the desired performance	The extent and quality of a person's performance are also determined by appropriate internal motivation and motivational support from the environment, resources, and working conditions. The following are the three main influences on performance: 1. Capability • abilities • knowledge • skills 2. Opportunity • role match • resources • guidance 3. Motivation • conditions and circumstances of the job • the person's perceptions of the situation	1. People do not know what is expected and, therefore, they do not do what they should be doing 2. People do not have the tools, space or authority to perform in the desired manner 3. People do not get feedback about performance quality 4. People are punished when they do it right 5. People are rewarded when they do it wrong 6. People are ignored whether they do it right or wrong 7. People do not know how to do it **Findings by Robert Bacal** (n.d.:2-3) 1. Aptitude – a person's natural ability to perform the task(s) 2. Skill level 3. Understanding the nature of the task and what is expected 4. Choice to expend effort 5. Choice of degree of effort to expend 6. Choice to persist 7. Outside factors that are beyond the control of the individual	1. There is too much information to comprehend 2. The tasks is boring 3. The person is not proficient at the task 4. People are unaware of action causes 5. There is a lack of confidence, people, procedures, or hardware 6. People rely on success in past experiences 7. People suffer from weariness or fatigue 8. There is confusion 9. There is a reactive response 10. Memory lapses occur 11. Fear of failure hampers people 12. Priorities are misaligned 13. People are spatially misoriented 14. There is inattention to detail 15. There is a rigid mindset 16. People have a myopic view of the situation 17. Scheduling pressure to complete task is high 18. People lack the specific knowledge required 19. Habit dies hard 20. Inappropriate assumptions are made 21. People use shortcuts 22. People do not understand instructions 23. Job performance standards are not defined 24. Disbelief in sensory input hampers performance 25. People use a favourite indication instead of diverse input 26. Indifferent attitudes prevail 27. Illness reduces productivity 28. Righteousness affects judgement 29. People are unable to focus on a task

Table 2.4 Summary of research findings on variables that affect human performance (continued)

Findings by William J. Rothwell (2005:156-157)	Findings by the U.S. Department of Labor (Rothwell, 2005:14-16)	Findings by James Reason and Alan Hobbs (2003:63)	Findings by George M. Piskurich (2002:55)
Rothwell (2005:156-157) provides the following perceived causes of human performance problems, in order of frequency: 1. Lack of knowledge 2. Insufficient opportunity to practise work tasks 3. Lack of rewards 4. Lack of clear feedback 5. Lack of timely feedback 6. Lack of information when needed 7. Lack of information 8. Not knowing who is responsible for what 9. Lack of worker motivation 10. Lack of clear organisational plans 11. Lack of tools 12. Rewards for undesirable performance 13. Lack of clear organisational policies 14. Fear for job security 15. Inadequate (wrong) tools 16. Lack of ability (wrong hire) 17. Rewards for not performing 18. Inadequate equipment 19. Lack of sense of who reports to whom 20. Tools/equipment not ergonomic	1. Skills and information • Training and continuous learning • Information sharing 2. Participation, organisation and partnership • Employee participation • Organisation structure • Worker-management partnerships 3. Compensation, security and work environment • Compensation linked to performance and skills • Employee security • Supportive work environment 4. Putting it all together • The company fully integrates its human resources policies and workplace practices with other essential business strategies • Quality and continuous improvement efforts are meshed with training, work organisation, employee involvement, and alternative compensation programs • Workers are involved in the design and purchase of new technologies • Workers have the opportunity to modify the technologies they use • Employees receive adequate training to use new technologies effectively	According to Reason and Hobbs (2003:63), performance problems are shaped by situation and task factors that are part of the environment in which the person is functioning. They have identified the following key factors that increase the probability of performance problems: 1. Poorly designed documentation 2. Time pressure 3. Poor housekeeping and tool control 4. Lack of coordination and poor communication practices 5. Availability and design of tools and equipment 6. Fatigue 7. Lack of knowledge and experience 8. Poorly designed procedures 9. Lack of procedure usage 10. Personal beliefs that promote violations	1. Lack of knowledge or skills 2. Lack of the proper physical resources to do the job 3. A problem or weak link in the structure or process of the work or work flow 4. A need for more information concerning the job 5. A lack of or change in leadership 6. Lack of information about the consequences of poorly done work for the organisation or personally for the performer 7. A problem with the motives and expectations of the workforce 8. Inadequate feedback 9. Inadequate incentives or rewards 10. Performer's lack of capacity to do the job

Table 2.4 Summary of research findings on variables that affect human performance (continued)

Findings by Thomas F. Gilbert (Rothwell *et al*., 2000:6-8)	Findings by Geary A. Rummler and Alan P. Brache (Rothwell *et al*., 2000:5-6)	Findings by EQE International Inc. (1999:A9-A10)

1. Environmental variables (external)
  • Data and information – the expectations about the job and the desired performance, such as job standards, goals and feedback
  • Financial resources, tools, equipment, time and environmental supports
  • Consequences, incentives and rewards
2. Individual variables (internal)
  • Skills and knowledge
  • Individual capacity is the capability that is required to perform effectively
  • Motives are the deeply embedded characteristics possessed by people and include the reasons that people do what they do, how people view themselves, their needs, desires, fears, and other internal personality traits
	1. Barriers that are related to the inputs to perform – signals to perform, conflicting tasks and actions, and resources, such as tools, equipment, finances and information
	2. Performance expectations – standards, goals, and expectations regarding the output
	3. Positive and negative consequences that are linked with the outcomes of performance
	4. Feedback that relates to the information people obtain regarding their performance
	5. The individual's knowledge and skill level in respect of the job and task
	6. The individual's capacity or ability to perform the job or task
	
	Findings by Maren Franklin (2006:9)
	1. Physical resources
	2. Structure/process
	3. Information
	4. Knowledge
	5. Motives
	6. Wellness
		1. Lack of equipment design records and equipment operating/maintenance history
		2. Lack of an equipment reliability programme
		3. Lack of a program for corrective maintenance, preventive maintenance, predictive maintenance, proactive maintenance, failure finding maintenance, and routine equipment rounds
		4. Lack of standards, policies, or administrative controls; standards, policies, or administrative controls are not used; lack of safety/hazard/risk review; lack of problem identification control; lack of product/material control; lack of procurement control; lack of document and configuration control; and lack of customer/interface/services
		5. Procedures not used, or are misleading/confusing, or wrong/incomplete
		6. Poor workplace layout, poor work environment, excessive workload, and intolerant systems
		7. Lack of training, a poor training records system, and poor training
		8. Lack of preparation and poor supervision during work
		9. Lack of communication or communication that is not timely, misunderstood communication, wrong instructions, poor communication during job turnover
		10. Inability to detect problems, poor sensory/perceptual capabilities, poor reasoning capabilities, poor motor/physical capabilities, poor attitude/attention, lack of rest/sleep (fatigue), and personal medication problems

2.4.2 Trends that affect human performance

In addition to the performance variables listed in Table 2.4, cognisance should also be taken of several trends, because they are regarded as key drivers of change that affect human performance in organisations. Rothwell *et al.* (2000:173) classify these trends into three categories, namely corporate trends, workforce trends and Human Resources trends. These three categories are discussed in more detail below.

2.4.2.1.   Corporate trends

While each industry has its own unique characteristics and unique responses to the global economy, the following trends appear to be true for most organisations, regardless of the industry they are in (Rothwell *et al*., 2000:173-182):

- *Organisations are shifting from a focus on restructuring and downsizing to a focus on improving customer service and growth.*
  This shift requires skilled workers in addition to material resources and investment capital. Career development opportunities are regarded as an employment benefit and, as a result, workers demand assignments that are challenging and provide growth opportunities. This, in turn, drives up the demand for workplace training; and succession planning becomes a more overt process (Rothwell *et al*., 2000:174-175).

- *Organisations are growing via mergers and acquisitions.*
  A survey conducted by Hewitt Associates LLC in 1998 (Rothwell *et al*., 2000:176) found that integrating organisational cultures poses the most significant challenge to companies involved in mergers and acquisitions, that communication was not immediate enough, and that

inadequate resources were dedicated to the communication effort (Rothwell *et al*., 2000:175-176).

- *Organisations are rapidly taking advantage of technology advances.*

  Improving technology has been the driver behind widespread corporate downsizing and has improved workforce productivity dramatically. The pace of technological change has increased the demand for highly educated, skilled workers. In addition, speed of response, flexibility and the adaptability of structured learning events will be critical to future success (Rothwell *et al*., 2000:176-177).

- *Organisations are reinventing their business processes due to the explosion of electronic commerce.*

  Electronic commerce has led to a major revolution in the way businesses and organisations operate. This change has required the *redefinition* of work processes and an environment that welcomes wholesale changes in the way work gets done (Rothwell *et al*., 2000:178-179).

- *Intellectual capital and knowledge management are increasingly important.*

  Rothwell *et al*. (2000:179) define *intellectual capital* as "the knowledge and experience possessed by an organization's workforce", and *knowledge management* as "the process by which an organization creates and leverages intellectual capital". Organisations have recognized that "knowledge management and the intellectual capital it creates are sources of competitive advantage" (Rothwell *et al*., 2000:179).

- *Organisations are outsourcing supporting functions.*

  "Outsourcing is a management strategy by which an organization farms out major, non-core functions to specialized, efficient service providers" (Rothwell *et al*., 2000:180). Any function that is not directly associated with a

business's core competencies or competitiveness is a candidate for outsourcing. KPMG Peat Marwick and The Outsourcing Institute have identified the following advantages of outsourcing (Rothwell *et al*., 2000:182) – outsourcing allows businesses to

- gain a greater level of expertise;
- enhance the ability of internal resources to focus on other, critical issues;
- become more flexible;
- accelerate reengineering benefits;
- access world-class capabilities;
- get a cash infusion;
- free internal resources for other purposes;
- outsource functions that are difficult to manage or are out of control;
- improve company focus;
- make capital funds available;
- reduce operating costs;
- reduce risks; and
- provide access to resources that are not available internally.

2.4.2.2.   *Workforce trends*

- *Skill requirements are increasing.*
  Due to the increasing skill requirements, there is an ongoing need for continuous training and career development. As a result, the recruitment and retention of skilled talent also become more of a challenge (Rothwell *et al*., 2000:183).

- *Technological advances are continuous.*
  Technological change has become a factor that organisations have accepted. They have therefore built continuous learning

solutions to address the ever-changing skill requirements to support the new technology (Rothwell *et al*., 2000:183).

- *The workforce must become more educated and diverse.*
Unfortunately, the increasing levels of education are not keeping pace with the demand for advanced skills in the workplace. The skills gap will need to be bridged by organisations and educational institutions that work together to produce the skills that organisations need. There will also be a greater need in future for cultural focus in the workplace (Rothwell *et al*., 2000:184-185).

- *Employees are working longer hours and weekends.*
Downsizing without work redesign has led to organisations' having to accomplish the same (or more) with fewer resources. As a result, employees often work weekends, work more than 40 hours per week, and/or work at home during some evenings. There is a growing demand to find ways to achieve organisational goals by working smarter rather than harder. This requires, amongst other things, that processes be redesigned, steps are taken to ensure that the necessary skills exist in the workplace, and performance management initiatives play a more important role in organisations (Rothwell *et al*., 2000:185-186).

- *Employees are taking greater responsibility for their own development.*
Employees are taking responsibility for their own careers. In order to do this successfully, employees need to understand the organisation's goals and the objectives and task requirements of their work. They also need consistent and clear feedback on their performance, and access to resources and information to enhance their skills and knowledge (Rothwell *et al*., 2000:186-187).

2.4.2.3   Human Resources trends

- *Corporate training departments are changing in size and composition.*

    As employee-to-trainer ratios are growing smaller, the demand for external providers of training and other performance improvement services increases. The type of training that is typically outsourced is executive development, quality and business practices, and training delivered via learning technologies. The type of training that is delivered in-house tends to be training on subject matter that is organisation-specific, such as the orientation of new employees and customer service (Rothwell *et al*., 2000:188-190).

- *Technology is revolutionizing the way training is delivered.*

    While classroom training was the primary method of training in the past, technology-based delivery methods have begun to gain broader acceptance. These include CD-ROM-based training, video teleconferencing, satellite broadcasts, Internet-based training, and electronic performance support systems (Rothwell *et al*., 2000:190-191).

- *Training departments are finding new ways to deliver services.*

    In addition to the technology-based training methods mentioned above, non-traditional structured learning approaches have also begun to find favour in some organisations. These include groupware, knowledge management systems, action learning, Open Space Technology, self-directed learning, group-based instruction, job rotation, mentoring and coaching programmes (Rothwell *et al*., 2000:191-192).

- *Training professionals are focusing more on interventions in performance improvement.*

  Organisations have begun to realize that not all performance problems can be solved by training alone. Workforce strategies are needed that will assist organisations to achieve their goals, to cascade the goals down through the organisations and, ultimately, enable the workforce to achieve those goals (Rothwell *et al*., 2000:192).

- *There is an increasing demand for employee development.*

  The fact that skilled labour is increasingly in short supply, workers who demand that career development opportunities become a condition of employment, and new technology that creates a constant demand for skill-upgrading efforts – all these result in an increase in the demand for employment development. Organisations need to bridge the skills gap with programmes of their own and they need to work with educational institutions to supply the future talent that organisations need. Employees should also take charge of their own development and will increasingly exert greater pressure on organisations to provide planned and unplanned learning opportunities (Rothwell *et al*., 2000:192-193).

- *Leadership development is seen as critical to organisational success.*

  Organisations are beginning to realize that leadership development plays a key role in competitive success. Leadership development must support the vision of leadership and requires dedication and commitment from the top of the organisation (Rothwell *et al*., 2000:193-194).

2.5   CONCLUSION

The purpose of this study is to develop a root cause analysis process for uncontrolled variations in human performance. A root cause analysis process

of this nature would require a specific set of dimensions and process questions. In order to develop these dimensions and questions, one needs to have a thorough understanding of human performance, as well as acknowledge the variables and trends that affect human performance. This chapter aimed to develop such an understanding.

The following is evident from the literature discussion in this chapter:

- Although various models follow different approaches, the general aim of all human performance models is to achieve the level of performance that would meet businesses' needs.
- The variances and trends that affect human performance can easily be regarded as a listing of the primary causes of performance problems. Although some research findings of the variances that affect human performance (as listed in this chapter) overlap, they prove that the causes of variations in human performance are diverse and numerous.

Performance problems occur when the conditions for optimal performance are lacking in some way. When this happens, the situation needs to be analysed further, so that first the performance gaps and then the root causes can be identified. The next chapter discusses how to analyse and manage human performance problems.

CHAPTER 3

ANALYSING AND MANAGING
HUMAN PERFORMANCE PROBLEMS

3.1   INTRODUCTION

This is the second of three literature review chapters that document the central concepts used in this study. Chapter 2 (the first literature review chapter) outlined several human performance models, as well as the sources of variance and trends that affect human performance. This chapter focuses on the analysis and management of human performance problems.

For the purposes of this study, a *performance problem* refers to any of the following (Ammerman, 1997:9):

- a difference between the actual performance and the performance requirement or performance expectation;
- an unwanted event, situation, or performance trend; and/or
- the main effect critical for a situation to occur.

This chapter is divided into the following sections:

- the goal of analysing and managing human performance problems;
- methods and tools used to analyse and manage human performance problems;
- managing performance problems pro-actively; and
- the role of human error in performance problems.

3.2   THE   GOAL   OF   ANALYSING   AND   MANAGING   HUMAN
PERFORMANCE PROBLEMS

Allison Rossett (1992:103-105) has identified three types of initiating situation for investigating and analysing human performance problems: first, when the organisation is making changes and introduces new policies, programmes,

initiatives and technologies; second, when employees are not doing what is expected from them (and as a result, performance problems occur); and third, when an investigation is mandated.

Another reason for analysing and managing human performance problems would be to minimize the costs that such problems create. When organisations calculate the total cost of performance problems, they should add the actual cost of the problem to the estimated cost of the potential consequences (Mager & Pipe, 1997:24). Mager and Pipe (1997:25-26) have identified the following sources of costs arising from performance problems:

- money lost directly, or as a result of lost goods or materials;

- time lost due to the deviation, or because of material shortages or lateness, slow service, or the need to re-work;

- an increase in waste, or the need to have waste hauled away or burned;

- equipment damage caused by the performance discrepancy;

- loss in production, or completed work;

- poor accuracy and poor quality of the completed work;

- increases in insurance policies caused by the discrepancy;

- an increase in the frequency of accidents;

- loss of business due to the discrepancy;

- duplicated efforts caused by the discrepancy;

- a need for more supervision, security, or more monitoring as a result of the discrepancy; and

- other sources, for instance, possible law suits or sexual harassment charges.

3.3 METHODS AND TOOLS USED TO ANALYSE AND MANAGE HUMAN PERFORMANCE PROBLEMS

In this section, some common methods and tools that can be used to help to analyse and manage human performance problems are discussed. These methods and tools provide organised and systematic ways of examining

human performance problems and performance improvement opportunities (Rothwell *et al*., 2000:51).

3.3.1 Data presentation methods and tools

It is important to collect, track and monitor key performance data, so that performance problems and opportunities can be uncovered. The following four trending methods are discussed in this section:

- pie and bar charts;
- line or run charts;
- Pareto charts; and
- process behaviour charts.

3.3.1.1 Pie and bar charts

"Pie and bar charts are visual representations used to compare quantities, amounts, or proportions" (Rothwell et al., 2000:78). These types of chart make differences more evident and easier to identify. "Bar charts are generally used to compare groups or categories, while pie charts typically show the relative percentages making up the whole" (Rothwell et al., 2000:78-79).

3.3.1.2 Line or run charts

Line or run charts display a series of data points and are useful for showing trends over time. Looking at data such as volume, cost, or time on a line chart can help to detect important trends (Rothwell *et al*., 2000:80).

3.3.1.3 Pareto Charts

The 80/20 rule or Pareto Principle was discovered by an Italian economist, Vilfredo Pareto, in 1897, when he observed that 80% of the wealth in Italy and also in other countries was held by 20%

of the people. The Pareto Principle implies that 80% of the result can be obtained from 20% of the work (Paradies & Unger, 2000:149). Logically, therefore, identifying and fixing a few major problems can produce a huge return on investment for performance improvement.

Pareto Charts can be used for the following:

- If a large percentage of the cost (approximately 80%) is concentrated in a small percentage of performance problem categories, then these categories indicate opportunities that should be targeted for improvement. In this case, reasonably priced corrective actions should yield a significant cost reduction and a good return on investment.
- If, on the other hand, the cost is spread more evenly across the performance problem categories, then improvement efforts may have a less dramatic effect and the organisation can follow one of the following two alternative routes (Paradies & Unger, 2000:155):
  - o the organisation can implement corrective action for each performance problem category and continue to use trending to identify future targeted improvement opportunities or to identify significant trends in the data over time; or
  - o the organisation can decide that performance is, in general, good enough and stop implementing corrective action for each incident and instead monitor performance for significant trends over time.

In summary, Pareto charts can indicate whether there are great opportunities, or only limited opportunities, for rapid improvement by addressing a single performance issue or several performance issues. It must be noted that to achieve the highest return on investment it is essential that the Pareto chart be scaled by cost, not by count.

3.3.1.4 Process behaviour charts

A process behaviour chart is "a specialized chart of performance over time with limits calculated using statistical process control algorithms" (Paradies & Unger, 2000:156). As long as a system functions within these limits, the system is behaving normally and no significant problems are present. However, if the limits have been exceeded, then that indicates a significant change to the system, or a significant problem. This requires a root cause analysis (finding the cause of the significant problem).

Process behaviour charts can be used in the following ways (Paradies & Unger, 2000:169):

- to plot performance in important jobs – if a point is detected outside the limits, then the problem should be analysed for its root cause and be corrected;
- together with Pareto Charts, to identify the consistently worst performance problems and then target them for elimination using effective root cause analysis;
- to plot a trend for proactive performance indicators for key jobs – when a significant trend is detected, the root cause of the problem causing the trend can be found and fixed;
- to plot the trend of the root causes of performance problems to look for significant trends; and
- to track both proactive performance indicators and outcomes data to determine whether or not any improvement strategies that have been implemented have brought about significant improvements in performance – this can then be used to prove that the corrective actions have made a difference and what the real improvement in the average performance was. It will also help justify the improvement effort.

3.3.2 Troubleshooting methods and tools

Solving human performance problems requires a systematic approach that helps to identify the real performance gaps and root causes. However, the success of an approach often depends on the quality of the data that is used. Rothwell *et al*. (2000:52) provide the following list of types of data that would assist in analysing performance problems:

- sales, revenue;
- market share;
- profitability;
- cost, expenses;
- inventory levels;
- cycle time;
- throughput;
- lead time;
- quality;
- customer service/satisfaction;
- delivery performance;
- grievances;
- performance appraisal results;
- exit interview(s);
- employee satisfaction;
- absenteeism;
- accidents; and
- benchmarking results.

The above data requirements can be drawn from the following potential sources of data (Rothwell *et al*., 2000:52):

- the Sales Department;
- Finance/Accounting;
- Plant/Operations Management;
- the Production/Scheduling Department;
- the Quality Control/Assurance Department;

- the Human Resources Department; and/or
- the Safety Department.

As has already been mentioned in Chapter 1, the most common troubleshooting tools and techniques used to analyse human performance include brainstorming, the fishbone diagram and the five why's technique (Piskurich, 2002:57-58; Rothwell *et al*., 2000:67-71). The following three additional approaches and tools are discussed in this section:

- the basic five-step approach;
- Paradies and Unger's system; and
- Mager and Pipe's Performance Analysis.

3.3.2.1 Basic five-step approach

Rummler and Brache's (1992:42-45) Human Performance Technology approach consists of the following five basic steps:

Step 1: Problem definition
The objective of Step 1 is to identify and agree on the performance that is required by the client or organisation, how it is measured and the time frame in which it is measured.

Step 2: Analysis
In this step, the problem is diagnosed; the cause is established; and the treatment is specified or prescribed. A complete analysis requires an examination of each of the following three levels:

- *The organisation level*:
  The objectives of this step are to determine what changes are required in the variables of the organisation level to improve performance to the desired level and to identify the cross-functional process(es) that should be examined further. The sub-steps usually include developing a holistic picture of the organisation to show how the various functions and

processes are related to the desired performance and how they affect it; and analysing performance data to identify gaps in performance and to name the critical processes.

- *The process level*:

  The objectives in this step are to determine the changes that are required at the process level to improve performance and to identify the jobs that should be examined further (Rummler and Brache, 1992:43). The sub-steps include (Rummler and Brache, 1992:43)

  - o determining the performance of key processes (in terms of the desired performance goals);
  - o identifying which process steps are not being performed properly and which ones are leading to the poor performance of those processes;
  - o determining the action(s) required to improve the performance of those processes; and
  - o identifying the jobs that are critical to the successful performance of the process(es), and that need to be analysed further for to improve performance.

- *The job/performer level:*

  The objectives of this step in the analysis are to determine what outputs of which critical jobs need to be improved in order for the key processes to work effectively and to produce the desired quality; and to identify the actions required to improve the job output (Rummler and Brache, 1992:43). This step consists primarily of identifying the gaps between the desired and the actual job outputs; and determining the cause(s) of poor job performance and the appropriate corrective action.

Step 3: Design and development
The objective of Step 3 is to design and develop those recommended changes that were specified as part of the

analysis step (Rummler and Brache, 1992:44). The process that is to be used to evaluate the effectiveness of the treatment is also developed in this step.

Step 4: Implementation and maintenance

This step aims is to implement and maintain the various solutions successfully. The key to the success of Step 4 is planning the sequence needed to introduce the various treatments, while top management's support is critical to successful implementation (Rummler and Brache, 1992:44).

Step 5: Evaluation

The objective of Step 5 is to gather data on performance and to assess whether the implemented "treatments" are producing the desired results; and, if not, to ascertain how the "treatments" must be modified to achieve the desired outcome (Rummler and Brache, 1992:44).

3.3.2.2 Paradies and Unger's system

Paradies and Unger (2000:289) developed a system that helps to identify major human performance-related causes of problems. The system consists of the following 15 questions that identify the issues that are to be examined (Paradies & Unger, 2000:290, *verbatim*):

- Was a person excessively fatigued, impaired, upset, bored, distracted or overwhelmed?
- Should the person have had and used a written procedure but did not?
- Was a mistake made while using a procedure?
- Were alarms or displays to recognize or to respond to a condition unavailable or misunderstood?
- Were displays, alarms, controls, tools, or equipment identified or operated improperly?

- Did the person need more skill or knowledge to perform the job or to respond to conditions or to understand system response?

- Was work performed in an adverse environment (such as hot, humid, dark, cramped, or hazardous)?

- Did work involve repetitive motion, uncomfortable positions, vibration, or heavy lifting?

- Did verbal communications or shift change play a role in this problem?

- Did failure to agree about the who/what/when/where of performing the job play a role in this problem?

- Was communication needed across organisational boundaries or with other facilities?

- Was a task performed in a hurry or a shortcut used?

- Had management been warned of this problem or had it happened before?

- Were policies, admin, controls or procedures not used, missing, or in need of improvement?

- Should an independent quality control check have caught the problem?

Once all 15 questions have been answered, the following seven basic cause categories can be analysed, as indicated by the questions (Paradies & Unger, 2000):

- *procedures* – procedures were not used or followed, were wrong, or were followed incorrectly;

- *training* – no training was given or understanding needs improvement;

- *quality control* – no inspection was done or quality control needs improvement;

- *communication* – there was no communication; communication was not timely; turnover needs improvement; or verbal communication was misunderstood;

- *management system* – standards, policies or administrative controls need improvement; standards, policies or administrative controls were not used; the employee relations were poor; or corrective action was needed;
- *human engineering* – there were problems with the human-machine interface or work environment, there is a complex system, or a non-fault tolerant system; and
- *work direction* – there was a problem with the preparation, the selection of the worker, or supervision during work.

3.3.2.3 Mager and Pipe's Performance Analysis

Mager and Pipe (1997:5) developed a Performance Analysis Flow Diagram (see Figure 3.1, next page) to discover why people do not perform the way they should. The flow diagram also assists in matching solutions to the true performance problems.

3.4 MANAGING PERFORMANCE PROBLEMS PRO-ACTIVELY

Human performance problems can be managed pro-actively by safeguarding the performance against potential sources of performance problems. The concept of "safeguarding" originated from the philosophy that management should ensure that there are sufficient safeguards between the sources of damage and the things that are susceptible to damage (Paradies & Unger, 2000:334).

Safeguards can be used in two ways (Paradies & Unger, 2000:344-345), namely, first, to help identify causal factors, since most causal factors are related to the failure of some type of safeguard; and, second, to evaluate the proposed corrective actions which are intended to strengthen safeguards or introduce new safeguards.

Is it worth solving? What's the problem?

Whose performance is concerning you?

Describe discrepancy

Is it worth solving?

Worth pursuing? — NO → Done

Can we apply fast fixes?

Expectations clear? — NO → Clarify expectations

Resources adequate? — NO → Provide resources

Performance quality visible? — NO → Provide feedback

Problem sufficiently solved? — YES → Done

Are consequences appropriate?

Is desired performance punishing? — YES → Remove punishment

Is poor performance rewarding? — YES → Remove rewards

Are performance consequences used effectively? — NO → Provide/re-arrange consequences

Problem sufficiently solved? — NO → To A

A

Do they already know how?

Genuine skill deficiency? — NO

Did it in the past? — NO / YES

Used often? — YES → Provide feedback — NO → Provide practice

Are there more clues?

Can task be made easier? — YES → Simplify task — NO

Any other obstacles? — YES → Remove obstacles — NO

Person has high potential to change? — NO → Replace person — YES → Train

Select and implement

Calculate costs → Select best solution(s) → Draft action plan → Implement and monitor → Done

Figure 3.1 Performance analysis flow diagram

Source: Mager and Pipe (1997:5)

James Reason (Anon, 2004:2) has written extensively about how humans and organisations make errors and how such error incidents can be avoided once their causes are understood. He has also developed what he calls the "Swiss Cheese" model of incident occurrence (see Figure 3.2), which he explains as follows:

> In an ideal world each defensive layer would be intact. In reality, however, they are more like slices of Swiss cheese, having many holes – though unlike in the cheese, holes are continually opening, shutting, and shifting their location. The presence of holes in any one 'slice' does not normally cause a bad outcome. Usually, this can happen only when the holes in many layers momentarily line up to permit a trajectory of accident opportunity. (Reason, 2000:3)
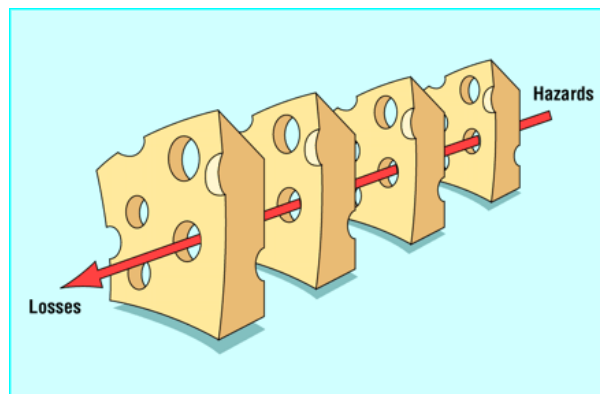
Figure 3.2 The Swiss cheese model
Source: Reason (2000:3)

According to Reason (2000:3), the holes in the defences arise either because of active failures or because of latent conditions:

- *Active failures* are unsafe deeds committed by people who are in direct contact with the system. Such acts take a variety of forms, which include slips, lapses, fumbles, mistakes, and procedural violations (Reason, 2000:3).

- *Latent conditions* are the unavoidable "resident pathogens" within the system. They arise from strategic decisions (made by designers, builders, procedure writers and top management) that have the potential of

introducing pathogens into the system. Latent conditions may lie dormant in the system for many years before any combine with active failures and local triggers to create performance problems (Reason, 2000:3). "Unlike active failures, latent conditions can be identified and remedied before an adverse event occurs" (Reason, 2000:3).

Experience has shown that no one type of defence is sufficient and therefore more multiple safeguards (defence in depth) are better than just one single strong safeguard, particularly when the negative consequences are severe (see Figure 3.3). Ideally, safeguards should possess both redundancy (there are multiple backups) and diversity (there is a variety of different safeguards) (Reason & Hobbs, 2003:13).
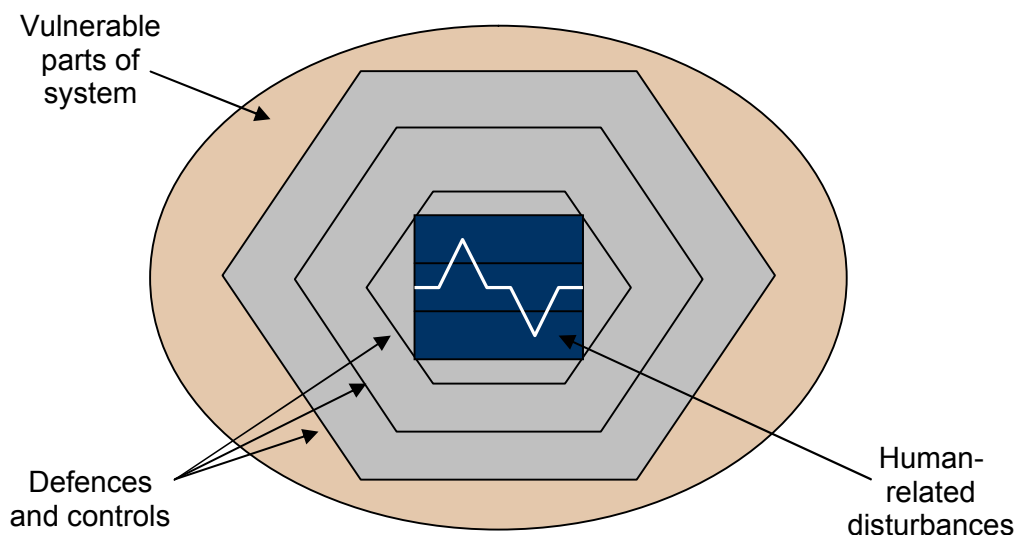
Figure 3.3 Defence in depth

Source: Reason and Hobbs (2003:13)

Although some safeguards are more effective in preventing negative consequences than others, safeguards are not infallible. Therefore, when putting safeguards in place, one should decide how many safeguards there should be and how effective the safeguards should be for the type of hazard they are protecting the performance against. The following types of safeguard are generally put in place (Paradies & Unger, 2000:337):

- *physical safeguards*, for example, insulation on a hot pipe and sunscreen;
- *natural safeguards*, for example, placing heavy objects on the bottom shelf, so that they cannot fall off and hurt someone;
- *human action safeguards*, for example, evacuating a building when the fire alarm sounds; or
- *administrative control safeguards*, for example, a poison sign on a bottle of poison, or a stop sign.

3.5 THE ROLE OF HUMAN ERROR IN PERFORMANCE PROBLEMS

3.5.1 The fundamentals of human error

Jim Reasons (in Latino & Latino, 2006:88) defines *human error* as "a generic term to encompass all those occasions in which a planned sequence of mental and physical activities fails to achieve its intended outcome, and when these failures cannot be attributed to some chance agency".

It seems obvious that a human error must have human origins – the temptation is then to focus on the individual psychological factors immediately preceding the making of an error and to do whatever seems necessary to prevent their recurrence. However, in a study conducted by Alan Hobbs in 1997 (Reason & Hobbs, 2003:3-4), it was found that "there are certain situations and work pressures that lead people into the same kind of error regardless of who is doing the job". This statement is explained well by the following explanation and model developed by Reason and Hobbs (2003:89-91):

- The performance incident begins with the negative consequences of organisational processes, management decisions and the system's culture.
- The underlying conditions are transmitted along departmental and organisational pathways to the various workplaces where they show themselves as conditions that promote errors and violations.

- At the level of the performer, these underlying conditions combine with psychological error and violation tendencies to create unsafe acts. Many unsafe acts are committed, but only a few of them actually penetrate the defences and safeguards to produce bad outcomes.

- Defences are features of the system that have been put there, not to prevent, but to help the system cope with, unplanned and untoward events that have happened in the past, or that have been anticipated by the system designers.

Latent failure pathway
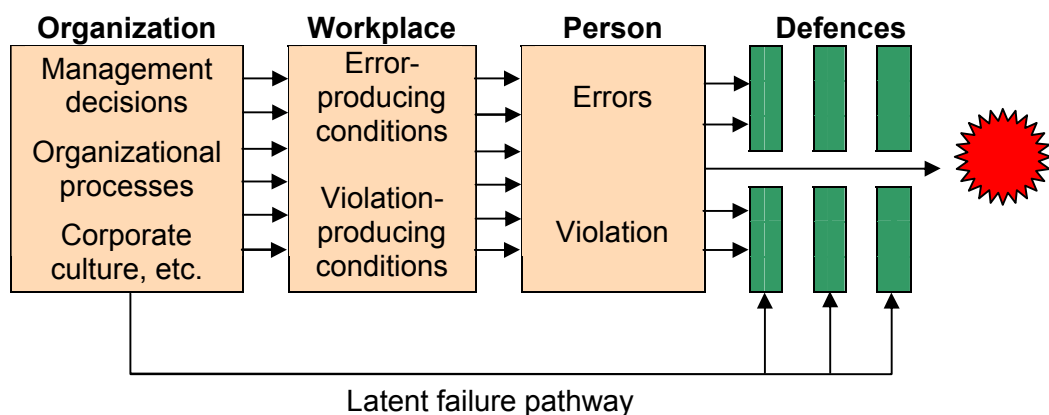
Figure 3.4 The stages involved in a performance incident

Source: Reason and Hobbs (2003:90)

Building on the above model developed by Reason and Hobbs, Balbir S. Dhillon (in Peterson, 2002:3) has identified the following common 14 reasons for human errors:

- inadequate lighting in the work area;
- inadequate training or skill;
- poor equipment design;
- high temperature in the work area;
- a high noise level;
- inadequate work layout;
- crowded work space;
- poor motivation;
- improper tools;

- poorly written equipment maintenance and operating procedures;

- inadequate handling of equipment;

- poor management;

- task complexity; and

- poor verbal communication.

This implies that one often has to deal with error-provoking tasks and error-inducing situations rather than with error-prone people. One should recognize that human actions are almost always constrained by factors beyond the person's immediate control, and that people find it difficult to avoid those actions that they never intended to commit in the first place (Reason & Hobbs, 2003:15). Many of these factors were mentioned among the research findings listed in Chapter 2.

Reason and Hobbs (2003:10) emphasize two important points about human error:

- *Errors are inevitable*. No one intends for them to happen, but everyone makes them.

- *Errors are consequences, not just causes*. They are shaped by local circumstances, such as the task, tools, equipment, and the workplace in general.

There are two ways in which people can go wrong – they can either do something they should not have done, or fail to do something they should have done (Reason & Hobbs, 2003:6). However, if one understands the above two factors, then, instead of focusing on what went wrong in the performer's head, one should rather focus on the nature of the system as a whole. The character of the system as a whole, the surrounding circumstances, and what was being done at the time all play a role in human error (Reason & Hobbs, 2003:12). According to Latino and Latino (2006:89), human beings have the ability, through their senses, to be more aware of their environments. If

their senses are sharp, they can detect changes and take action to prevent errors from occurring.

Human error is often treated as a standard set of unwanted acts. In reality, errors fall into distinct types that require different kinds of remedial action and that occur at different levels in the organisation (Reason & Hobbs, 2003:19). Reason and Hobbs (2003:39-40) outline three ways in which planned actions may fail to achieve their current goals, namely skill-based errors, mistakes and violations.

3.5.1.1 Skill-based errors

Skill-based errors occur when the plan of action is entirely appropriate, but the actions themselves do not go as planned (Reason & Hobbs, 2003:40). Skill-based errors are identified with the following three related aspects of human information processing (Reason & Hobbs, 2003:40-48):

- *recognition failures*, which fall into two main groups, namely the misidentification of objects, messages, or signals; and the non-detection of problems;
- *memory failures*, which can occur during encoding (or input), storage, and/or retrieval (or output); and
- *attention failures*, which are caused internally by distractions and externally by distractions.

3.5.1.2 Mistakes

Mistakes occur when actions go entirely as planned, but the plan is inadequate to achieve the desired goal. Mistakes can be split into the following two classes (Reason & Hobbs, 2003:49-53):

- *rule-based mistakes*, which occur when a good rule is applied in a situation for which it is not appropriate, or when a (bad) rule is applied that would get the job done, but with unwanted consequences; and

- *knowledge-based mistakes*, which occur due to either failed problem-solving, and/or a lack of knowledge.

3.5.1.3 Violations

Violations occur when actions deviate intentionally from the safe method of working, in other words, people fail to apply good rules. Violations may be a contravention of formal rules and procedures, unwritten norms or standard practice. There are three main violation categories (Reason & Hobbs, 2003:55-58):

- *routine violations*, which are committed to avoid unnecessary effort, get the job done quickly, demonstrate skill, or circumvent what seem to be unnecessarily laborious procedures;

- *thrill-seeking or optimizing violations*, which are committed to appear macho, to avoid boredom, or simply for the thrill; and

- *situational violations*, which occur due to a mismatch between work situations and procedures, for example, when it is impossible to get the job done by sticking rigidly to the procedures.

Different errors lead to different consequences and, therefore, it is important to understand the different types of error. An Australian maintenance study (Reason & Hobbs, 2003:59) compared errors that led to quality incidents to errors that led to worker safety incidents (see Figure 3.5 on next page). The study showed that the three most common errors that led to quality incidents were memory lapses, violations and knowledge-based mistakes. Slips were the most frequent error type that led to worker safety incidents. The study showed, in summary, that the errors that cause injury may be different to the errors that affect the quality of work. Both these problems need to be addressed, but they may require different interventions.

71
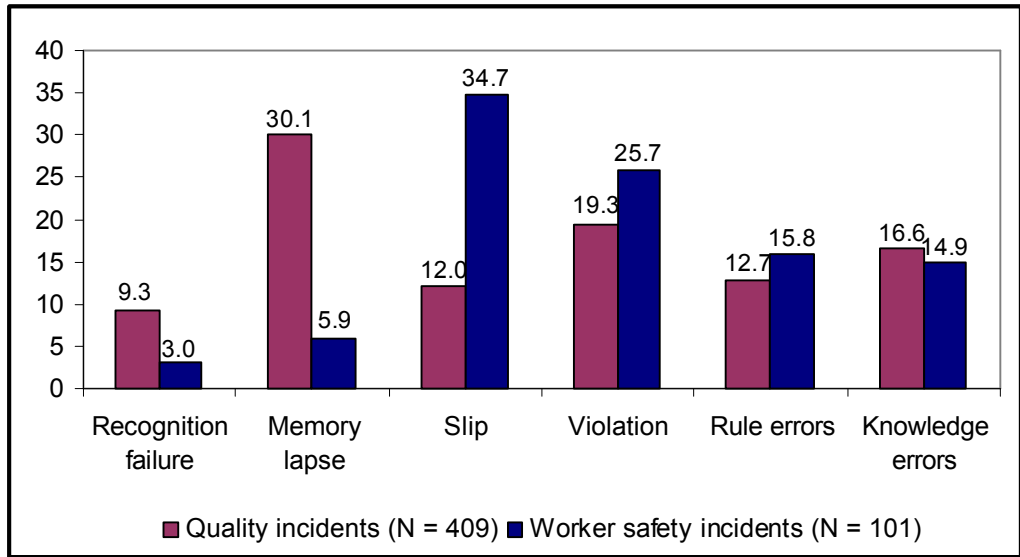
Figure 3.5 A comparison between error types

Source: Reason and Hobbs (2003:59)

Another study indicated that particular factors tend to lead to specific types of error (see Figure 3.6).
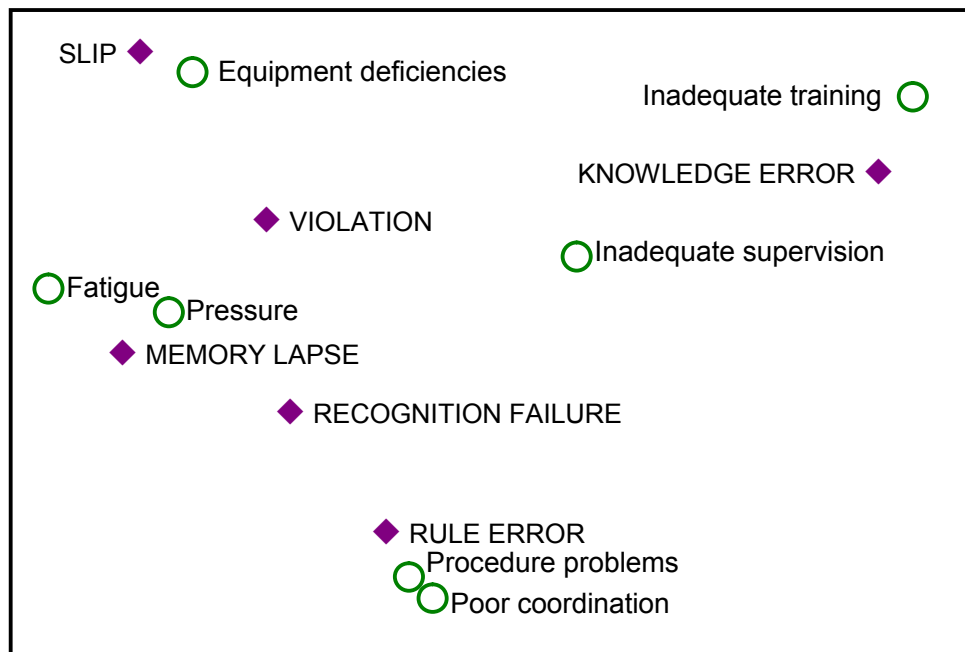
Figure 3.6 Links between types of error and performance factors

Source: Reason and Hobbs (2003:74)

The above study by Reason and Hobbs (2003:74) has, more specifically, indicated that, first, memory lapses are closely associated

with time pressure and fatigue; and, second, rule-based errors are linked to inadequate procedures and coordination.

While the risk of human error can never be eliminated entirely, it should be managed effectively. People in the organisation should understand why human error occurs and how the risk of human error can be controlled. According to Reason and Hobbs (2003:17), removing error-promoting situations and improving defences are the two most important aspects of effective error management.

3.5.2 Managing human error

Managing human error has two components (Reason, 2000:4) – first, limiting the incidence of dangerous errors; and, second, creating systems that are better able to tolerate the occurrence of errors and contain their damaging effects.

Without a set of guiding principles, efforts to manage human error have little chance of being successful. Reason and Hobbs (2003:96-100) list the following guiding principles for human error management:

- "Human error is both universal and inevitable" (Reason and Hobbs, 2003:96). Such errors are rarely malicious acts and can never be eliminated.
- Errors are not intrinsically bad; without them, people can neither learn nor acquire the skills that are essential for safe and efficient work.
- One cannot change the human condition, but one can change the conditions in which humans work. Identifying the characteristics of situations that provoke unwanted actions is essential to effective error management.
- "The best people can make the worst mistakes" (Reason and Hobbs, 2003:97). Errors can strike anywhere, at any time; and no one is immune. The best people often occupy the most responsible

positions; and, therefore, their errors can have the greatest impact upon the system as a whole.

- People cannot easily avoid errors they do not intend to commit. If the intention is to remedy errors, it is useless to blame people for their errors, but everyone should at least be accountable for his/her errors and strive to avoid their recurrence.

- "Errors are consequences rather than causes" (Reason and Hobbs, 2003:97). An error is the product of a chain of events that involves people, teams, tasks, workplaces and organisational factors. Therefore, discovering an error is the beginning of the search for a cause, not the end of the process.

- "Many errors fall into recurrent patterns" (Reason and Hobbs, 2003:98). Systematic or recurrent errors occur in work situations that recur many times in the course of activities.

- Errors can occur at all levels of the system. A general rule of thumb is that the higher up the organisation an individual is, the more dangerous his/her errors potentially are. Therefore, human error management techniques need to be applied across the whole system.

- Human error management is about managing the manageable. One of the most common errors in human error management is trying to change those aspects of human nature that are virtually unchangeable. An important step in effective human error management is to recognize the existence of a tendency to blame individual persons and to fight against such a tendency.

- Human error management is about making good people excellent. The principal aim of human error management is to make well-trained and highly motivated people excellent. People need to be informed about the ways in which human performance problems can arise and they should be trained to plan how they might detect and recover errors before the errors cause harm.

- There is no single best way. Different types of performance problem occur at different levels of the organisation and each requires

different management techniques. Different organisational cultures also require the "mixing and matching" of different combinations of techniques. Each organisation has to choose or develop the methods that work best for that organisation.

- Effective human error management aims at continuous reform rather than at local fixes. Instead of trying to prevent the recurrence of individual errors, what is required is reforming the conditions under which people work, as well as strengthening the system and reducing the system's deficiencies. Reforming the whole system should be a continuous process that aims at reducing and containing whole groups of errors rather than single blunders.

Human error management has three components, namely error reduction, error containment and managing activities so that the system continues to work effectively. Managing human error is the most challenging and difficult part of this process. For human error management to have a lasting effect, it needs to be continuously monitored and adjusted to changing conditions.

Effective or comprehensive human error management involves targeting different counter-measures at different parts of the company – counter-measures can be targeted at the person, the work team, the workplace and the task, and the organisation as a whole.

3.5.2.1 Counter-measures targeted at the person

Such counter-measures involve coming to grips with a number of people-related issues:

- understanding error-provoking factors, such as the following (Reason & Hobbs, 2003:104-105):
  - excessive reliance on memory;
  - interruptions;
  - pressure;
  - tiredness;

- o inadequate coordination;
- o unfamiliar jobs;
- o ambiguity; and
- o highly routine procedures;
- understanding why people violate good procedures – there are two techniques that are generally used for reducing violations (Reason & Hobbs, 2003:106-107), first, efforts to scare people into compliance (for instance, by using graphic posters and videos that highlight the consequences of unsafe behaviour); and, second, social controls (this is related to the extent to which other people whose opinions matter to the individual would approve or disapprove of the violating behaviour); and
- achieving the right degree of mental readiness for a task before it begins, which can greatly enhance the quality and reliability of human performance (Reason & Hobbs, 2003:110) – mental rehearsal improves the quality of the mental model and helps in activating the correct task steps, rather than the wrong ones, towards the intended goal.

3.5.2.2 Counter-measures targeted at the work team

Training programmes that deal with team issues generally include the following (Reason & Hobbs, 2003:114, *verbatim*):
- teaching team members how to pool their intellectual resources;
- learning to acquire a collective situational awareness that admits challenges from junior team members;
- emphasizing the importance of teamwork;
- establishing a common terminology to minimize communication problems;
- training for leadership and team membership skills;
- identifying organisational norms and their effects on safety;

- understanding organisational culture and recognition of shared values;
- improving communication skills; and
- understanding and managing stress.

3.5.2.3 Counter-measures targeted at the workplace and task

Making good people better will only have limited effect if the work environment and task continue to elicit errors. Some of the most powerful interventions to reduce errors are those directed at removing task-related challenges to work quality (Reason & Hobbs, 2003:119). The following are key aspects of the task and environment that can have a powerful impact on error reduction (Reason & Hobbs, 2003:119-126):

- *Fatigue management*

  Fatigue can increase the likelihood of error in the same way that alcohol does. If work is carried out outside standard hours, then fatigue management is one of the most important issues facing the organisation.

- *Task frequency*

  The error rate for tasks that are performed infrequently is likely to be high, because inexperienced workers tend to perform at the error-prone knowledge-base level. Once they have gained experience, there is a smaller likelihood of knowledge-based errors, but the probability of skill-based slips and lapses increases. Both unusual and routine tasks create their own kind of errors and therefore intelligent task assignment can help to reduce risks.

- *Design*

  Many errors have their origins in inadequate system design. It is not possible to design systems that eliminate the possibility of errors altogether, but both designers and users of systems should do everything possible to reduce the occurrence.

Potential users of the system should establish at the outset that the information received is clear and unambiguous and that the system is distinctively marked and easy to interpret.

- *Housekeeping*

  On the one hand, housekeeping should avoid an excessive concern with cleanliness, tidiness and outward form, but, on the other hand, it should also avoid neglecting dangerous slovenliness. It is important to find a standard of housekeeping that meets the needs of safe, swift and effective operations, but that does not go too far beyond these aims.

- *Spares, tools and equipment*

  An important part of managing error is getting the task environment right. Practical issues such as a lack of availability of spares and equipment can lead to errors, as employees struggle to perform their tasks in the face of obstacles and frustrations.

- *Omissions*

  It is important, first, to know in advance where an omission is likely to happen; and, second, to draw people's attention to the possibility of omission so that they might avoid it. Reason and Hobbs (2003:127) have developed a 20-item task step checklist as practical error management tool that can be applied to a specific task procedure to identify omission-provoking steps or items.

3.5.2.4 Counter-measures targeted at the organisation as a whole

Managing error requires action not only at the level of the individual or the workplace, but at all levels of the organisation. Activities often share a number of common factors that have a profound effect upon the success of the system as a whole. "At the organisational level, these factors include organisational

structure, training and selection, people management, the provision of tools and equipment, commercial and operational pressures, planning and scheduling, communication and the maintenance of buildings and equipment" (Reason & Hobbs, 2003:134). Local conditions within a particular workplace that have a direct influence upon the reliability and efficiency of employees include factors such as knowledge, skills and the ability of the workforce, the quality of tools and equipment, the availability of parts, paperwork, manuals and procedures, ease of access to the job, and computer support (Reason & Hobbs, 2003:134).

The following are techniques for managing organisational factors that exert a powerful upstream influence on errors (Reason & Hobbs, 2003:135-142):

- *Reactive outcome measures*

    This involves learning the right lessons from past events. If an organisation is serious about reducing and containing human factor problems, it first needs to understand the nature and varieties of the errors that occur within its own system. It should analyse human errors according to the factors that may be associated with their occurrence. If there are recurrent error patterns, this indicates that there are conditions within the workplace or system that keep producing the same kinds or error, regardless of who is doing the job.

- *Proactive process measures*

    This involves the deployment of targeted remedial actions to increase the resistance to hazards. Proactive process assessment tools are used to identify and prioritize the workplace and organisational factors that have an adverse effect on human performance. They do not depend on the prior occurrence of errors – they are workplace and organisational factors that may cause errors later, so that

remedial efforts can be directed at the problems that are most in need of attention. Reason and Hobbs (2003:140-141) have identified the following generic organisational factors in different locations: organisational structure, people management, provision and quality tools and equipment, training and selection, commercial and operational pressures, planning and scheduling, maintenance of building and equipment, and communication.

- *Putting appropriate defences in place*

  Even if organisations do their best to prevent human errors, errors are likely to still occur and when they do, they often have adverse consequences beyond the task at hand. Therefore, organisations need to ensure that their systems are as error-tolerant as possible. To achieve this, they need two types of defences, namely defences designed to detect human errors, and defences intended to contain the consequences of undetected human errors. Nobody can ever guarantee total immunity from human errors, accidents, or human performance problems, but organisations can increase the system's intrinsic resistance by identifying weaknesses in the error detection defences and strengthening these defences by identifying and eliminating the known causal ingredients that are latent in the system. The aim should be to be as resistant as reasonably practical to the organisation.

3.6 CONCLUSION

Human performance has a direct impact on organisational performance. Thus, for organisations to achieve their goals, employees need to meet or exceed performance expectations. Human performance problems occur when there is a good reason to assume that employees have the capacity to do what is expected of them, but do not do so.

The following conclusions can be drawn from the literature discussion in this chapter:

- Tracking and monitoring performance can help organisations to ensure that good quality data are collected from the most reliable sources. If these data are fed into a systematic troubleshooting approach, they would help organisations identify the performance gaps and root causes of the performance problem(s).

- Human performance can be managed pro-actively by identifying potential causes of performance problems and then implementing multiple safeguards against these causes.

- Although human error is often treated as the cause of performance problems, it is frequently merely a consequence of error-provoking tasks and error-inducing situations. Human error can be controlled by implementing the correct counter-measures that target the person, the work team, the workplace, the task and the organisation as a whole.

The purpose of this study is to develop a root cause analysis process for uncontrolled variations in human performance. Root cause analysis is all about making order out of chaos and finding out "what is going on". The next chapter focuses on root cause analysis as a problem-solving tool that can assist organisations in finding and disseminating information that would help in the quest to find the answers to human performance problems.

CHAPTER 4

ROOT CAUSE ANALYSIS LITERATURE

4.1 INTRODUCTION

As described in Chapter 1, root cause analysis can be traced to the broader field of TQM. Root cause analysis is an integral part of the large TQM toolbox of problem analysis, problem-solving and improvement tools (Andersen & Fagerhaug, 2006:12).

This chapter is the last of three that document a literature review that covers the central concepts used in this study. It provides a detailed overview of the key concepts and processes used in the root cause analysis.

This chapter is divided into the following sections:
- types of causes;
- understanding the concept of root cause analysis; and
- criteria for an effective root cause analysis system.

4.2 TYPES OF CAUSES

During the process of root cause analysis, causes are referred to in several different ways, including the following:
- *Presumptive causes*
  These causes may be apparent at the beginning of the investigation or emerge during the data collection process. These are hypotheses that would explain the effects of the problem, but that need validation (Ammerman, 1997:64).
- *Contributing causes*
  These causes alone would not have created the problem, but are important enough to be recognized as needing corrective action to improve the quality of the process or product (Ammerman, 1997:64). Contributing

causes form links in the chain of cause-and-effect relationships that ultimately create the problem.

- *Compound causes*

Different factors can combine to cause the problem (Andersen & Fagerhaug, 2006:4).

- *Root cause*

This is the most basic cause or reason for a problem that can reasonably be identified and that management has control to fix. If this is corrected, it will prevent recurrence of the problem. In other words, root causes directly lead to the problem.

4.3 UNDERSTANDING THE CONCEPT OF ROOT CAUSE ANALYSIS

There does not seem to be a single, generally accepted definition of what root cause analysis is. In this study, two different, but complementary, explanations of root cause analysis are investigated. These explanations are based on the definitions developed by W.J. Rothwell (2005) and Andersen and Fagerhaug (2006) respectively.

4.3.1 Root cause analysis as an approach that traces causes and effects

W.J. Rothwell (2005:162) defines *root cause analysis* as a past-oriented approach that traces the causes and effects and pinpoints the causes of problems. This definition is similar to that of Latino and Latino (2006:117), who state that all root cause analysis approaches share the common characteristic of examining cause-and-effect relationships.

This approach to root cause analysis is based on the principle that cause and effect relationships govern everything that happens and as such is the path to effective root cause analysis. Based on their experience, Latino and Latino (2006:18) believe that any undesirable outcome will have, on average, a series of 10 to 14 cause-and-effect relationships that line up in a particular pattern in order for that event to

occur. The event is the last effect and we notice that something is wrong because of the event.

Gano (1999:38-48) explains the characteristics of the cause and effect principle as follows:

- *Cause and effect are the same thing.*

  Cause and effect only differ in the way they are perceived. When one starts with an effect that has serious consequences, one wants to prevent that effect from occurring. When one asks why it occurred, one finds a cause; but if one asks "why" again, what was just a cause becomes an effect. Therefore, cause and effect are the same thing, only perceived from different perspectives.

- *Cause and effect are part of an infinite continuum of causes.*

  By repeatedly asking "why", one develops a cause chain or linear path of causes. One usually starts the process with an effect or consequence that one wants to solve and prevent from recurring. However, no matter where one starts, one is always in the middle of a continuous chain of causes and the starting point is merely a function of one's perception and goals.

- *Each effect has at least two causes in the form of actions and conditions.*

  Each effect has two or more causes – one in the passive state (conditions) and the other active (actions). Gano (1999:41) defines *action causes* as "momentary causes that bring conditions together to cause and effect", and *condition causes* as "causes that exist over time prior to an action". Several conditions usually come together with an action to cause an effect. Together, the action and condition causes form part of an ever-expanding infinite set of possible causes.

- *An effect exists only if its causes exist at the same point in time and space.*

  It is highly unlikely that a single technical failure or an isolated human error would be enough to cause a major incident (Reason & Hobbs, 2003:77). Every effect observed is caused by one or more

existing conditional causes that exist in the same time, are located in the same space, and are set in motion by an action. Latent conditions arise from strategic decisions made by designers, manufacturers, regulators and top management, and relate to things such as goal-setting, scheduling, budgeting, policy, standards and the provision of tools and equipment. These conditions could turn into error- and violation-producing conditions, which, in turn, interact with human psychology to cause unsafe acts, errors and violations (Reason & Hobbs, 2003:77-78). The instant the action occurs, the effect is created. If the time or space is changed, the effect will not be created. Gano (1999:46) describes this in the graphic illustration in Figure 4.1.
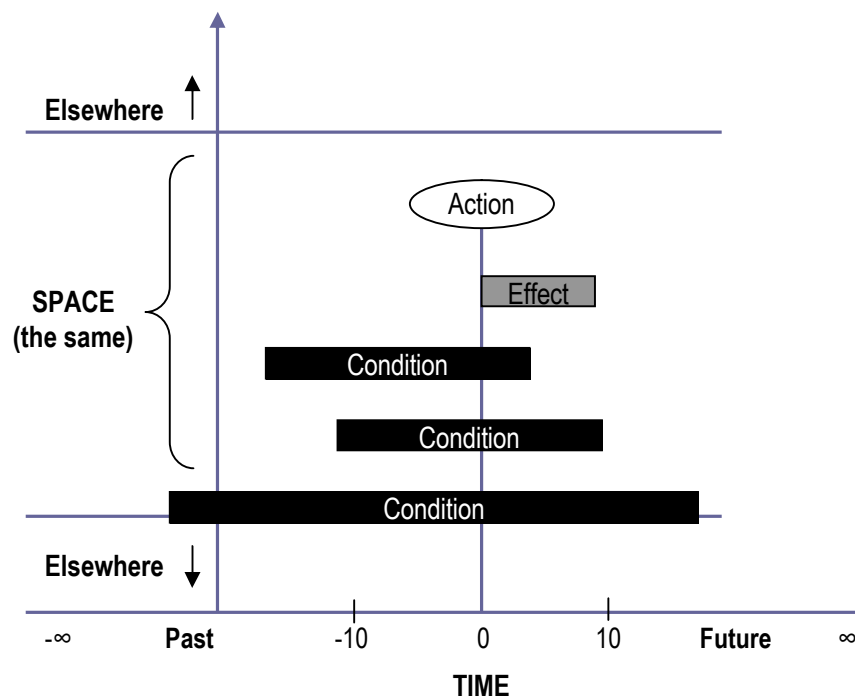
Figure 4.1 Cause and effect relationships in time and space
Source: Adapted from Gano (1999:46)

4.3.2 Root cause analysis as a structured investigation

Andersen and Fagerhaug (2006:12) define root cause analysis as "a structured investigation that aims to identify the true cause of a problem and the actions necessary to eliminate it". This definition is supported

by Paradies and Unger (2000:318). They claim that expert professional troubleshooters solve problems by doing the following (Paradies & Unger, 2000:318, *verbatim*) – they

- approach a problem systematically;

- carefully collect and preserve all the information available;

- obtain a history of equipment operation and performance;

- combine useful information into a sequence of events that helps decipher the causal relationship of multiple failures and discard superfluous facts;

- use knowledge of similar equipment and failure trouble-shooting guides to simplify the analysis process and save needless effort; and

- use a systematic root cause analysis tool to find the fixable cause of the failure, rather than just treat the symptoms.

Two structured approaches to root cause analysis are discussed for purposes of this study, namely a four-step root cause analysis process and change analysis.

4.3.2.1 A four-step root cause analysis process

According to EQE International Inc. (1999:6), a root cause analysis process follows four main steps (see next page).
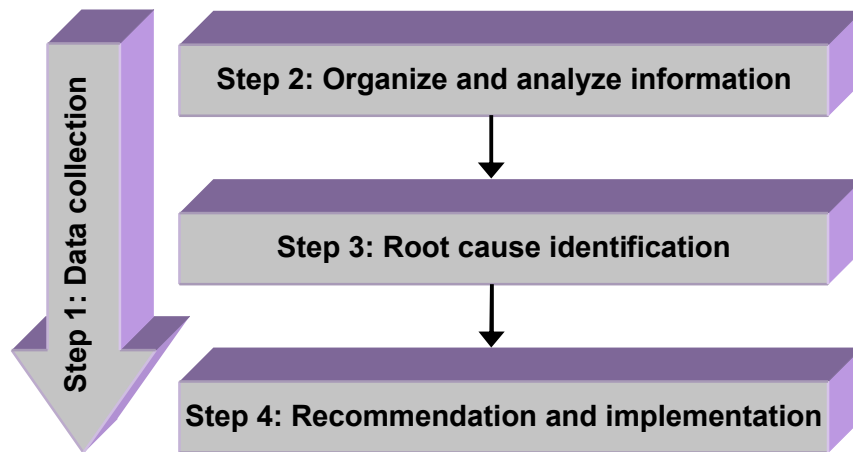
Figure 4.2 A four-step root cause analysis process

Source: Adapted from EQE International Inc. (1999:6)

Step 1: Data collection

The majority of time spent analysing an event is spent on gathering data and evidence. Evidence is data that supports a conclusion, or, as defined by Latino and Latino (2006:124), is "any data used to prove or disprove the validity of a hypothesis in the course of an investigation and/or analysis".

The factual evidence derived from data gathering serves as the basis for all valid conclusions and recommendations that are made as a result of the root cause analysis. We usually base a conclusion on one of the following (Gano, 1999:75-81):

- *Sensed evidence*

  This is the highest quality of evidence and consists of knowing by means of sight, sound, smell, touch and taste.

- *Inferred evidence*

  This is evidence that is known by repeatable causal relationships. It is less desirable than sensed evidence; and it relies on the assumption that the person concerned knows the causal relationship. There are two types of inferred evidence:

- o *intuition* – inferred evidence based on both reason and emotions, but, because it occurs at a subconscious level, people usually cannot explain where it comes from; and

- o *emotional evidence* – inferred evidence from a known repeatable causal relationship, but the five senses are not involved in the knowing process (although this type of evidence is very real and should therefore not be ignored as evidence of a cause, emotions should be regarded as suspect because they are not always reliable).

Data gathering is an ongoing process throughout the root cause analysis. Without effective data gathering, the event cannot be truly understood and the root cause(s) associated with the event cannot be identified. To ensure effective data gathering, a comprehensive workflow must be established and should address the following questions (Latino & Latino, 2006:72, *verbatim*):

- Who will collect the data?

- What data is important?

- When will the data be collected?

- Where will it be stored?

- Who will verify the data?

- Who will enter the data?

According to EQE International Inc. (1999:9-10) and Latino and Latino (2006:90-98), fives basic types of data are collected during a root cause analysis investigation:

- *Parts/physical*

  This data consists of something physical or tangible, such as parts, residues or chemical samples. The data is first identified and preserved, and then it is tested or analysed physically.

- *Position*

  This data consists of physical relationships among items and

people at the scene and environmental factors, as well as time relationships that define the sequence of events and provide information for correlation analysis, or cause-effect relationships.

- *People*

  Interviews are conducted with witnesses. Efforts to talk to the physical observers of the event must be relentless and immediate to avoid the risk of losing some degree of short-term memory, as well as the risk that observers will discuss their opinion of what happened with others. This data is the most fragile and needs to be the first priority.

- *Paper*

  This data consists of data on paper and data stored electronically that can be printed out on paper, for example, documentation records, logs and data-recording results, procedures, memos, correspondence, programme manuals, and policy statements. Many management systems are documented on paper and, therefore, paper data can often lead to the discovery of the root cause(s).

- *Paradigms*

  Joel Barker (in Latino & Latino, 2006:97) defines a *paradigm* as "a set of rules and regulations that: (a) defines boundaries, and (b) tells you what to do to be successful within those boundaries". It describes how people view the world and react and respond to situations. This inherently affects how people approach problem-solving and ultimately determines the success of a root cause analysis effort.

Table 4.1 displays a summary of the items that are collected and reviewed, as well as the tools and methods that are used during data collection (Ammerman, 1997:14; Gano, 1999:131; Latino & Latino, 2006:73-101; Paradies & Unger, 2000:408).

Table 4.1 Data collection

Tools used for data collection	Methods used for data collection	Documents to be reviewed	Data items to be collected
• Digital and video cameras • Paper, pens, pencils and highlighters • Clipboard • Interview guidelines • Evidence preservation checklist • Wire tags and ID equipment • Grid paper for mapping • Photo log sheets • Observation sheets • Tape measure and steel ruler • Flashlight • Labels and tags • Calculator • Caution, boundary and masking tape • Feeler gauges • Marking pens and paint • Sealable plastic bags • Dictaphone or small tape recorder for notes • Magnifying glass • Magnet • Rags • Sample bottles/vials • Mirror • Sound level meter • Light meter • Thermometer (non-mercury containing) • Gloves • Hardhat, safety glasses, face shield and ear plugs • Steel toed shoes • Tweezers	• Conducting interviews • Observation at the workplace • Conducting surveys • Conduct focus group sessions • Taking photographs • Performing requested laboratory tests • Performing the work tasks under investigation	• Operating/working logs • Correspondence, including internal memos and emails • Sales contact information • Meeting minutes • Inspection/testing and safety records • Maintenance records/histories • Equipment history records and logs • Computer records • Recorder tracings • Policies • Procedures and/or instructions • Vendor manuals • Process and instrumentation drawings and specifications • Design information • Change documents • Trend charts and graphs • Plant parameter readings • Sample analysis and lab reports • Work schedules • Quality control reports • Equipment supplier and manufacturer records • Financial reports • Training records • Purchasing requisitions/ authorizations • Non-destructive testing results • Employee file information • Production histories • Medical histories/ patient records • Past root cause analysis reports • Labelling of equipment/products • Statistical process control/statistical quality control information	• Functional location • Asset ID • Event date • Equipment category • Equipment class • Equipment type • Unit or area • Failed component • Event mode • Model number • Material cost • Labour cost • Total cost • Lost opportunity cost • Other related costs • Out of service date/time • Maintenance start date/time • Maintenance end date/time • In service date/time

Max Ammerman (1997:15) offers the following guidelines for collecting data:

- Collect data pertinent to
  - conditions before, during, and after the event;
  - environmental factors such as weather conditions; and
  - time of day, day of the week, amount of overtime worked.
- When taking a series of photographs, carefully document and label each photograph, showing, for instance, the sequence of photographs, distances, orientations and times.
- Collect, label, and preserve physical evidence such as failed components, ruptured gaskets, burned leads, blown fuses, spilled fluids, or partially completed work orders or procedures.
- Establish a quarantine area for failed equipment or components, or tag and separate pieces of material.
- Consider things that occurred around the event area even if they might at first seem irrelevant, for example, hardware of software associated with the event, recent programme or equipment changes, and the physical environment.
- Ask the following questions to review and verify the data to ensure accuracy and objectivity:
  - Is eyewitness testimony consistent?
  - Does the information support the physical evidence?
  - Is more information needed?
  - Do I need to hold a second interview to check certain aspects of the situation?
  - Has information been used in such a way as to overcome personal bias?

Step 2: Organise and analyse information

The purpose of Step 2 is to organise and analyse the information gathered during the investigation and to identify gaps and

deficiencies in the information. The goal of data analysis is to identify the key equipment failures and human errors that have led to or allowed the incident to occur.

Incidents usually develop from clearly defined sequences of events that involve performance errors, changes, oversights, and omissions. The investigator needs to identify and document not only the negative events, but also the relevant conditions and non-hazardous events related to the incident sequence. The following information is usually collected to describe an incident:

- events, actions or conditions that could have initiated a change during the sequence of events;
- actions – sensory, physical and mental – performed by people/things, or the state of the parameters that are related to the incident;
- sources of the data;
- times at which the event or condition started and ended; and
- the location where the event/condition began or occurred.

After all the data have been collected, the investigator is in a good position to identify factors that were major contributors to the incident. These are referred to as causal factors. Causal factors are those equipment failures and human errors that, if eliminated, would have prevented the incident or reduced its consequences.

Step 3: Root cause identification

Mark Paradies and David Busch (in Paradies & Unger, 2000:52) define a *root cause* as "the most basic cause (or causes) that can reasonably be identified that management has control to fix and, when fixed, will prevent (or significantly reduce the likelihood of) the problem's recurrence."

The following key ideas are significant in the above definition (Paradies & Unger, 2000:52-53):

- When the root cause is found, something is found that management can fix that will prevent the problem's recurrence.

- According to the definition, a root cause is something that falls within management's grasp to fix.

- An investigator has expended a "reasonable" effort if the fixable cause of an incident has been found.

- A problem may have more than one root cause. Paradies and Unger's (2000:53) research has proven that simple incidents have on average two to three root causes, while more complex incidents in more complex systems have 10 or more root causes.

The identification of root causes helps the investigator to examine and establish, in a systematic way, why the incident occurred so that the problems surrounding the occurrence can be fixed.

Step 4: Recommendation and implementation of solutions

The facts discovered during the investigation should lead to causal factors and root causes, which, in turn, should lead to recommendations of solutions. Gano (1999:90) defines a *solution* as "an action taken upon a cause to affect a desired condition". The purpose of Step 4 is thus to generate achievable recommendations of solutions (or corrective actions) that will avoid the recurrence of the root cause(s).

Preventing recurrence implies that the event does not happen again for the same (known) set of causes. Even though it might not always be possible, organisations should strive for 100%

non-repeat. This may require a combination of solutions – one solution may prevent recurrence 90% of the time, while a second solution may prevent it the other 10%. This means that the solutions that are developed should not only address the specific circumstances of the event that has occurred, but should also seek to make improvements in management systems and/or inherent safety. With this is mind, it means that, in general, three types of solutions should be generated for each root cause (EQE International Inc., 1999:33), first, solutions that will correct the specific problem; second, solutions that will correct similar existing problems; and, third, solutions that will correct the system that created the problems.

According to Gano (1999:100), the following list represents the most common favourite solution categories that should be avoided as sole or final solutions, because using these favourite solutions as a first or only resort indicates that the organisation is in a rut, and chances are that the problem will repeat itself:

- punishment;
- reprimand;
- replacement of the broken part;
- investigation;
- revision of the procedure;
- writing of a new procedure;
- changes to the management programme (re-engineering);
- redesign;
- putting up a warning sign; and
- ignoring the problem ("stuff happens").

Before solutions or corrective actions are recommended, they should be reviewed to ensure that they will be efficient and effective and that they will not cause more unexpected problems. Paradies and Unger (2000:77-82) suggest two techniques to

assist with this, namely the Safeguard Analysis and the SMARTER procedure.

a. *Safeguard Analysis*

The Safeguard Analysis – which is similar to safeguarding, as discussed in Chapter 3 – is used to judge the adequacy of the suggested solution or corrective actions. This is done by reviewing the sequence of events to determine whether the proposed corrective actions will provide enough defence in-depth to reasonably assure that the incident will not recur. The information gained from the Safeguard Analysis can also be used in an environment where resources (time, money and people) are limited, to determine which of the suggested corrective actions is/are most important.

b. *SMARTER*

Each corrective action should be reviewed for each of the following elements – is it (Paradies & Unger, 2000:81, *verbatim*)

Specific?	• Who will do what by when?
	• Are corrective actions specified in numbers?
Measurable?	• Can the corrective action be measured (quantitatively) to see when it is done and to see if it worked?
	• Will it prevent future incidents?
Accountable?	• Is the person responsible for implementing the corrective action clearly defined?
	• Is the due date clearly specified?
Reasonable?	• Is every suggested corrective action practical?
	• Is there a simpler or less expensive way to do the same thing?
	• Can you convince management that there

is a reasonable return on investment for this corrective action?

- Have you discussed the corrective action with those who will own it – those who will have to implement it and live with it – and do they believe it is reasonable?

Timely?
- Is the due date for the corrective action soon enough, given the consequences of another failure?
- If the frequency of failure is high and the consequences of failure are significant, does the report offer interim action to reduce the risk while the final corrective actions are being implemented?

Effective?
- Will the corrective action prevent or significantly reduce the odds of this problem happening again?

Reviewed?
- Will this corrective action cause any problems?
- Has someone independent from the investigation team reviewed the corrective action for unintended negative impacts on the process or the people?

In addition to checking the suggested solution for its efficiency and effectiveness, it is also important to ensure that it is viable.

The following criteria will ensure that the solution or recommended corrective actions are viable (EQE International Inc., 1999:33; Gano, 1999:93):

- The solutions must prevent recurrence of the condition/event.

- The solutions must be within both the control and capability of the organisation to implement.
- The solutions must be directly related to the root causes.
- The solutions must meet the following goals and objectives:
  - The solution must not cause undesirable problems.
  - The solution must avoid similar occurrences, for instance, at different locations.
  - The solution must offer reasonable value for its cost.
- Implementation of the solutions must not introduce unacceptable risks.

The following questions will help ensure that the above criteria for developing and implementing solutions are met (EQE International Inc., 1999:34):

- Is there at least one solution associated with each root cause?
- Does the solution specifically address the root cause?
- Will the solution cause detrimental effects?
- What are the consequences of implementing the solution?
- What are the consequences of not implementing the solution?
- What is the cost of implementing the solution?
- Will training be required as part of implementing the solution?
- In what time frame can the solution reasonably be implemented?
- What resources are required for successful development of the solution?
- What resources are required for successful implementation and continued effectiveness of the solution?
- What impact will the development and implementation of the solution have on other work groups?
- Is implementation of the solution measurable?

Once the solutions or corrective actions have been approved, a system needs to be set up to track the implementation and

measure its effectiveness. Paradies and Unger (2000:96) suggest the following process:

- *Document any immediate, short-term fixes*
  What actions have been taken to repair damage, fix broken equipment, care for or rehabilitate injured people, and get the process back in operation?

- *Document, track and validate long-term fixes*
  Did the corrective action meet its intent and was it effective? If the fix worked, share the proven results with other facilities in the organisation.

To make the implementation process successful requires management involvement. Management can be involved by, first, spending some of its time focusing on the company's improvement efforts; and, second, ensuring resources are being applied to the performance improvement efforts (Paradies & Unger, 2000:98).

4.3.2.2 Change Analysis

In addition to the four-step process outlined above, Change Analysis is another structured root cause analysis process. Change Analysis was popularized in the early 1960's when Charles Kepner and Ben Tregoe developed a technique that identifies and compares differences between two similar, but not identical, processes or outcomes, to uncover changes that could cause problems (Paradies & Unger, 2000:350).

Figure 4.3 (see next page) illustrates the Change Analysis process.
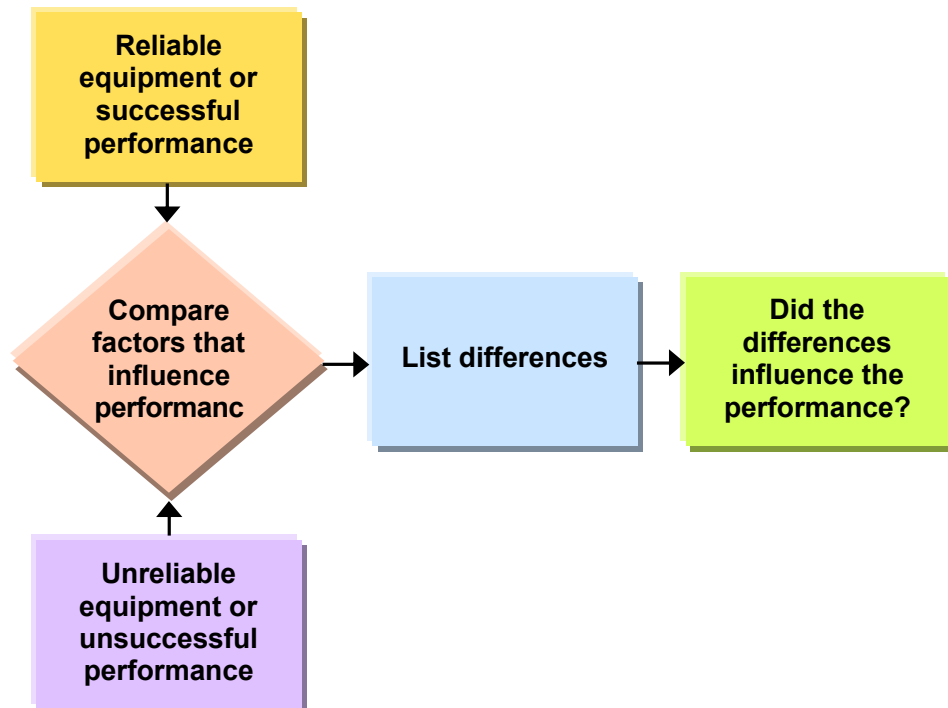
Figure 4.3 The Change Analysis process

Source: Adapted from Paradies and Unger (2000:351)

The quality of the Change Analysis depends on the quality of the list of factors that have been developed. If key factors have been overlooked, then important information that contributed to the problem might be missed. The following seven questions can be used to help identify the factors that influence performance (Paradies & Unger, 2000:354, 380):

- Who performed the work?
- What tools, equipment, displays, controls, distributed control system, procedures, technical manuals, administrative controls, drawings, status boards, chemicals, communication equipment, warning signs, labels, or other aids were used to perform the work?
- When was the work performed?
- Where was the work performed?
- Why?
- To what extent?

- Under what conditions was the work performed?

According the Paradies and Unger (2000:354), the following categories can be evaluated to make a more complete list for human performance issues:

- procedures;

- training;

- quality control;

- communications;

- management systems;

- human engineering; and

- work direction.

Changes do not always cause problems; and not all changes cause problems. Change Analysis does, however, help investigators to recognize problems caused by subtle changes or differences which frequently do cause problems.

4.4 CRITERIA FOR AN EFFECTIVE ROOT CAUSE ANALYSIS SYSTEM

Effective root cause analysis means that the same problem never occurs again due to the same causes. Ineffective root cause analysis occurs due to the following five factors (Gano, 1999:31-33; Latino & Latino, 2006:110-111):

- *Incomplete problem definition*

  This is caused by the false belief that the problem is obvious and the subsequent rush to find a solution. The belief that the problem is obvious is caused by the belief in a single reality discussed above and the notion that people all think the same. If the problem is not properly defined, causes are ignored, and the focus is on sharing favourite solutions to show everyone else how smart one is. As a result, little or no synergy occurs; the problem is never fully understood and therefore occurs again. When the problem does recur, another favourite solution is implemented and the cycle continues.

- *Unknown causal relationships*

  Causal relationships often remain unknown because people do not seem to think causally. They tend to think and talk in terms of human error, lack of training and other categorical causes aligned with their favourite solution.

- *A focus on solutions*

  By focusing on solutions without following the root cause analysis discipline and clearly defining the problem and its causes, organisations often find themselves solving the wrong problem. People focus on solutions because the human mind searches for what it already knows and when people find what they know, they validate the rightness of the search and cease to look any further. They seek the familiar and call it "right" or "real". This tendency is called "the favourite solution mindset" and it prevents effective root cause analysis most of the time.

- *Acceptance of opinions as facts*

  This phenomenon often occurs when methodologies are used that promote solutions before proving that hypotheses are factual, or when there is a lot of pressure to reach consensus quickly and implement solutions so that things can get back to "normal". This leads to a trial-and-error approach and to spending money – which does not solve the problem.

- *Destructive team behaviour*

  A dominating team member can make other team members feel intimidated. When that happens, they will not participate, and it puts pressure on them to accept the dominating team member's opinion as fact. Team members that are reluctant to participate, that go off on a tangent or that argue a lot are detrimental to the team's achieving success during a root cause analysis.

In addition to the above reasons for ineffective root cause analyses, research conducted by Robert Nelms (in Latino & Latino, 2006:25) indicated the following reasons why root cause analysis initiatives fail:

- root cause analysis is almost contrary to human nature (according to 28% of the respondents);
- incentives and/or the priority to do root cause analysis are absent (19%);

- root cause analysis takes time (people say they do not have time) (14%);
- root cause analysis processes are ill-defined or misdefined (12%);
- "western culture" seems to have a short-term focus and people are rewarded for short-term results (9%);
- people say they have not had to do root cause analysis in the past, so they ask why they should do so now (8%);
- most people do not understand how important it is to learn from things that go wrong (5%); and
- root cause analyses are not the respondents' responsibility (5%).

The above list shows that every objection to root cause analysis can be overcome if a proper strategy and support structure are developed and implemented. Paradies and Unger's (2000:53-55) extensive research since 1983 pinpointed the following criteria for a good root cause system – it is

- easy to use in the field by non-experts;
- effective in consistently identifying root causes (two people with the same information and using the same technique should arrive at the same answer; and effective root cause analysis helps the problem solver to analyse the event systematically, so that he/she can understand exactly what happened, can spot what has caused it, can go beyond his/her own knowledge to find the problem's root causes, and can develop effective corrective actions that – when they are implemented – will prevent the problems' recurrence or significantly reduce their likelihood);
- well documented (clear documentation of the system and techniques is essential for effective learning and consistent application);
- accompanied by effective user training followed by application of the techniques in the field, to learn and develop root cause analysis skills;
- credible with the workforce (it must stop the negative cycle of blame fixing and help the problem solver to develop effective corrective actions);
- helpful in presenting the results to management, so that management understands what needs to be fixed and the results convince management to take action; and

- designed to allow collection, comparison, and measurement of root cause trends.

4.5 CONCLUSION

The aim of this chapter was to enable a better understanding of some of the concepts and processes used in root cause analysis. The following is evident from the literature discussion in this chapter:

- One approach to root cause analysis is to focus on cause and effect relationships. Cause and effect relationships help organisations to identify patterns and to understand better the sequence of events and what has happened.

- Another approach to root cause analysis is to follow a systematic, structured process that focuses on data collection, information analysis, the identification of root causes and the implementation of solutions.

- The root cause analysis system that is used must be credible and well-documented. An effective root cause analysis process would identify root causes effectively and consistently and would control the causes in a way that would prevent them from recurring.

This was the last of three chapters that covered the literature that is central to this study. The next chapter discusses the type and nature of the study's research approach.

CHAPTER 5

RATIONALE FOR THE RESEARCH APPROACH

5.1 INTRODUCTION

According to Emory and Cooper (1991:139), a *research design* can be defined as the following:

- a plan for selecting the sources and types of information relevant to the research question;

- a framework for specifying the relationships between the study's variables; and

- a blueprint for outlining all the procedures, from the formulation of the hypotheses to the analysis of the data.

The type of research undertaken in this project is qualitative in nature and was developed from critical theory. Critical theory asks: "How can this situation be understood in order to change it?" Action research goes beyond this and goes into action by asking, "How can it be changed?" (McNiff & Whitehead, 2006:41). This chapter justifies action research as the selected research approach. According to Gabel (in De Jager, 2002:10), action research is "a model of inquiry and provides a practical framework for qualitative investigations".

The following aspects are discussed in this chapter, with specific reference to their use in this study:

- a qualitative research design;

- action research; and

- ethical issues relevant to the study.

5.2 QUALITATIVE RESEARCH DESIGN

There are two broad categories of research design, namely quantitative designs and qualitative designs.

Quantitative designs "use numbers and statistical methods" and tend "to be based on numerical measurements of specific aspects of phenomena; [they] abstract[ ] from particular instances to seek general descriptions or to test causal hypotheses; [they] seek[ ] measurements and analyses that are easily replicable by other researchers" (King, Keohane & Verba in Thomas, 2003:2).

Qualitative designs "seek explanations and predictions that will generalize to other persons and places" (Glesne & Peshkin in Thomas, 2003:2). According to Strauss and Corbin (1998), qualitative researchers clarify data by giving them meaning, translating them, or making them understandable. Qualitative research emphasizes the significance of social context for understanding the social world. It is ideal for complex phenomena about which there is little certain knowledge, such as this study. Qualitative methods are extremely useful for the examination of phenomena and to find out how to understand a phenomenon (Social Assessment, LLC, n.d.).

5.2.1 The nature of qualitative data

Qualitative research builds on a person's verbal skills and requires skilful interpretation of data in the form of words. The words are based on observation, interviews or documents and the data collection activities are typically carried out in close proximity to a local setting for a sustained period.

Qualitative data are usually not immediately accessible for analysis, but require some processing. The apparent simplicity of the data can mask a good deal of complexity and therefore requires a lot of care and self-awareness on the part of the researcher (Miles & Huberman, 1994:11-12). "Qualitative researchers are judged by how insightfully they

interpret the data and present their findings, and by how well the interpretation feeds their material" (Social Assessment, LLC, n.d.). This means that a researcher doing qualitative research adopts a special style and role of observation and measurement, and that also applies to me, as a researcher, in this study.

According to Miles and Huberman (1994:10), qualitative data share a number of features and strengths – they

- focus on naturally occurring, ordinary events in natural settings;
- are rich and have a strong potential for revealing complexity;
- are collected over a sustained period and are therefore powerful tools for studying any process and assessing causality;
- emphasize people's "lived experience" and are well suited to locating the meanings people attach to the events, processes and structures of their lives;
- are often the best strategy for discovering and exploring a new area and developing hypotheses;
- have strong potential for testing hypotheses; and
- are very useful to supplement, validate, explain, illuminate, or reinterpret quantitative data gathered from the same setting.

5.2.2 Qualitative data analysis

Miles and Huberman (1994:10-11) describe qualitative analysis as a continuous, iterative process that consists of the following concurrent flows of activity (see also Figure 5.1 on the next page):

- *data reduction*, which refers to the process of selecting, focusing, simplifying, abstracting and transforming the data;
- *data display*, which is an organised, compressed assembly of information that permits conclusions to be drawn and action; and
- *conclusion-drawing and verification*, which refers to the decision about what things mean and how the meanings that emerge from the data have to be tested for their validity.
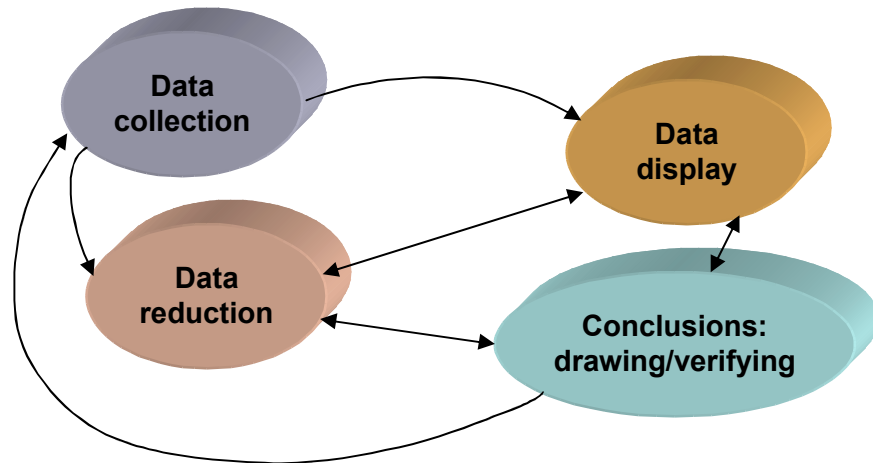
Figure 5.1 Components of qualitative analysis

Source: Miles and Huberman (1994:12)

The following analytical practices are generally used across different qualitative research methods (Miles & Huberman, 1994:9, *verbatim*):

- affixing codes to a set of field notes drawn from observations or interviews;
- noting reflections or other remarks in the margins;
- sorting and sifting through these materials to identify similar phrases, relationships between variables, patterns, themes, distinct differences between subgroups, and common sequences;
- isolating these patterns and processes, commonalities and differences, and taking them out to the field in the next wave of data collection;
- gradually elaborating a small set of generalizations that cover the consistencies discerned in the database; and
- confronting those generalizations with a formalized body of knowledge in the form of constructs or theories.

According to Miles and Huberman (1994:8-9), the following three approaches to qualitative data analysis are followed:

- *Interpretivism* sees human activity as "text" – as a collection of symbols expressing layers of meaning. This text is interpreted through deep understanding and empathy or "indwelling" with the

subject of one's inquiries. This approach leads to a practical understanding of meanings and actions. Qualitative researchers in semiotics, in deconstructivism, in aesthetic criticism, in ethnomethodology and in hermeneutics often pursue this line of inquiry (Miles and Huberman, 1994:8).

- *Social anthropology* focuses on the behavioural regularities in everyday situations, such as language use, artefacts, rituals and relationships. These regularities are expressed as patterns, language or rules and are meant to provide the inferential keys to the culture or society under study. Many social anthropologists are also concerned with the genesis or refinement of theory. They may begin with a conceptual framework and take the framework out to the field for testing, refinement, or qualification. Researchers in life history, grounded theory, ecological psychology, narrative studies, and in a wide range of applied studies often take this line of inquiry (Miles and Huberman, 1994:8).

- *Collaborative social research* undertakes collective action in a social setting and is also known as action research. The researchers design the outlines of a field experiment and once the data has been collated, it is given to the "activists", both as feedback and to craft the next stage of operations. In the case of collaborative action research, the researchers join closely with the participants from the outset, so that the social environment can be transformed through a process of critical inquiry. This approach is found in fields such as critical ethnography and action science (Miles and Huberman, 1994:8-9).

The purpose of this study is to develop a root cause analysis process for uncontrolled variations in human performance. This will contribute a new process to both root cause analysis and human performance management. For this reason, the study followed an action research approach.

5.3 ACTION RESEARCH

5.3.1 What is action research?

Action research has its academic roots in sociology, social psychology, psychology, organisational studies, and education (Web Center for Social Research Methods, n.d.). McKernan (1996:5) defines *action research* as a

> reflective process whereby in a given problem area, where one wishes to improve practice or personal understanding, inquiry is carried out by the practitioner – first, to clearly define the problem; secondly, to specify a plan of action – including the testing of hypotheses by application of action to the problem. Evaluation is then undertaken to monitor and establish the effectiveness of the action taken. Finally, participants reflect upon, explain developments, and communicate these results to the community of action researchers. Action research is systematic self-reflective scientific inquiry by practitioners to improve practice.

McKernan's definition is supported by Dicks (in De Jager, 2002:7), who states that action research tends to be

- *cyclical* (similar steps tend to occur in a similar sequence);
- *participative* (clients and informants are involved in the process as active partners);
- *qualitative* (it deals more with language than with numbers); and
- *reflective* (critical reflection on the process and outcomes are important parts of each cycle).

Most forms of action research use a cyclical or spiral process that alternates between action and critical reflection (see Figure 5.2 on the next page).
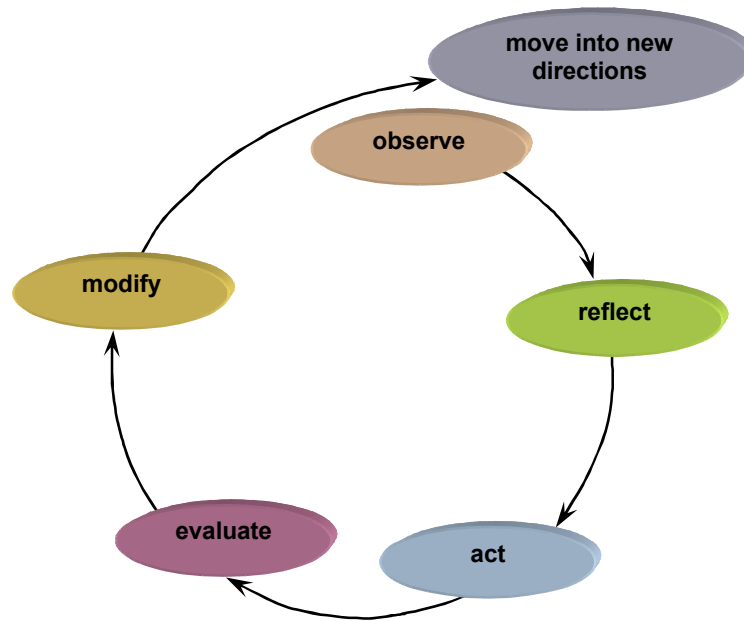
Figure 5.2 An action research cycle

Source: McNiff and Whitehead (2006:9)

In later cycles, the process alternates between data collection and interpretation in the light of the understanding developed in the earlier cycles. Such a study is therefore both an emergent and iterative process – it takes shape as understanding increases and converges towards a better understanding of what happens (Web Center for Social Research Methods, n.d.).

In summary, the following conclusions can be drawn about action research (De Jager, 2002:7): first, action research is about real-life action; second, it is about life-long research; and, third, it is a collaborative group activity and involves people with different perspectives.

5.3.2 The purpose of action research

All sound researchers share a number of features. According to McNiff and Whitehead (2006:22, *verbatim*), they

- identify a research issue;
- identify research aims;
- set out a research design (plan);
- gather data;
- estimate criteria and standards of judgement;
- generate evidence from the data;
- make a claim to knowledge;
- submit the claim to critique;
- explain the significance of the work;
- disseminate the findings; and
- link new knowledge to existing knowledge.

While all research generates new knowledge, action research generates a special kind of knowledge and is used to improve one's understanding; develop one's learning and influence others' learning (McNiff & Whitehead, 2006:13-14).

According to McNiff and Whitehead (2006:45), action research has two main purposes, namely, first, to contribute to new practices and, second, to contribute to new theory.

McNiff and Whitehead (2006:32) argue that the main social purposes of action research include that it aims to improve workplace practices by improving learning, to promote the ongoing democratic evaluation of learning and practices, and to create good social orders by influencing the education of social formations.

The purpose of action research is *not* to draw comparisons, show statistical correlations, or demonstrate a cause and effect relationship. These are addressed by social science instead.

5.3.3 Underpinning assumptions of action research

The following are the underpinning assumptions of action research (McNiff & Whitehead, 2006:23-32):

- *Ontological assumptions*
  - Action research is value-laden and ethically committed.
  - Action research aims to understand what I/we are doing.
  - Action research assumes that the researcher is in relation with everything else in the research field and influences, and is influenced by, others.
- *Epistemological assumptions*
  - The object of enquiry in action research is the "I" in relation to other "I's".
  - Knowledge is vague.
  - Knowledge is often subjective and unbiased and individuals have to negotiate these meanings with other knowing individuals.
- *Methodological assumptions*
  - Action research is participatory and collaborative – it takes place in social contexts and engages other people.
  - Action research begins with a concern and follows through a developmental process that shows cycles of action and reflection.
  - Action researchers aim to examine their practice with a view to improving it.

5.3.4 The action research process and plan

The steps in the action research process are the following (McNiff & Whitehead, 2006:91):

- Review the current practice.

- Identify an aspect that needs investigation.

- Visualize a way forward.

- Try it out.

- Take stock of what happens.

- Modify what is done in the light of what has been found and continue working in this new way.

- Monitor what is done.

- Review and evaluate the adapted action.

- Assess the validity of the account of learning.

- Improve practices in the light of the evaluation.

The above process can be transformed into the following series of questions, which can act as an action plan for action research (McNiff & Whitehead, 2006:192-195):

- *What is my concern?*

    This is a description of what the research is about and how the concern has led one to decide to research the issue.

- *Why am I concerned?*

    This is an explanation of how the situation could be seen as a realization of, or a denial of, one's values. It articulates the values that inspire one's work.

- *What kinds of experience can I describe to show why I am concerned?*

    This is a description of what the situation is like, what others are thinking and doing, and one's dissatisfaction with the current situation.

- *What can I do about it?*

    This is an explanation of how one thinks about the situation, how one thinks it can be addressed, and the ethical considerations of involving others and working in a social context where the proposed actions may have implications for others.

- *What will I do about it?*

  This is an explanation of the course of action to be taken, some of the practicalities involved, and how good ethical conduct is ensured.

- *What kind of data will I gather to show the situation as it unfolds?*

  This is a description of the situation as it develops, drawing on the data gathered. It describes what happened, why it happened, and what was achieved.

- *How will I explain my educational influences in learning?*

  This is a description of one's original value that inspired the work and how judgements about one's own influences are made.

- *How will I ensure that any conclusions I reach are reasonably fair and accurate?*

  This is an explanation of the procedures to be followed to test and critique the provisional conclusions at all steps of the research.

- *How will I evaluate the validity of the evidence-based account of my learning?*

  This is a description of the criteria and standards of judgement, as well as the significance for evaluating the validity of the account of learning.

- *How will I modify my concerns, ideas and practice in the light of my evaluations?*

  This is a description of how the research will lead to the development of new practices and new thinking (theorizing) and how the new practice will be tested to evaluate what is being done and how to improve it where necessary.

5.3.5 Gathering and interpreting the data

When looking for data during action research, one looks for episodes of practice that will produce evidence of one's own learning, as well as the learning of others (McNiff & Whitehead, 2006:137). The following questions need to be answered early in the process (McNiff & Whitehead, 2006:134):

- How will practice be monitored?

- How often will data be gathered?

- Which data gathering techniques will be used?

The following are some of the most common data-gathering techniques used during action research (McNiff & Whitehead, 2006:139-142):

- observation and data gathering techniques to observe and record one's own as well as other people's actions:
  o field notes;
  o record sheets and observation schedules; and
  o sociometric analysis; and

- observation and data gathering techniques to observe and record one's own as well as other people's learning:
  o written accounts;
  o personal logs and diaries;
  o questionnaires; and
  o surveys and interviews.

The frequency with which data are gathered depends on the overall length and intensity of the project. Data can be collected using documented practices, such as diaries, personal letters, policy statements, and agendas and minutes of meetings. Alternatively, data can also be gathered at the research site where researcher and participants meet. Situations such as role play, performance, artworks, or video-taping can be set up at the research site, so that people can explore their learning and find ways of articulating it (McNiff & Whitehead, 2006:143-144).

The purpose of gathering data is to generate evidence to support the researcher's claim to knowledge. Producing evidence involves analysing data and establishing the validity of a claim. Generating evidence is a rigorous process that involves the following (McNiff & Whitehead, 2006:148):

- making a claim to knowledge, by saying one knows something now that was not known before and adding it to the public body of knowledge;

- establishing criteria and standards of judgement;

- searching the data archive and selecting data; and

- generating evidence.

5.3.6 Testing validity

"Validity refers to establishing the truth value of a claim, its authenticity or trustworthiness" (McNiff & Whitehead, 2006:157).

To get other people to agree that a researcher's claim to validity is credible, he/she must put his/her findings into the public arena with an explicit articulation of the procedures that have been used to demonstrate the methodological rigour of the study, so that its validity can be tested against other people's critical assessment. If others agree, then the claim can be accepted as valid.

5.3.7 Establishing legitimacy

"Legitimacy refers to getting the account accepted in the public domain, by getting people to listen to you and take your work seriously, in the hope that they may be open to learning from it or trying out something similar for themselves" (McNiff & Whitehead, 2006:157).

To establish the legitimacy of a study and have its findings accepted in the public domain, a researcher should to be able to show the relevance and significance of the research project to others. People will listen if they can see how the ideas can enrich their own lives. The research project should produce new things that people can learn, which will feed back into new actions, which in turn will generate new learning. This is an ongoing process and others would want to see how they could do something similar in their own contexts.

Action research is significant if the researcher can generate and test the theory in relation to his/her own learning, the learning of others in workplaces and social situations, and the education of social formations (McNiff & Whitehead, 2006:233). "The education of social formations" refers to changes in the rules that regulate social organisations and move the social formation in the direction of values that carry hope for the future of humanity. This involves the learning process that people engage in when they decide to improve their collective capacity for generating theory to improve learning.

5.4   ETHICAL ISSUES

Sieber and House (in Miles & Huberman, 1994:289-290) suggest that the following core principles guide ethical choice:

- *beneficence* – this involves maximizing good outcomes for science, humanity in general and the individual research participants in particular, while avoiding or minimizing unnecessary harm, risk, or wrong;
- *respect* – this implies protecting the autonomy of (autonomous) persons, with courtesy and respect for individuals as persons, including those who are not autonomous; furthermore, understanding others' aims and interests, not being condescending;
- *justice* – this includes ensuring reasonable, non-exploitative and carefully considered procedures and their fair administration, and distributing costs and benefits fairly among persons and groups;
- *non-coercion and non-manipulation* – this means not using force or threats, or leading others to cooperate when it is against their interests;
- *support for democratic values and institutions* – this includes making a commitment to equality and liberty, working against oppression and subjugation.

Miles and Huberman (1994:290-295) suggest that the following series of issues typically need attention before, during, and after qualitative studies:

- *Worthiness of the project*

  Is the project worth doing? Will it contribute in some significant way to a domain broader than the researcher's funding, publication opportunities, and career? Is it congruent with the values important to the researcher? A researcher is likely to pursue a study that is only opportunistic, without larger significance or real meaning to the researcher, in a shallow way, devoting less care to the design and data collection.

- *Competence boundaries*

  Does the researcher have enough expertise to carry out a good quality study? Is the researcher prepared to be supervised, trained, consulted with? Is such help available? Unacknowledged incompetence is responsible for the following in qualitative studies: blissful ignorance on the part of the researcher, underdesign of the study, the accumulation of large amounts of poorly collected, unanalysed data, and superficial and hasty conclusion-drawing when deadlines loom.

- *Informed consent*

  Do the people who are being studied have full information about what the study will involve and do they give the consent to participate freely? Weak consent and ambiguity about later stages of analysis can lead to poor data and can be damaging to study quality and to the interests of the people in the case.

- *Benefits, costs, and reciprocity*

  What will each party to the study gain from having participated? What do they have to invest in time, energy, or money? Is the balance equitable? Study participants' concern about the inequity of benefits and costs can jeopardize access and lead to thin data.

- *Harm and risk*

  What might this study do to hurt the people involved? How likely is it that such harm will occur? If harm is expected, access and data quality may suffer. The prospect of immediately impending harm can put pressure on the researcher to revise or delete conclusions, or to self-censor them in advance.

- *Honesty and trust*

  What is the researcher's relationship with the people being studied? Do they trust each other? If people feel betrayed by the researcher when they read the report, they will reject it as a reasonable interpretation of what happened.

- *Privacy, confidentiality, and anonymity*

  In what ways will the study intrude, or come closer to people than they want? How will information be guarded? How identifiable are the individuals and organisations studied? Sieber (in Miles & Huberman, 1994:293) distinguishes the three terms in the following way:

  - *privacy* – "control over others' access to oneself and associated information; preservation of boundaries against giving protected information or receiving unwanted information (Miles & Huberman, 1994:293);

  - *confidentiality* – agreements with a person or organisation about what will be done with their data; this may include legal constraints; and

  - *anonymity* – lack of identifiers (information that would indicate which individuals or organisations provided which data).

  When privacy has been threatened, new analytical moves may be needed to protect data quality. Using member checks to verify or extend interpretations and conclusions helps with anonymity problems. Explicit confidentiality agreements about where raw data and analyses will be stored, and who will have access to them, can enhance data quality by increasing trust.

- *Intervention and advocacy*

  What does the researcher do when he/she sees harmful, illegal, or wrongful behaviour on the part of others during the study? Whose interests are being advocated? If the researcher decides to withhold "guilty knowledge" in favour of continued access, his/her public reports, conceptualization and explanatory theories may become lopsided.

- *Research integrity and quality*

  Is the study conducted carefully, thoughtfully and correctly in terms of some reasonable set of standards? If the researcher does not attend to the issue of goodness criteria in the study, he/she is on shaky intellectual ground.

Scientific rigour and trustworthiness, internal and external validity and social consequences are important quality factors in qualitative research (Social Assessment, LLC, n.d.).

- *Ownership of data and conclusions*

  Who owns the field notes and analyses, and once the reports have been written, who controls their diffusion? Freedom of scholarly inquiry, career advancement and recognition are strong values. Sources of funding should be disclosed. The researcher needs to be clear on the political context of his/her work. The broader use of audits can, for instance, be used to improve the quality of conclusions. However, researchers need to guard against agreeing too easily to others' veto efforts, or to altering important substantive aspects as a way of assuring publication or continued funding.

- *Use and misuse of results*

  Does the researcher have an obligation to help ensure that the findings are used appropriately? What if they are used harmfully or wrongly? From the start, the researcher needs to be as clear as possible about how committed he/she is to supporting the use of the findings. Such clarity encourages strong technical attention to how the material is used (for example, in producing reports), and focuses attention on the ethical issues.

Ethical considerations that are, more specifically, applicable in action research involve the following three aspects (McNiff & Whitehead, 2006:86-87): first, the researcher must negotiate and secure permission in writing to do the research; second, the researcher must protect the participants by not naming or identifying them in any way; and, third, the researcher must assure good faith at all times by always doing what he/she says that he/she is going to do.

Finally, Miles and Huberman (1994:296-297) offer the following advice about the ethical issues:

- *Awareness*

  Researchers should discuss their general ethical positions. Reasoning inductively from past situations in which the researcher felt uncertain about the right thing to do, or situations in which the researcher felt comfortable, can be helpful.

- *Anticipation*

  Most of the issues raised in this chapter can benefit from advance thinking during the early stage of project design. Running through the issues as a sort of checklist can help the researcher to avoid problems later.

- *Preliminary agreements*

  Researchers should contract with case participants early. These must be done explicitly during entry and access, and must be committed to paper.

- *Documentation and reflection*

  It is easy to become preoccupied with the demands of data collection and analysis and to miss latent, potentially painful ethical issues until it is too late. Some routinized structure can help to foreground mild worries that often prove to be a distant early warning of problems.

- *Third parties*

  Because ethical issues often tend to be masked by taken-for-granted assumptions, beliefs and values, involving a trusted third party can be very helpful. Such a person can raise issues that the researcher may have overlooked, suggest alternative viewpoints, help make tacit assumptions explicit, be an advocate for respondents, or serve as a mediator between respondents and researchers when there are unresolved problems.

- *Regular checking and renegotiation*

  The evolution of any qualitative study normally involves some twists and turns that no one expected. As a result, initial agreements and working procedures almost always need to be updated. It is therefore useful to create the expectation that agreements may need renegotiation from the start and to make it clear that "recheck" meetings can be called at any point by either the researcher or the respondents.

The ethical decisions and standards applied during this research are discussed in Chapter 6.

5.5 CONCLUSION

This chapter has argued for the selection of qualitative research, and more specifically action research, as the most suitable research approach for the research problem at hand. The following requirements qualified this study as an action research project:

- the research required a collaborative process that involved all the participants who tested the root cause analysis process;
- a better understanding of the problem and solution needed to be developed from the data that were collected during each round of testing;
- testing of the root cause analysis process needed to take place in participants' natural settings;
- interpreting participants' feedback required sorting and sifting through their comments to identify similar phrases, patterns, and themes;
- participants' feedback needed to be used to revisit the process for a next round of testing;
- the steps in the process were repeated till an adequate solution was identified and developed; and
- developing a process such as a root cause analysis process requires life-long research.

The next chapter explains the research methodology and the iterative, cyclical process that was followed to develop an adequate solution to the research problem, based on the rationale described in this chapter.

CHAPTER 6

RESEARCH METHODOLOGY AND METHODS USED

6.1   INTRODUCTION

This study was conducted to develop a root cause analysis process that will uncover the root cause(s) of uncontrolled variation in human performance and prevent the recurrence of events causing the variation. The purpose of this chapter is to explain and document the research methodology and testing strategy followed in this study. The following aspects are covered in this chapter:

- the research design;
- the research approach; and
- ensuring ethical conduct.

6.2   RESEARCH DESIGN

The type of research undertaken in this project was action research. Action research has been described as "an informal, qualitative, formative, subjective, interpretive, reflective and experiential model of inquiry" (MacIsaac, 1996). The primary intent of action research is to provide a framework for qualitative investigations (MacIsaac, 1996).

Action research was chosen as the best research method for this study because it is a cyclical, iterative process that is rigorous, responsive, flexible, and would contribute to the development of a root cause analysis process, as undertaken in this research project.

Table 6.1 (see next page) provides a summary of the characteristics of action research as applied in this study.

Table 6.1 Summary of the characteristics of action research applied in this study

Characteristics of action research	Application to this study
It is collaborative.	All the participants in this study contributed to the development of the root cause analysis process.
It compiles evidence.	The researcher collected and applied the evidence to gain a better understanding of the problem and the required solution.
It is ever-changing.	The root cause analysis process was continually updated to accommodate new information.
It allows critical analysis.	All the participants contributed to the development of the root cause analysis process through critical analysis and feedback.
It is cyclical / a self-reflective spiral.	This study took place over two and a half years of iterative and cyclical activities that eventually resulted in a root cause analysis process for variations in human performance.
It is experiential.	The process was tested against real-life situations and a case study.
It is flexible.	The flexible nature of this study provided for changes in the process to develop a better understanding of root cause analysis practices.
It is formative.	Changes were made continuously during the study and to the root cause analysis process that was being developed.
It can be informal.	The researcher, supervisors, facilitators, and participants all contributed to the solution.
It allows for keeping a record.	The researcher kept a record of activities, the feedback received and the changes that were made to the root cause analysis process.

Table 6.1 Summary of the characteristics of action research applied in this study (continued)

Characteristic of action research	Application to this study
It is participative.	The researcher and participants were involved as active participants in the research process to improve their own root cause analysis and performance management practices.
It encourages problem-solving.	All the participants gained problem-solving skills by testing the root cause analysis process.
It is qualitative.	Qualitative data collection methods, such as feedback and interviews, were used in this study.
It permits a reasoned justification.	Enough evidence was collected to validate judgements.
It starts small.	This study started by applying the root cause analysis process to only one person's performance variation.
It is not subjective.	Discussions between the researcher, facilitators and participants helped avoid subjectivity.
It encourages systematic learning.	This study was a systematic process during which people acted deliberately to bring about the changes.
It allows theorising.	This study was about the theory to change present root cause analysis practices in human performance management.

Source: Adapted from De Jager (2002:8-9)

6.3   RESEARCH PROCESS

The root cause analysis process that was initially developed was tried out, then modified time after time in the light of what was observed, or the feedback that was received. Thus, the protocol followed in this study was iterative or cyclical and was aimed at developing a deeper understanding of the problem and the required solution.
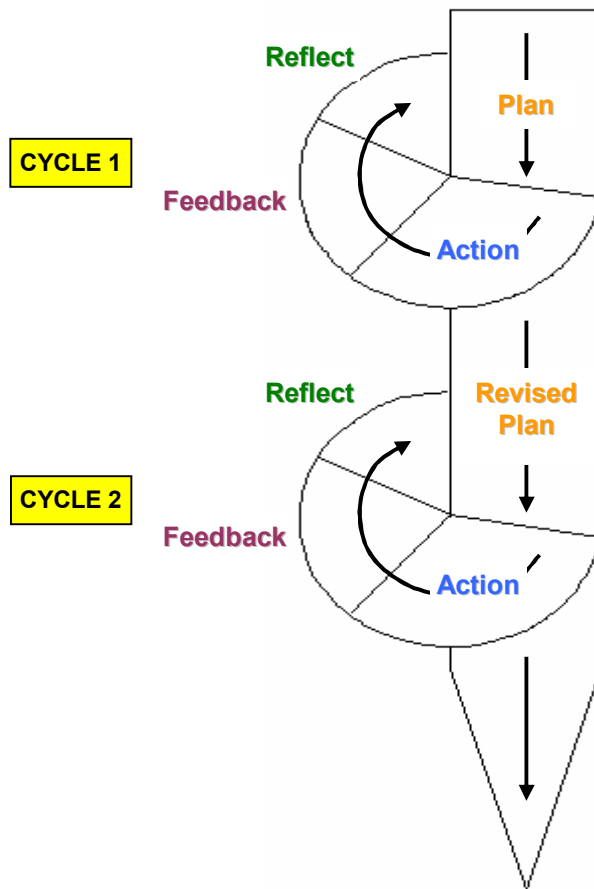
Figure 6.1 The iterative nature of the study

Source: Adapted from Hopkins in MacIsaac (1996)

Figure 6.1 displays the iterative nature of action research. The process consisted of the following steps:

- *realising a problem* – realising that some kind of improvement or change was needed to the cause analysis approach that is currently used in performance management;

- *planning* – developing a better understanding of the problem and planning for the intervention;
- *action* – carrying out the intervention;
- *feedback* – collecting pertinent feedback during and around the intervention; and
- *reflection and revision* – using reflection to develop a new intervention from the body of previous knowledge; and carrying out a new intervention, until a sufficient solution for the problem was achieved.

The above steps occurred in more or less the same sequence every time during the study. The realization of the problem led to planning and the planning was embedded in the action, feedback and reflection and revision. The steps repeated themselves until a sufficient solution to the problem that was initially identified had been developed, namely the development of a root cause analysis process for uncontrolled variations in human performance.

The action research process that was followed in this study is outlined in Figure 6.2 (see next page). There were three cycles, as discussed below.

6.3.1 Cycle 1

6.3.1.1 Identifying the initial problem

This study evolved from the shortcoming that currently exists in the field of human performance management. Most performance management models acknowledge that there is a need to identify the cause(s) of a performance gap by conducting a cause analysis. However, as indicated in Chapter 1, the cause analysis techniques and tools that are currently used are limited, have little or no logical structure, and do not allow for objective analysis. This situation is aggravated by the fact that people are so solution-oriented that, instead of first analysing the performance problem for causes, they jump straight into focusing on "solutions".

To address this shortcoming, the study aimed to develop a systematic root cause analysis process that would uncover, solve and prevent the root cause(s) of an uncontrolled variation in human performance. It also aimed to develop a human performance management model.
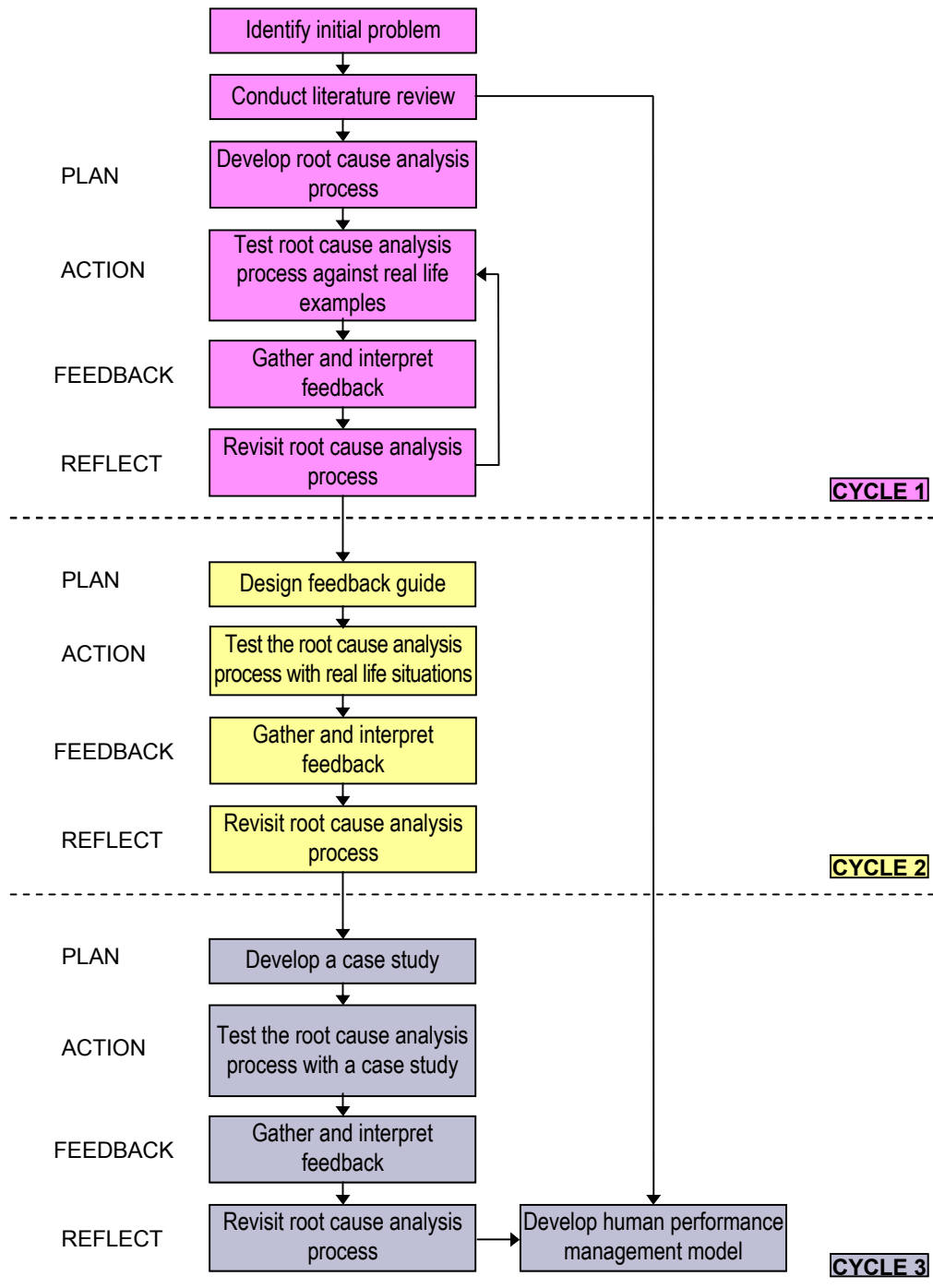
Figure 6.2 The action research process

128

6.3.1.2 Conducting the literature review

An extensive review was done of books, journals, conference papers, theses, dissertations and articles to achieve the following:

- gather important information and gain deeper insight into the fields of human performance management, improvement and root cause analysis in order to deepen the significance of this study;

- develop a sufficient knowledge base to develop a human performance management model and a root cause analysis process that would be suitable to identify uncontrolled variations in human performance;

- determine what is already known about human performance management and root cause analysis and how this study fits into the larger universe of these fields, to ensure that the results of this study will make a distinctive contribution; and

- become better acquainted with the design and methodologies of action research, to direct the study more efficiently and prevent potential problems that could lead to invalid findings and/or conclusions.

6.3.1.3 Developing the root cause analysis process

Developing a root cause analysis process that would be suitable for uncontrolled variations in human performance required, first, a good understanding of the different root cause analysis tools and techniques and, second, a thorough understanding of the different factors that affect human performance.

Previous studies, such as the ones mentioned in Chapter 2, showed that the list of factors that have an impact on human performance is almost endless. To make the list more manageable, and for the purposes of this study, the factors were clustered into the following main categories:

- information;

- resources;

- task performance;

- consequences;

- knowledge and skills;

- performer (of the task); and

- environment.

The first version of the root cause analysis process consisted of the following five steps:

Step 1: State the performance variation
The first step of the root cause analysis process (Version 1) focused on the performer, as well as the undesirable performance that required attention. The significance of the problem was also questioned in the first step.

Step 2: Define the problem
This step focused on data collection, to help understand the details of the problem. It was developed in the format of an "is-is not" matrix – an "is-is not" matrix clarifies what the problem is and is not about. This approach shows contrasts more clearly, helps identify issues that are definitely not related to the problem, and helps determine areas that need to be investigated more closely. *The "is-is not"* matrix *was the method of choice because it is one of the very few existing problem-solving techniques that establish an objective data point against which possible causes can be evaluated on paper first, before investing time and money to prove them in real life.*

This step of the process consisted of "is" and "is not" questions for each of the following dimensions: who, what, where, when, how, and to what extent.

Step 3: Identify causal factors

This step started with an activity flow diagram, so that it was possible to understand better what happened, how the task was performed, and what the task requirements were. In the second part of this step, the actual performance was compared to the standard for each of the following factors: information, resources, task performance, consequences, knowledge and skills, performer, and environment. When there is a variation in performance, it is rarely caused by a single factor and, therefore, the purpose of this step was to identify all the factors that were either missing or ineffective. Step 3 consisted of 59 process questions.

Step 4: Determine root cause

In this step, possible causes for the human performance variation were hypothesized. The main aim of this step was to select the best available theory of those available and to reject the possible causes that did not fit the evidence. In this way, wasting further effort and time on invalidated theories was avoided. The focus then shifted to the most plausible theory and to finding ways to check it in practice and double-check the information and assumptions that led to the conclusion.

Step 5: Develop corrective actions

The primary objective of Step 5 in the root cause analysis process (Version 1) was to develop an action plan that would correct the performance variation.

6.3.1.4 Testing the root cause analysis process

The development of a root cause analysis process evolved from continuous testing and refinement. The purposes of testing the root cause analysis process were

- to determine whether the process managed to uncover all the information required to solve the variation in performance;
- to determine whether there was a logical flow to the process;
- to identify any problem areas, so that they could be corrected; and
- to determine whether the process questions were easy to understand and interpret.

The first version of the root cause analysis process was tested by applying it during the following sessions:

- a one-on-one consultation with the manager of a sales consultant who was not growing the business through existing and new customers;
- a one-on-one consultation with a supervisor of a front-line employee who was tardy at doing certain jobs and following work procedures; and
- a case study about a repairman who was not following the company's sales lead programme.

In qualitative research, a researcher's objectivity is of the utmost importance. According to Glesne and Peshkin (in Thomas, 2003:2), care must be taken to prevent the researcher from "contaminating" the data through personal involvement with the research subjects. To avoid contamination of the data, the following guidelines were applied during the testing process:

- being open to the ideas and views of the people to whom the root cause analysis process was applied;
- trusting the root cause analysis process and not following a usual way of thinking and working; and
- not taking shortcuts, but rather putting energy and effort into the application.

Instead of referring to "objectivity", Lincoln and Guba (in Hoepfl, 1997:60) prefer to talk about the "confirmability" of the research. This refers to "the degree to which the researcher can demonstrate the neutrality of the research interpretations" (Lincoln and Guba in Hoepfl, 1997:60), by providing an audit trail. The following audit trail was kept from the above process applications, to comply with the requirements of confirmability:

- raw data;

- process notes;

- personal notes; and

- the preliminary development information.

6.3.1.5 Gathering and interpreting feedback

Based on observations and the feedback that was received, the following aspects worked well in the first version of the root cause analysis process:

- the process managed to make a clear distinction between what the problem is and is not;

- the process also indicated gaps in the information – standards often either did not exist, or had not been properly communicated or explained to the performer; and

- the process helped generate a list of possible causes and furthermore, helped reduce the list of possible causes to the few that were most plausible.

The following was learnt from the first round of testing and highlighted areas in the root cause analysis process that required more work:

- The first version of the root cause analysis process was simply too long. This was especially due to the 59 process questions in Step 3. It became evident that merely by building on to Step 2 of the process, a lot of the information in Step 3

would be covered; and Step 3 would then become superfluous.

- Step 1 in the process needed to be a specific statement of the performance variation, instead of a vague problem statement, such as "negativity". It is important to delve deeper, to uncover the expectation that lies behind the complaint.

- The information that enters the analysis must be realistic, true, and factual. Rumours and unchecked allegations are not good enough.

- The action(s) that makes up the solution must be realistic and must fit within the bounds of the true situation that exists. Ultimately, the solution must meet the test of reality, must be understood and agreed upon.

6.3.1.6 *Revisiting the root cause analysis process*

Based on the initial testing that had been done, the following changes were made to the root cause analysis process:

- Sharper, more specific questions were developed to move away from general problem statements, such as "negativity", to focus on the specific behaviour that was causing concern.

- The process was changed to allow for two possible approaches – the first was based on intuition and experience and required that possible causes be listed up-front, while the second approach was more fact-based and used differences and changes as the basis for developing possible causes.

- The dimensions in the "is-is not" matrix were reduced and now included only the following dimensions: who, what, where, when, and trend; these dimensions gave the most significant information during the root cause analysis. As a result, the number of process questions in Step 2 was reduced from 12 to six.

- Step 3 in the root cause analysis process was deleted. All the performance elements that were covered in Step 3 should surface through the search for differences and changes in the who, what, where and when dimensions.

As a result of the above changes, Version 2 of the root cause analysis process consisted of the following steps:

Step 1: Determine the performance gap

The performance gap represents the difference between the actual, observed performance and the authenticated expected performance. The purpose of the first step is to describe this difference (or gap) in performance in specific terms and to determine if the variance is significant and requires further attention and remedial action. Step 1 of the root cause analysis process (Version 2) consisted of the following sub-steps:

- Check the performance standard.
- Describe the actual performance.
- Establish the performance gap.
- Determine the significance of the performance gap.

Step 2: Analyse the performance variation

This step starts with looking for possible clues and using both the clues and experience to formulate possible causes for the performance variation. The step then gathers additional information about the problem, using the "is-is not" matrix. Each possible cause is then tested against each element in the "is-is not" matrix, to screen the possible causes and identify the most plausible one(s). Step 2 in the root cause analysis process (Version 2) consisted of the following sub-steps:

- List possible causes (intuitive approach).
- Define the performance variation.
- Test the possible causes.

- Confirm the most plausible cause.

Step 3: Plan corrective and protective action

This step focuses on the proper and realistic corrective and protective actions that would bring about the expected and observed performance within the desired and acceptable limits. Step 3 in the root cause analysis process (Version 2) consisted of the following sub-steps:

- Establish the root cause.
- Develop an action plan.

6.3.2 Cycle 2

6.3.2.1 Designing a feedback guide

The researcher developed a feedback guide (see Table 6.2) to gather specific feedback from participants after they had applied the root cause analysis process to their real life situations themselves.

The purposes of obtaining feedback from participants were
- to judge the goodness of the root cause analysis process;
- to identify problem areas that required further improvement;
- to evaluate the strengths and weaknesses of the root cause analysis process; and
- to determine the value of the root cause analysis process in practice.

The overall aim of the feedback was to develop a better quality root cause analysis process that would be suitable for analysing uncontrolled variations in human performance.

Table 6.2 The feedback guide

1.	Describe the performance gap that was analysed with the process.		
2.	Describe the outcome that was reached with the process.		
3.	What value did the process add to the above situation?		
4.	Did the process follow a logical flow? If not, please describe how the flow of the process can be improved.	YES	NO
5.	Were all the questions in the process clear (easy to understand)? If not, please list the specific question(s) and describe why it (they) was (were) difficult to understand.	YES	NO
6.	Were all the questions in the process specific enough to elicit the required response/information? If not, please list the specific question(s) and describe why it (they) caused confusion.	YES	NO
7.	Were there areas in the situation that were important, but not identified by the process? If so, please describe them in detail.	YES	NO
8.	What are the current strengths of the process?		
9.	What are the current weaknesses of the process?		
10.	How can the process be improved, or what can be added to the process to make it more effective?		
11.	In which situations would the process be most useful?		
12.	In which situations would the process be least useful?		
13.	Who in your organisation would benefit most from the process?		
14.	Other comments/suggestions:		

6.3.2.2 Testing the root cause analysis process

The root cause analysis process was tested by 29 students who were doing their master's degrees in Counselling Psychology at the Consortium Institute of Management and Business Analysis (CIMBA) in Asolo, Italy. CIMBA was founded in 1991 and offers undergraduate, graduate and executive programmes to local and international students.

Students tested the root cause analysis process by applying the process to their own situations. The support materials provided to the students included a worksheet, the process questions and the feedback sheet (see Table 6.2).

Mr Scott B. Newton, a Managing Partner at CIMBA Business Advisement srl., led the session and coached students during their applications. Mr Newton is a highly skilled and experienced consultant and has facilitated numerous root cause analysis sessions for clients globally.

The following are examples of the type of situations that the root cause analysis process was applied to – a performer who
- is late and/or absent from meetings;
- ignores emails, calls and messages and has not met with the supervisor for three weeks;
- does not complete the test in the allocated time;
- does not consistently interact socially;
- does not attend classes; and
- breaks the law by stealing.

6.3.2.3 Gathering and interpreting data

Feedback was obtained in the following formats:

- worksheets that were completed by the participants who applied the root cause analysis process to their own situations – reviewing the original worksheets to identify information gaps, or incorrect information, was a great way of identifying potential problem areas in the root cause analysis process; and

- numerous telephonic discussions with Mr Newton from CIMBA Business Advisement srl., who championed this testing phase.

The following is a summary of the areas in the root cause analysis process that required further improvement:

- People are generally not used to thinking in the direction of "is not" information. Therefore, the "is not" questions needed to be phrased very specifically to ensure a "tight" problem description against which the possible causes could be tested.

- It is more difficult to find the root cause if the human performance variation is caused by an underlying personal problem which nobody else is aware of.

- One should be wary not to fall into the trap of focusing on a symptom of the human performance variation, instead of the real problem.

- In most cases, the participants did not know what was causing the uncontrolled variation in the human performance and, therefore, they did not benefit much from the intuitive approach. It would have been more effective to follow the rational approach in these instances – to go straight into the identification of differences and changes and then to develop possible causes, using the information on differences and changes.

- The technique of "question to the void" (asking follow-up questions until all the details are exposed) in all process questions proved to be critical. Without it, an important "piece

of the puzzle" could easily be overlooked, which would leave the problem unsolved.

6.3.2.4 *Revisiting the root cause analysis process*

Based on the testing conducted by the 29 students, the following changes were made to the root cause analysis process:

- Process questions were tightened up to achieve the following:
  - process questions that are short, sharp and specific; and
  - more specific "is not" responses.
- Additional questions were added to some of the process steps, to achieve the following:
  - to provide the appraiser with a choice of questions; and
  - to make the root cause analysis process applicable to as many situations as possible.
- The five why's technique was added at an early stage of the process to ensure that the analysis focuses on the real performance issue at hand, instead of a symptom of the problem.
- New questions were added to determine the significance of the human performance variation.
- The intuitive approach, which required the participant to use his/her experience and "gut feel" to list possible causes early in the process, was removed. This was replaced with the search for discrepancies in each dimension of the "is-is not" matrix.
- "Question to the void" was added to the questions in the "is-is not" matrix.
- The question about trend in the "is-is not" matrix was deleted.
- A selection matrix was added to evaluate the possible solutions.

As a result of the above changes, Version 3 of the root cause analysis process consisted of the following steps:

Step 1: Identify the performance variation

The purpose of the first step was to determine the variation in performance, and whether the variation was significant and required further attention and remedial action. Step 1 of the root cause analysis process (Version 3) consisted of the following sub-steps:

- Recognize that a performance requirement is not met.
- Identify the performer.
- Check the performance standard.
- Describe the actual performance.
- Describe the variation in performance.
- Stair-step the problem (sharpen the problem by separating the cause and effect) to unveil the problem that lies behind the symptom.
- Determine the significance of the performance variation.

Step 2: Analyse the performance variation

In this step, additional information about the problem was gathered, using the "is-is not" matrix. The "is-is not" matrix focuses on the performer, the performer's behaviour, and where and when the variation in performance takes place. A comparison between "is" and "is not" information is made to search for differences, evidence of change, and/or any unusual features. This information is used as clues for the development of possible causes for the human performance variation. Each possible cause is tested against each element in the "is-is not" matrix, to screen the possible causes and identify the most plausible one(s). Step 2 in the root cause analysis process (Version 3) consisted of the following sub-steps:

- Describe the performance variation.

- List possible causes.
- Test the possible causes.
- Confirm the most plausible cause.

Step 3: Rectify the performance variation

This step focuses on the corrective and remedial actions that would bring the expected and observed performance into the desired and acceptable limits. Step 3 in the root cause analysis process (Version 3) consisted of the following sub-steps:

- Describe the confirmed cause.
- Establish the root cause.
- Develop a solution.

6.3.3 Cycle 3

6.3.3.1 Developing a case study

Yin (in Ramolefe, 2004:32) defines a *case study* is "an empirical inquiry that investigates contemporary phenomena within their real life context when the boundaries between phenomena and context are not clearly evident and in which multiple sources of evidence are used".

According to Emory and Cooper (1991:143), "a single, well-designed case study can provide a major challenge to a theory and provide a source of new hypotheses and constructs at the same time". In addition to this, Cohen and Manson (*verbatim*, in Blaxter, Hughes & Tight, 2001:73, cited by Ramolefe, 2004:32) have also outlined the following advantages of a case study:

- Case study data are drawn from people's experiences and practices and so are seen to be strong in reality.
- Case studies allow for generalization from a specific instance to a more general issue.

- Case studies allow the researcher to show the complexity of social life.

- Case studies can provide a data source from which further analysis can be made.

- Because case studies build on actual practices and experiences, they can be linked to action and their insight contributes to changing practice.

- Because the data contained in case studies are close to people's experiences, they can be more persuasive and more accessible.

The following disadvantages of case studies have, however, been highlighted by Denscombe (in Ramolefe, 2004:35):

- The point at which a case study approach is most vulnerable to criticism is in relation to the credibility of generalizations made from its findings.

- On the technical side, the boundaries of the case study can prove difficult to define in an absolute and clear-cut fashion.

- Negotiating access to case study settings can be a difficult and demanding task.

- It is hard for case study researchers to achieve their aim of investigating situations as the situations occur naturally without any effect from their presence.

- Case studies are often perceived as producing "soft" data and are accused of lacking the degree of rigour expected of social research.

For the purposes of this research study, a case study was sourced from Thinking Dimensions International (TDI). TDI was founded in 1998 and specializes in root cause analysis, decision-making, project management and innovation.

The case study that was selected describes a human performance problem that the organisation experienced, namely a high error rate on claims transactions, due to incorrect data input by one of its employees.

The purpose of choosing this case study was

- to present a human performance situation that provided the participants with an opportunity to apply the root cause analysis process;
- to place participants in the role of managers and give them the opportunity to apply the root cause analysis process to a human performance problem that they had probably not experienced in their own workplace;
- to test the reliability of the root cause analysis process (would the process lead different participants who had the same set of information to the same cause?); and
- to apply and evaluate the root cause analysis process, so that final changes could be made to the process based on the feedback received.

6.3.3.2 Testing the root cause analysis process

Five of the ten consultants at Thinking Dimensions Group (South Africa) Pty Ltd (TDG) volunteered to test the root cause analysis process by applying it to the selected case study. TDG was founded in 1986 and specializes in the following fields: root cause analysis, decision-making, project management, innovation, and Six Sigma.

Because the focus of qualitative research is on depth, the emphasis is rarely on the sheer number of participants. According to Patton (in Jones, 2002:4), "sample size depends on what you want to know, the purpose of the inquiry, what's at stake, what will be useful, what will have credibility, and what can

be done with available time and resources". Patton suggests (in Jones, 2002:4) that the researcher must establish a minimum sample size based upon the number of participants needed to provide "reasonable coverage of the phenomenon given the purpose of the study". Lincoln and Guba (in Jones, 2002:4) recommend sampling to the point of redundancy, stopping at the point at which no new information is being gained from participants.

Although five participants may seem like a relatively small sample size, the comments cited from Jones (2002), above, confirm that appropriate sample size has less to do with the actual numbers of participants and more to do with the quality and depth of information elicited through the research process. The five participants who volunteered had between five months and 25 years experience in the root cause analysis field. This represented a good range for the following purposes:

- determining whether the root cause analysis process would lead a novel as well as an experienced person to the root cause;
- obtaining an inexperienced person's feedback about the process's ease of use; and
- obtaining feedback from experienced as well as inexperienced root cause analysis practitioners.

The support materials that were provided to the participants included the case study, a worksheet, the process questions and the feedback sheet. The same feedback guide as that used in Cycle 2 was employed (see Table 6.2).

Participants completed the case study application individually and at their own pace. The completed worksheets and feedback sheets were submitted for analysis and interpretation via facsimile and email.

6.3.3.3 Gathering and interpreting feedback

Feedback was obtained in the following formats:

- a review of the worksheets that the participants who applied the root cause analysis process to the case study had completed – incorrect information or gaps in the information highlighted potential problem areas in the root cause analysis process;

- a review of the feedback sheets for themes and golden threads – this process helped make sense of the feedback and identified the areas in the root cause analysis process that needed further improvement; and

- informal discussions with the participants about their applications to obtain supplementary information about the root cause analysis process – open dialogue between the researcher and participants played an important role during this study, with all five participants contributing to the development of the best solution.

The findings of this testing phase were as follows:

- Although the five consultants applied the root cause analysis process independently, it led them all to exactly the same root cause, which provides sufficient proof of the process's reliability.

- The following is a summary of the areas in the root cause analysis process that required further improvement:
  - o The process does not allow for enough stakeholder involvement. This is a crucial element in any root cause analysis process, because it is very rare that any single person possesses all the information needed to solve a problem. Collaboration, especially with the performer, is

146

vital to solving a human performance problem successfully.

- o The first part of the process might be too long and was somewhat confusing to some participants.
- o The need for testing the possible causes (hypotheses) was questioned by some participants. The reason they gave was that people often know what is causing their behaviour and will share the information during a consultative process that establishes trust and openness.
- o Some participants, even though they are experienced root cause analysis consultants, found the latter part of the process somewhat difficult and required additional assistance in completing it.

6.3.3.4 Revisiting the root cause analysis process

Based on the testing conducted by the five consultants, the following changes were made to the root cause analysis process:

- The first part of the process was shortened and simplified.
- The root cause analysis process was split into two parts:
  - o *Part 1 is to be completed by the manager/supervisor prior to his/her discussion with the performer*.
    The purpose of this phase is
    - ~ to gain a better understanding of the performance variation;
    - ~ to develop a specific description of the performance variation;
    - ~ to consult the required stakeholders and other sources of information about the performance situation; and
    - ~ to prepare the manager/supervisor for his/her discussion with the performer.
  - o *Part 2 is to be completed jointly by the manager/ supervisor and the performer*.

147

The purpose of this phase is

~ to give the manager/supervisor and the performer an opportunity to share information, so that they can reach a shared understanding of the performance situation;

~ to create an environment of trust and openness, so that the manager/supervisor and the performer together can identify the contributing factors that might have been causing the performance variation;

~ to allow collaboration and cooperation, so that the manager/supervisor and the performer can reach consensus on the root cause(s); and

~ to assist the manager/supervisor and the performer in reaching agreement on the action plan that would remove the performance problem for good.

As a result of the above changes, the final version (Version 4) of the root cause analysis process consisted of the phases and steps set out in Figure 6.3.

Phase 1: Performance variation assessment
Step 1: Define the performance variation
Step 2: Describe the performance variation
Phase 2: Performance variation discussion
Step 1: Identify contributing factors
Step 2: Crystallize the most likely cause(s)
Step 3: Determine the root cause
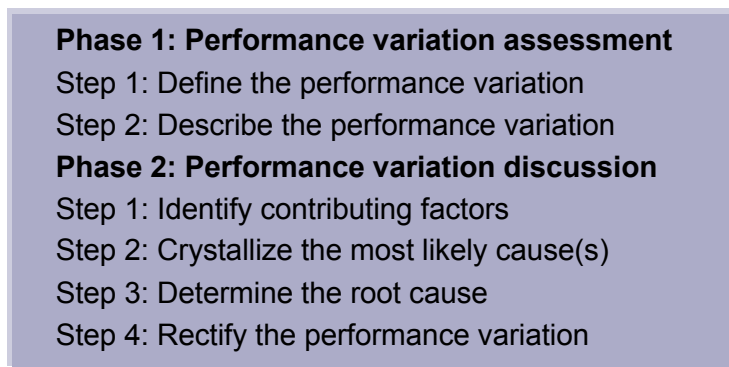Step 4: Rectify the performance variation

Figure 6.3 The root cause analysis phases and steps

Version 4 of the root cause analysis process is discussed in detail in Chapter 7.

6.3.3.5 *Developing a Human Performance Management Model*

As indicated in Chapter 2, the development of a Human Performance Management Model is not new. Many researchers have long focused on the development of an appropriate performance management model.

The root cause analysis tool developed as a result of this research is, however, different and new. It provides a systematic and analytical process to describe the gap between the desired and actual human performance, to identify factors that contribute to the human performance variation, to uncover root causes, and to select and implement interventions to fix the root causes. The ultimate aim of the root cause analysis process is to solve human performance problems at the employee level in order to achieve the desired organisational results.

The purpose of the Human Performance Management Model is to integrate the root cause analysis method and strategy into a holistic approach that will enhance employee performance and allow employees and management to participate actively in all stages of the human performance management process. The true value of the Human Performance Management Model lies in the fact that it becomes a management tool and also improves communication between the manager and employee. By using the model, managers can ensure that employees are pursuing the organisation's goals and are behaving in ways that are consistent with the organisation's vision statement.

The Human Performance Management Model was developed by means of an extensive review of books, journals, conference papers and articles. The following was achieved by means of the literature review:

- Deeper insight was gained into the fields of human performance management and human performance improvement.

- A knowledge base that was sufficient to develop a human performance management model was developed.

- Knowledge was gained about the human performance management models that already exist, to ensure that the model that is developed as a result of this study will make a distinctive contribution.

The Human Performance Management Model that was developed as a result of this study is discussed in detail, together with the final version of the root cause analysis process, in Chapter 7.

6.4 ENSURING ETHICAL CONDUCT

A consideration of ethics is fundamental to all research and it is the researcher's responsibility to ensure that his/her research is ethical. The following ethical standards were applied during the research:

- A sound research methodology was followed to ensure the advancement of knowledge.

- The appropriate confidentiality was maintained throughout the research, by ensuring that the participants and performers whose performance was evaluated remained anonymous.

- Objectivity was ensured by allowing participant involvement and participation at all stages of the research process.

- Participants who tested the root cause analysis process agreed voluntarily to be part of the study and understood the purposes of the research.

- Permission was obtained from CIMBA and TDG for their students/ employees to participate in the research.

- Trust and transparency was instilled between the researcher and participants, by allowing participants to do their applications independently and to complete their own worksheets.
- A project archive was kept of all feedback received to substantiate the research findings.
- Respect for individual differences was shown by giving all participants an equal opportunity to participate, give input and feedback.

6.5   CONCLUSION

This chapter outlined the research design, research approach, and ethical standards that were applied in this study.

The characteristics of action research are evident in this study. The study followed three iterative cycles of testing. After every cycle, there was a deeper understanding of the problem and the required solution. Based on this, the root cause analysis process was revisited before it was tested again. This process was repeated till an adequate solution was developed. All necessary consideration was given to ensure that the researcher's conduct was ethical throughout the research process.

In the next chapter, the final version of the root cause analysis process and the Human Performance Management Model are outlined and discussed in detail.

CHAPTER 7

RESEARCH RESULTS AND FINDINGS

7.1 INTRODUCTION

Previous chapters have outlined the research problem, literature review, research approach, and the methods that were used to gather, interpret and analyse the data. The elements and concepts that were derived from the literature review, together with the testing described in Chapter 6, were used to develop a root cause analysis process and human performance management model that would be suitable for analysing uncontrolled variations in human performance.

This chapter discusses the phases and steps of this root cause analysis process – the Human Performance Variation Analysis (HPVA) process. It also describes the Human Performance Management Model that was developed as a result of this study.

7.2 AN OVERVIEW OF THE HUMAN PERFORMANCE VARIATION ANALYSIS (HPVA) PROCESS

The HPVA process is a structured root cause analysis process that enables the systematic collection of the valid and reliable information that is required to solve an uncontrolled variation in human performance. In other words, the HPVA process provides a map for working through a human performance problem. It helps to gather all the relevant information that will lead to the root cause of the human performance variation, and ensures that all the relevant information is considered before reaching conclusions and taking corrective action.

Before applying the HPVA process, however, the situation should meet certain criteria, namely:

- the performance, job or situation under investigation must be critical;

- the human performance variation is likely to get worse if no action is taken;

- the level of performance that the performer is expected to achieve must be practical, achievable and realistic – if it is not, then the standard needs to be revisited;

- the supervisor/manager and performer must share the same understanding of the expected/required level of performance (the standard);

- the cause for the human performance variation must be unknown and be difficult to find; and

- the costs and benefits of solving the human performance variation must outweigh the costs and benefits of leaving it alone.

If the above criteria are met, then there is a strong likelihood that the organisation is facing a human performance problem that requires further and deeper analysis. In this case, the HPVA process can be applied to reveal the cause(s) of the uncontrolled variation in human performance.

Elements of different problem-solving tools and techniques were used to develop the HPVA process in this study, including the "is-is not" matrix, the five why's technique, and the matrix diagram. The HPVA process developed in this study consists of three parts and 11 steps, as depicted in Figure 7.1 (see next page).
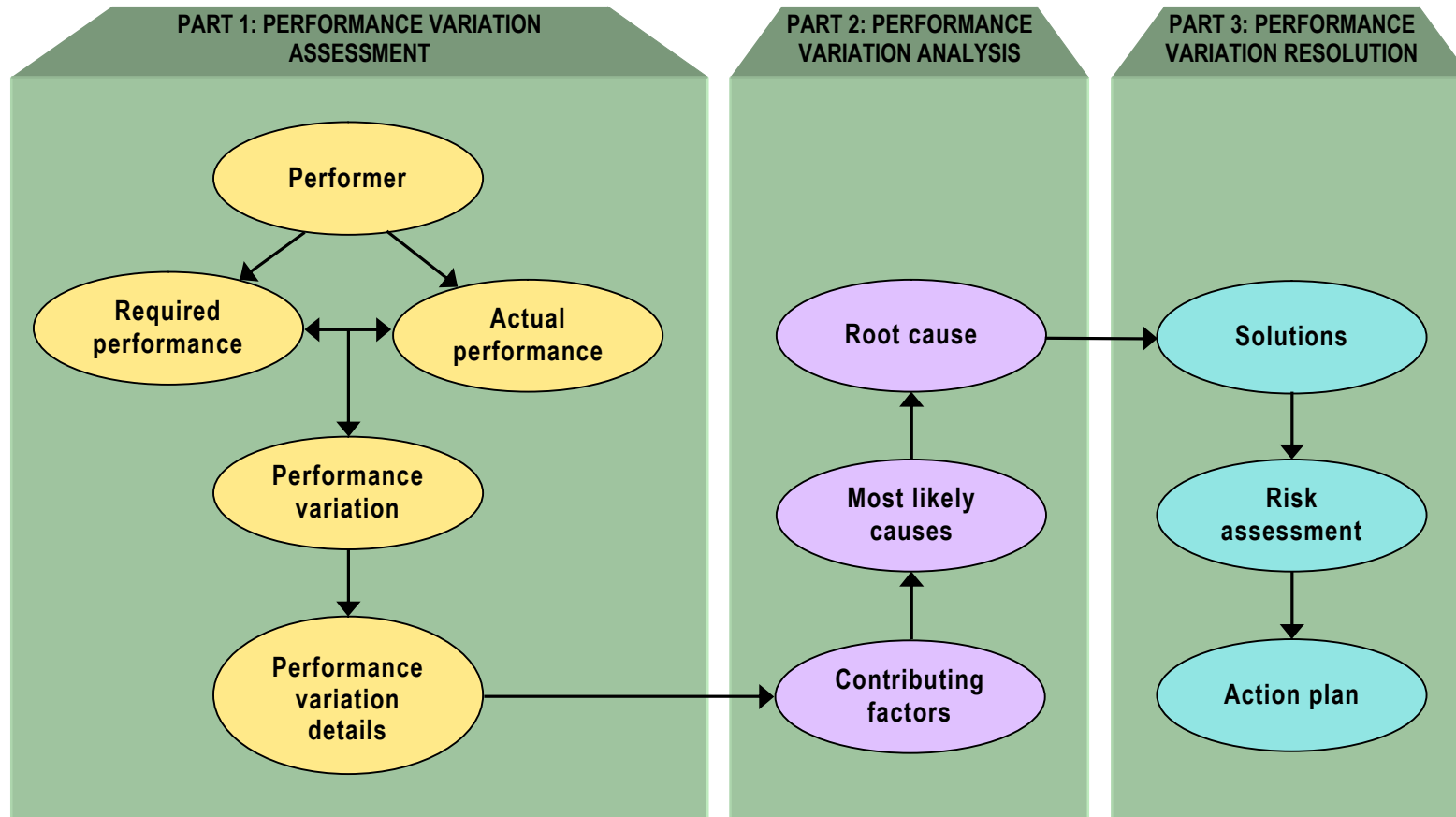
Figure 7.1 The Human Performance Variation Analysis (HPVA) process and steps

7.3 THE HUMAN PERFORMANCE VARIATION ANALYSIS (HPVA) PROCESS AND STEPS

7.3.1 Part 1: Performance variation assessment

The purpose of Part 1 of the HPVA process is to identify, and clearly and specifically define and describe, first, the person whose performance is to be analysed, and, second, the performance variation that needs to be analysed and solved. This ensures that everyone has a shared understanding of the situation and that the analysis is focused.

In Part 1 of the HPVA process, it is important, first, to ensure that adequate time is spent on this part of the process, because it will focus the analysis and will later be used to test possible causes against; and, second, to ensure that the information that is used in this part of the process has been obtained from reliable sources, is factual and has been verified.

Part 1 of the HPVA process consists of five steps, as already depicted in Figure 7.1.

Step 1: Identify the performer

Step 1 of the process is to identify the specific person, or persons, whose performance is of concern. Being specific in this step helps to ensure that one is dealing with a human performance problem and not with a technical, machine-related problem.

Different human performance problems have different causes and therefore one should ideally focus on a specific, single performer. However, when one does analyse the performance of a group, the group members should all be performing the exact same job or task and display exactly the same performance variation. If this is not the

155

case, or if one cannot verify this factually, then each person in the group's performance must be analysed separately.

> **How to do it:**
> Write down the name of the person whose performance concerns you.

Step 2: Describe the performance requirement

The performance requirement represents the performance standard and correct behaviour, as well as the performance goals and expectations regarding the performance output. The performance requirement provides a performance baseline or reference point. If one does not know what the desired behaviour and performance is, one is not able to determine whether or not the current level of performance is unusual and undesirable.

> **How to do it:**
> Write down what the expected/required level of performance is.

Step 3: Describe the actual performance

In this step, the actual performance must be described in terms of specific details. The purpose of this step is to gain more knowledge about the problem situation under review. One needs to make an extra effort to gather as much information about the performance variation as possible.

The most valid source of information in Step 3 is to *observe* the actual performance oneself. What has been observed must then be put into words as accurately as possible.

> **How to do it:**
> Describe exactly what the performer currently does (or not does), or how exactly is the performer currently performs the job/task.

Step 4: Describe the performance variation

To determine the performance variation, the authenticated performance requirement must be compared to the performer's actual performance. The performance variation is the discrepancy between the desired performance and what actually happens. If the discrepancy is undesirable for the specific job or performer, then the situation calls for further action.

The performance variation must not focus on a symptom of the problem, but must describe the real issue at hand – the problem that lies behind the symptom – in specific terms. A specific problem description – one that will sharpen the analysis – must meet the following criteria (Ammerman, 1997:10-11):

- it focuses on the gap between what is and what should be;
- it states the effect – what is wrong, not why it is wrong;
- it is measurable – for example, how often, how much, when – and avoids broad and ambiguous categories like "morale", "productivity", and "communication";
- it is stated in a positive manner and describes the "pain" or problem;
- it avoids "lack of" and "no" statements (these imply solutions);
- it highlights the significance of effects, and may state areas of discomfort, hurt, or annoyance, or how people are affected.

> **How to do it:**
> Compare the authenticated human performance requirement with the performer's actual performance and describe the human performance variation in specific terms.

Step 5: Describe the performance variation details

If no information about the performance variation is available, facts tend to be twisted to suit theories, instead of theories created to suit facts. The purpose of Step 5 is

- to ensure proper data collection about the human performance variation;

- to make the problem details visible to everyone concerned; and

- to ensure that there are no misunderstandings, but that there is a shared understanding about the problem situation instead.

This step focuses on facts about the human performance variation in question, stated in as straightforward and objective a manner as possible. What the observer sees is what he/she records. The problem description must be as free of error and uncertainty as possible. A good point to start with is to determine what is known "for sure", what the observer believes to be true, and what he/she does not know. Consulting the right people during this step will ensure that validated, factual information is recorded. The best sources of information are people who have first-hand knowledge about and experience of the particular job that is being analysed. When one is approaching other stakeholders or sources of information, the quality of the questions will determine the quality of the answers. Therefore, the questions to the various stakeholders should be kept sharp and concise, to ensure that they will add worthwhile information to the analysis.

To give an exact description of the problem situation, one needs to gather information by asking a series of specific questions. Questions are a key to identifying and describing the details that will lead the analyst to the cause of the human performance variation. In this step, questions are asked against the following dimensions:

- *the performer*, by name, whose performance is of concern;

- *the job or task* in which the undesired performance or behaviour is noticed;

- *the specific performance or behaviour* that does not meet the expectation;

- *the geographic location* in which the undesired performance or behaviour is seen or reported;

- *when in clock or calendar time* the performance variation occurred for the first time (knowing the time will help establish the relationship between the performance variation and other occurrences); and

- *the times or frequencies* at which the performance variation is noticed or reported.

The following types of information are recorded in an "is-is not" matrix for each of the above dimensions:

- information about what the human performance variation *is* (the information recorded must be factual; if the "is" information cannot be recorded for any of the above dimensions, it means that the details about the performance variation are incomplete; and in this instance, one needs to reach out to new sources of information that may potentially have the information that one still seeks); and

- information about what the human performance variation *is not* (this type of information indicates the boundaries or limits of the performance variation – these boundaries separate what the human performance variation *is* and what lies outside and *is not* part of the problem).

Generally, people are not used to asking "is not" questions. However, people soon see how these questions clarify the details about the human performance variation and how much more they can find out about the performance variation when they compare the "is" information to the "is not" information.

The information gathered during this step in the HPVA process is also used later during the process to test possible causes against. Testing possible causes on paper is much cheaper than verifying each possible cause in practice. Therefore, this step in the HPVA process also serves as a screening tool later in the analysis.

> **How to do it:**
> Record both "is" and "is not" information for each of the following dimensions:
> - the performer;
> - the job/task;
> - the specific performance or behaviour being analysed;
> - the geographic location;
> - the clock or calendar time; and
> - the times or frequencies.

7.3.2 Part 2: Performance Variation Analysis

Part 2 of the HPVA process has been designed to be completed jointly by the manager/supervisor and the performer. The aim is to get the most accurate information about why the human performance variation exists. It is difficult to solve a problem when people have a different understanding about the problem and its causes. Bear in mind that the person performing the job or task is the person most likely to know what is causing the variation in performance. Applying the HPVA process jointly, also, first, helps set a collaborative process in motion between the performer and the manager/supervisor; and, second, clarifies each person's role in addressing the performance variation.

The ultimate purpose of Part 2 of the HPVA process is to identify the root cause of the human performance variation. This part of the HPVA process consists of three steps (as already depicted in Figure 7.1, above).

Step 1: Identify contributing factors

Step 1 focuses on the factors that could have contributed or caused the performance variation. This step is designed to determine the following:

- Why is there a variation in this person's performance, but not in the performance of others who perform the same or similar jobs or tasks?

- Why is there a performance variation in this task or job of the performer, but not in other jobs or tasks that he/she performs?

- Why has this specific performance variation occurred?

- Why does the performance variation occur at this specific geographic location, but not at other places?

- Why did the performance variation occur for the first time at this time and date, but not at other times or other days when the same task/job was performed?

- Why does the performance variation occur at these times or frequencies, but not at other times or frequencies?

Answers to the above questions are obtained by focusing on, first, the discrepancies between the "is" and the "is not" information; and, second, changes that explain the discrepancies between the "is" and "is not" information.

As was noted in Chapter 2, the factors that affect human performance are numerous and diverse. Therefore, the aim of the first step of this phase is to list all the factors that are either missing or ineffective and that could have caused or contributed to the human performance variation. This step focuses on five categories of human performance factors, namely factors that pertain to

- *the performer*, for example, his/her skills, competency, capacity, motives and suitability for the job or task;

- *the job or task*, for example, the job design, the complexity of the job, workload, workflow, information, policies, procedures and supervision;

- *the performance itself*, for example, the job expectations, consequences and feedback;

- *the geographic location* where the job or task is performed, for example, the physical working conditions, resources, and job aids;

- *the date and time* at which the performance variation occurred for the first time; and

- *the times and frequency* at which the performance variation is noticed.

Both the experience and the intuition of the analyst become useful in this step of the HPVA process. It is important to keep on digging into the problem's details as long as new information or information that has previously been overlooked still remains to be discovered.

In some instances, it might even be necessary to involve more people or seek out ideas and additional information from other people who have special skills and knowledge and to incorporate this information into the analysis. One of the most valuable sources of information is the experience and opinion of those who are the closest to the scene of action. Never rule these people out; instead, encourage their input. They might provide merely an opinion, or something recalled and unconfirmed, but something that really happened. One needs to use everything one knows to understand what could have caused the human performance variation.

An analyst knows that he/she has reached the point of saturation when the same information is repeated and no new information about the performance problem surfaces.

How to do it:
- List everything that is special or unique of the "is" when compared to the "is not".
- Record all the changes that have taken place.
- List factors that were either missing or ineffective and that could have caused or contributed to the human performance variation:
  - performer: skills, competencies, capacity, motives, suitability;
  - job/task: job design, complexity, workload, workflow, information, policies, procedures, supervision;
  - specific performance or behaviour: expectations, consequences, feedback; and
  - geographic location: physical working conditions, resources, job aids.

Step 2: Crystallize the most likely causes

Usually, various factors come together to constitute a cause. Once all the factors that might have caused or contributed to the human performance variation have been identified, one can start to hypothesize possible causes for the performance variation. This is done by means of the following steps:

- Evaluate all the factors that were listed and identify the ones that have failed or were missing. Describe how each of the failing or missing factors was ineffective and why it was ineffective.

- Describe how each factor, or a combination of factors, could have caused the performance variation, or could have prevented the performer from performing to standard.

- Ask, "how could the performance variation have occurred?". Asking "how could", instead of "why" at this stage in the HPVA process ensures that possible causes are identified beyond the ones that are merely the most likely ones. According to Paradies and Unger (2000:36), humans have a negative emotional response to the question "why" if it is asked during a root cause analysis process.

The above process will result in a list of reasons which can be used separately, or in combination, to phrase specific statements or hypotheses that explain why the performance variation occurred.

163

> **How to do it:**
> Consider the list of contributing factors and list all the likely causes for the performance variation, or ones that prevent the performer from performing up to standard.

Step 3: Identify the root cause

This step in the HPVA process aims to achieve the following:

- eliminate apparent and presumptive cause statements that the performance variation details do not support;

- select the most plausible cause that requires further verification; and

- identify the root cause of the performance variation that requires corrective action.

Step 3 in the HPVA process requires the use of information and reasoning skills based on logic to support or eliminate possible causes. There are three stages to pass through before a possible cause can be confirmed to be the root cause of the performance variation:

- *Stage 1: Proving the cause on paper*
  Any possible cause is merely speculation, until it has been confirmed or proved. Proving the possible cause on paper first serves as a "screening tool" to screen out the "born losers", so that the organisation does not spend much time and money on them. Therefore, it reduces the time and cost that it would take to verify each cause statement in real life.

  Proof of a possible cause needs to be based on fact. In the HPVA process, each possible cause statement is checked against what is known about the performance variation, as recorded in the "is-is not" matrix. If a cause statement is true for the specific performance variation, then it must first account for all the performance variation details ("this explains that") for both the problem (the "is") and comparable ("is not") situations. Then it must make logical and

practical sense. In other words, a cause statement is proven if it explains all the performance variation details in the "is-is not" matrix, without exception and without many assumptions.

- *Stage 2: Confirming the cause in real life*
  A manager or supervisor who must resolve a performance problem carries a large responsibility for getting it right. Therefore, questioning his/her own conclusions and confirming it in real life is an essential step in the HPVA process.

  Having a likely explanation does not yet guarantee that it is the precise cause of the human performance variation. This can only be determined when evidence or hard data have been collected that confirm the likely cause in real life. This is done by conducting an independent experiment in which the cause produces exactly the same human performance variation that is of concern, or if independent evidence confirms the link between the cause and the effect.

  The truth is available and can be confirmed by gathering additional information from sources that have some knowledge of the situation; this usually involves people who are in a position to observe and see what is really happening. The aim with this step is to deliberately seek evidence to prove that the supposed cause for the human performance variation is the correct one.

  The method of confirmation depends on the nature of the cause. The following are examples of methods of confirmation:
  o Gather all relevant evidence or hard data that would confirm the possible cause as fact.
  o Check and verify all assumptions that have been made.
  o In certain situations, implement corrective action(s) on a trial basis, provided that it is practical and inexpensive to do so.

- *Stage 3: Determining the root cause*

Knowing *what* has happened and being able to prove and confirm it is essential in preventing the cause from recurring. However, knowing *why* it has happened is also a vital part of managing human performance in future.

The basic principle of cause and effect is that every action has at least one conditional cause that existed in time before the action set in motion a chain of events that caused the undesirable effect (see Figure 4.1). Therefore, the aim of this stage is to identify the conditional cause(s) that existed in time when the performance variation occurred. The conditional cause(s) is the true root cause(s) for the performance variation. Therefore, the only way to prevent a recurrence of the same human performance variation due to the same root cause(s) is to address the conditional cause(s).

W. Edward Deming (cited in Paradies & Unger, 2000:6) said that "[m]anagement's job is to improve the system". Improving the system is the key to improving performance. This includes improving equipment, procedures, tools, communication techniques, training, human factors design, supervisory techniques, resources, policies, rules and anything else that may have an impact on people's ability to achieve their goals.

At this stage, the HPVA process switches from determining "how could" to "what happened". The focus changes to discovering why the performer behaved in the manner that he/she did. To find the root cause for the human performance variation, one needs to understand the reason for the performer's behaviour.

The following criteria help to establish whether or not the identified cause is the true root cause (Ammerman, 1997:68-69):
  o the human performance variation would not have occurred if the root cause had not been present;

166

- o the human performance variation will not recur due to the same causal factor if the root cause is corrected or eliminated; and

- o correction or elimination of the root cause will prevent recurrence of similar conditions.

> **How to do it:**
> - Prove the cause on paper by checking it against the "is" and "is not" information.
> - Gather additional information to prove the most plausible cause in real life.
> - Determine what has caused the cause, or why the event happened.

7.3.3 Part 3: Performance variation resolution

Like Part 2 of the HPVA process, Part 3 of the HPVA process was designed to be completed jointly by the responding manager/supervisor and the performer. Involving the performer in this part of the process is important, because he/she is the person who will be responsible for implementing the solution and making it successful. The advantage of making the performer responsible is that he/she knows the situation the best and knows what the solution entails; and he/she is the person who will work with the solution and be responsible for its implementation. Management would, however, need to take responsibility for any corrective actions that are related to management issues.

The aim of Part 3 of the HPVA process is to develop an action plan that would rectify the human performance variation and set things right again. This part of the HPVA process consists of the following three steps, as depicted in Figure 7.1 (above):

Step 1: Select the most workable solution

"The only difference between a problem and a solution is that people understand the solution" (Kettering, cited in Paradies & Unger, 2000:281).

The purpose of the first step in Part 3 of the HPVA process is to identify all the corrective actions required to prevent the human performance variation from recurring, or greatly reduce the probability that the human performance variation will recur due to the same root cause. Corrective actions are the countermeasures taken against the root or contributing causes (Ammerman, 1997:71).

The goal is, first, to draw on the experience, knowledge and judgement of the best information sources to create a pool of ideas, and, second, to select the best actions from the possibilities available that would correct the causes that created the specific human performance variation. The following requirements need to be considered when selecting actions:

- The action must add value – it must prevent the human performance variation from recurring, by eliminating or reducing the root cause.
- It must be viable to implement the action with current or readily obtainable resources – consider the time, costs and resources that the action will require for successful implementation and its continued effectiveness. The action must be less expensive than allowing the performance problem to continue.
- The organisation must be capable of implementing the action; and the action must be compatible with its other commitments.
- The action must be acceptable to others in the organisation; and it must be free, or relatively free, from negative effects on other areas and people in the organisation.

Finally, when selecting a solution, one must put oneself in the performer's position and ask oneself whether the proposed action steps are realistic in view of the performance situation.

> **How to do it:**
> - List all the possible solutions that will address the root cause of the performance variation.
> - Evaluate each possible solution for the following:
>   - cost;
>   - value-adding;
>   - ease of implementation; and
>   - level of acceptability.
> - List all the actions that will – individually or collectively – meet the above criteria the best and will correct the performance variation.
> - List all the actions that will – individually or collectively – prevent the cause(s) from recurring.

Step 2: Do a risk assessment

The initial action plan that contains the corrective actions needs to go through a process of inspection and improvement before it can be considered adequate. The aim of Step 2 is to ensure that the implementation of the action plan is practical, by anticipating and avoiding or minimizing any adverse effects, risks or negative consequences as a result of the corrective actions to be taken.

The following sequence is followed in this step of the HPVA process:

- Examine the the plan, as well as other areas and activities in the organisation and the external environment and anticipate any potential risks that may result from the corrective actions.

- Identify ways to prevent these risks.

- Examine the the plan, as well as other areas and activities in the organisation and the external environment, and anticipate potential negative side effects that may result from the corrective actions.

- Identify ways to minimize these potential negative side effects if they do occur.

- Reach agreement on the most effective and viable preventive and contingent actions.

- Update the action plan by incorporating the selected preventive and contingent actions.

> **How to do it:**
> - Consider any potential negative side effects or risks as a result of the action steps.
> - List any actions that would avoid or minimize these potential negative side effects or risks.

Step 3: Finalize the action plan

The final action plan must be practical, workable and realistic and must include the following:

- cost-effective actions that will correct the conditional causes and will prevent the performance problem from recurring, or greatly reduce the probability that the human performance variation will recur due to the same root cause;

- cost-effective actions that will avoid or minimize any adverse effects, risks or negative consequences as a result of the corrective actions;

- the sequence of events that must be carried out;

- the name of the responsible person that is accountable for each action;

- information on when each action needs to be implemented; and

- a list of the costs involved in implementing the plan (optional).

It is important also to decide the following before finalizing and implementing the action plan:

- Consider ways to simplify and streamline the plan and to avoid any potential misunderstanding.

- Decide who will monitor and how the results and effectiveness of the action plan will be monitored.

- Decide who will give feedback and communicate the results of the action plan to those who are affected by the performance problem, as well as those who are involved in the implementation of the plan.

- If the action plan will affect others in the organisation or management issues, determine what management participation and approval are necessary prior to implementing the plan.

> **How to do it:**
> Complete the action plan by adding the following:
> - the name of the person responsible for each action step;
> - details about by when each action step must be completed; and
> - the name of the person responsible for monitoring the plan and giving feedback.

7.4   INTRODUCING THE HPVA PROCESS INTO THE ORGANISATION

The HPVA process can be a great tool, but like many other things, it is not likely to succeed without the necessary support. The following sequence is suggested, on the basis of experience of the researcher, to introduce the HPVA process into the organisation:

- Start with a pilot to demonstrate the value of the HPVA process. This requires at least one motivated manager who "buys into" the process, learns about and applies the HPVA process to a human performance problem where the implementation of the process would produce rapid improvements.
- Publicize the successes that have been achieved with the HPVA process.
- Spread the process throughout the organisation and train other managers and supervisors to apply the HPVA process successfully.
- Finally, incorporate the HPVA process into the organisation's policies, procedures and systems to ensure that the process is used.

Based on the findings in this study, the following elements are regarded as important to ensure that the HPVA process is successfully introduced into the organisation:

- Top management must give its consent and show its support for the HPVA process.

- Top management must attend an overview session of the HPVA process, to show everyone in the organisation that management has also learned the process and endorses it.

- Top management must outline its expectations and the purpose of the HPVA process in the organisation.

- Top management must help advocate the benefits of the HPVA process to everyone in the organisation.

- Top management must communicate the implementation process and outline how management will assist to ensure that the objectives are achieved.

- Policies, procedures and systems must be updated to include the HPVA process.

- Everyone in the organisation must be trained in the HPVA process and must have a thorough understanding of the requirements for success.

- Human Resources practitioners must support and drive the implementation process and must remove any potential obstacles.

- Human Resources practitioners must provide training to ensure that all managers and supervisors are able to apply the HPVA process.

- Human Resources practitioners must ensure that all support structures are in place and are working as they should.

- Human Resources practitioners must ensure that the HPVA process is conducted fairly and consistently throughout the entire organisation.

It is clear from the above information that the HPVA process is a joint effort and needs an integrative mindset. Management, Human Resources practitioners and employees must all work in partnership to ensure that the HPVA is successfully introduced into the organisation.

7.5 THE HUMAN PERFORMANCE MANAGEMENT MODEL

The primary purpose of the HPVA process is to get human performance back on standard after uncontrolled variation in performance has been noticed. However, to make real progress and optimize the HPVA process's full potential, one not only needs to address individual incidents of uncontrolled variations, but also continually needs to manage the situation to detect and address any occurrence (or recurrence) of a human performance variation. To achieve this and manage human performance effectively, the HPVA process must form part of a human performance management model. The HPVA should not be viewed as just another intervention; instead, the link between the HPVA and human performance management must be understood.

To incorporate the HPVA process into a human performance management model successfully requires the following within the organisation:

- *Senior management* needs to commit itself to the human performance management process and give managers/supervisors the support they need.
- *Managers/supervisors* must accept the responsibility, first, to manage human performance in their own departments on an ongoing basis, and, second, to ensure that the human performance management process maintains its momentum.
- *Adequate resources* must be devoted to and be available during the human performance management process.
- *Everybody involved* in the HPVA process must be *trained* on the process and other skills to ensure success and consistency.
- *Policies and guiding procedures* that will ensure consistency in the manner in which the human performance management model is applied must be developed and instituted.
- *A database* is needed to capture, first, organisational learning and, second, information about human performance management to enable reporting and trending.

The human performance management model developed in this study consists of the following ten steps:

- *Step 1:   List all uncontrolled human performance problems.*
- *Step 2:   Identify significant/priority problems.*
- *Step 3:   Check the standard.*
- *Step 4:   Determine whether the cause is known.*
- *Step 5:   Apply the HPVA process (three phases and eleven steps).*
- *Step 6:   Implement the solution.*
- *Step 7:   Evaluate the results.*
- *Step 8:   Monitor and sustain the improvement.*
- *Step 9:   Capture organisational learning.*
- *Step 10: Extend the solution into the future.*

These ten steps are discussed in more detail below, and they are also depicted in the researcher's diagram in Figure 7.2 (next page).

7.5.1 List all uncontrolled human performance problems

The expected level of performance is usually measured in terms of business objectives, such as quality, quantity, time, cost and customer satisfaction. A performance problem occurs when there is a negative deviation from the expected level of performance.

In the first step of the model, all human performance problems due to uncontrolled variations are identified and listed by defining the performer and the human performance variation.
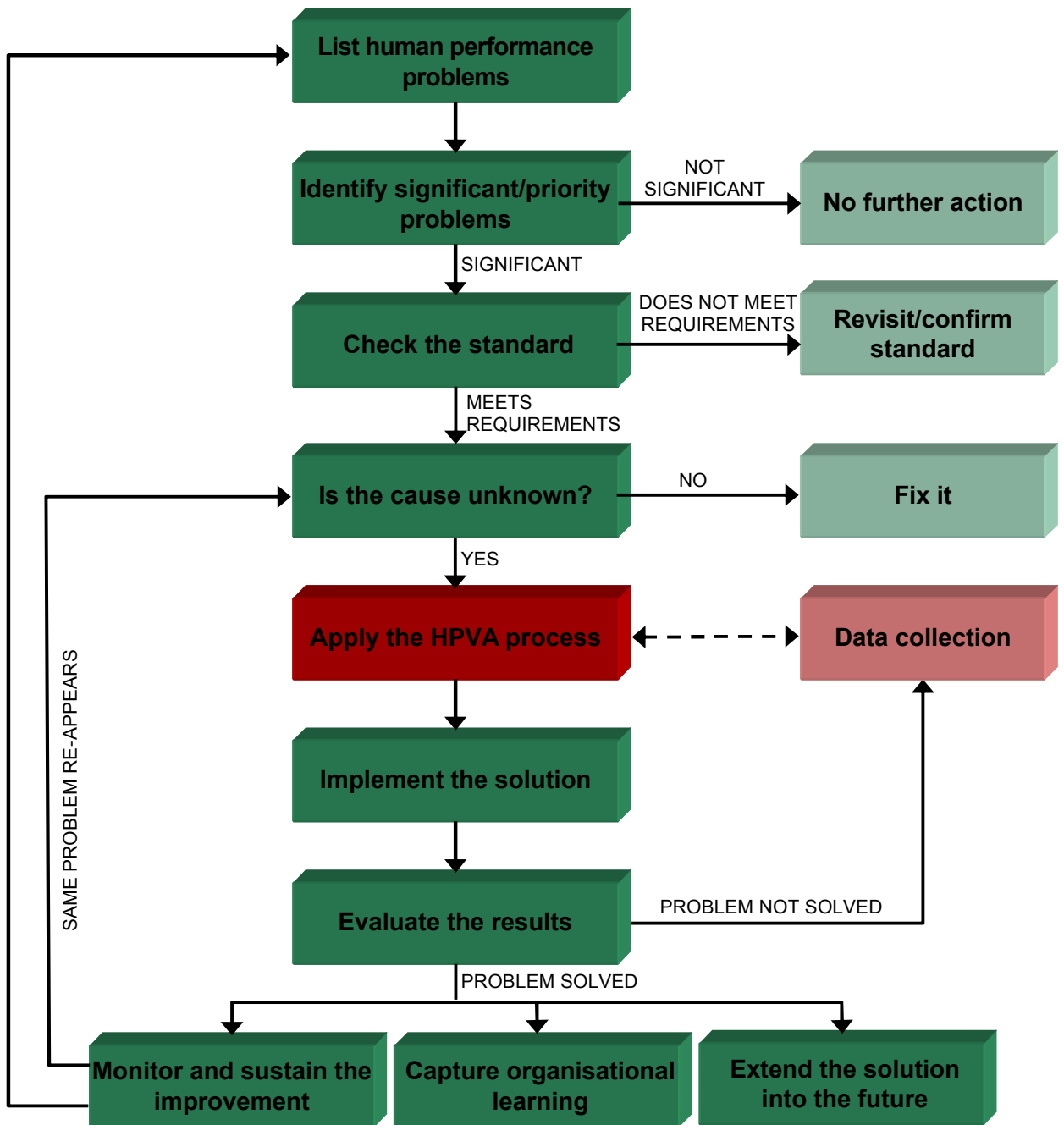
Figure 7.2 The Human Performance Management Model

7.5.2 Identify significant/priority problems

Step 2 is a screening process used to distinguish between significant problems and the less significant ones, or the ones that are likely to go away by themselves given time. The following criteria help determine how significant a human performance problem is:

- How often does the performance problem occur?
- What is (are) the impact, result(s) or consequence(s) of the human performance problem?
- Will the human performance problem get worse, if it is left alone? It is important to note that even though the problem might be small now, it may grow into a large problem as conditions change.
- Do the costs and benefits of solving the human performance problem outweigh the benefits of leaving it alone?

Human performance problems that have little significance, or a low priority, should not be the focus of the organisation's attention, efforts and resources.

7.5.3 Check the standard

The standard usually represents the output level of an average but experienced performer. It therefore serves as a benchmark of the output. Human performance problems may often be solved simply by establishing, communicating or updating the standard. Therefore, the following needs to be checked in terms of the standard:

- Has the standard been clearly stated and communicated?
- Do the manager/supervisor and performer have a shared understanding of the standard?
- Is the standard practical, measurable, achievable and realistic?
- Has the standard been updated according to changing work methods and/or conditions?

If any of the above questions receive a "no" response, then the standard needs to be revisited or reconfirmed before continuing with the process as outlined by the Human Performance Management Model. As stated before, correcting the standard may in itself solve the human performance problem.

7.5.4 Determine whether the cause is known

It is important that a human performance problem is addressed systematically by applying the HPVA process to ensure that the root cause is found and the performance problem is corrected. However, it is not productive to apply the HPVA process to a problem of which the cause is already *factually* known. If this is the case, one should not fall in the "analysis paralysis" trap, but should rather just implement what is necessary to fix the problem. A word of caution though – the cause must be *factually* true. If it is not, it would be worth analysing the human performance problem by applying the HPVA process.

7.5.5 Apply the Human Performance Variation Analysis (HPVA) process

The main aim of the HPVA process is to find the root cause for the human performance variation. The HPVA process with its phases and steps has been discussed in detail earlier in this chapter. Cognisance should, however, be taken of the following **guidelines** when applying the HPVA process:

- The manager/supervisor must be comfortable with the HPVA process as an approach to analyse uncontrolled variations in human performance.
- The manager/supervisor must not try to take shortcuts in an attempt to speed up the HPVA process.
- The manager/supervisor must search for facts vigorously and must under no circumstances settle for or accept hearsay as fact.
- The manager/supervisor must be disciplined and willing to spend the necessary time to gather all information that is required by the HPVA process.

In addition to the above guidelines, Mager and Pipe (1997:166-168) also offer the following **general guidelines** to those who conduct any type of cause analysis:

- *Control your face and words*, especially if your understanding of the situation allows you to see solutions invisible to the performer.

- *Expect and look for hidden agendas*. Keep asking questions and observing until you are confident that you have learned how things are and why they are the way they are.

- *Respect the person whose performance you are analysing*. There are reasons why things are being done the way they are and, therefore, the performer may not take kindly to an implication that his/her way is not the best way or to the thought that for years he/she has been doing things wrong.

- *Respect the performer's values*. People are not necessarily wrong because their values, habits and practices differ from yours. Your purpose is to solve a specific performance problem, not to solve all the problems.

- *Allow the performer to save face*. Do not offer solutions until you have walked through the analysis with the performer and understand the environment in which the problem lives.

- *Allow the performer to solve the problem;* then you do not have to "sell" the solution or work as hard to get it implemented. By doing the analysis aloud, asking questions and reflecting answers, the performer might be able to make the connection between the problem and solution him/herself.

The application of the HPVA process and data collection go hand-in-hand. Data can be obtained either through the organisation's data system, or alternatively, by conducting interviews with people that are closest to the work. Other data collection methods include live observations, simulated demonstrations and document reviews.

In the HPVA process, as mentioned previously in this chapter, data are collected around the following elements:

- the *performer;*

- the *job/task* in which the undesired performance or behaviour is noticed;

- the *performance event* that does not meet the expectation;

- the *geographic location* in which the undesired performance or behaviour is seen or reported; and

- the *time and frequency* when the performance variation occurs.

7.5.6 Implement the solution

The purpose of this step in the Human Performance Management Model is to implement the corrective actions in a way that would solve the human performance variation. An implementation plan should – at least – include the following elements:

- *the corrective actions* as identified during the HPVA application that need to be implemented;

- *the name of the person* who is responsible for carrying out each activity, as well as that of the person who will be monitoring the progress of each activity; and

- *a schedule* of when each activity must be carried out.

Always involve the performer in the implementation plan and ensure that the performer has given his/her full support and is committed to the plan.

If the implementation plan is going to require a change, then acceptance of the suggested changes and a favourable climate for its implementation are important. To minimize any form of resistance, as much information as possible needs to be communicated to everyone who might be affected or who might present any obstacles to an effective implementation.

Finally, regular feedback must be provided to the performer about the results of the implementation and whether the targets are achieved. If

the targets are not being achieved, then the implementation plan needs to be adapted by incorporating additional interventions.

7.5.7 Evaluate the results

Once the corrective actions have been implemented, their results need to be evaluated continually. Evaluation is important for the following reasons:

- to determine if the corrective actions are effective;
- to determine if the performance problem has been rectified;
- to determine if the solution meets its objectives;
- to show that the investment has added value; and
- to give feedback on the effectiveness and success of the action plan.

Evaluation can occur at any time during the implementation process and with any frequency. The effectiveness of the corrective actions can be evaluated in any of the following ways:

- Measure the outcomes achieved.
- Verify with stakeholders whether the desired results have been achieved.
- Create a tracking system whereby the human performance output can be measured.
- Compare the performer's performance to that of an exemplar.
- Draw a trend line that compares the performance before the corrective actions were implemented to the performance afterwards.

Stakeholders of the evaluation process include all those who have been affected by the human performance variation and the implementation of the action plan. Different stakeholders would be interested in different elements of the evaluation process and therefore it is important to develop a sound and rigorous data collection plan that integrates the data into the objectives that have been set.

If the evaluation process proves that the corrective actions have not been successful, then one needs to go back to the HPVA application and search for new, additional information that might have been overlooked previously. If the problem cannot be solved with the existing information, then it means that a piece of the puzzle remains missing. In such a case, the manager/supervisor needs to reach out to new sources of information and keep on searching for new facts about the human performance variation.

7.5.8   Monitor and sustain the improvement

If the corrective actions prove to be successful, then the new, improved performance level needs to be monitored and sustained. If not, performance might very well slip and the performance variation might recur.

The following will assist management when monitoring and sustaining the performance improvement:

- Continuously monitor the performance level to prevent its dropping to the previous level of poor performance.
- Establish open communication between the manager/supervisor and the performer and give the performer regular feedback on his/her performance.
- Analyse and correct the human performance as soon as the variation falls outside the performance limits. Whenever the human performance variation recurs, then one of the following actions needs to be taken:
  o If the cause for the variation is factually known, then the appropriate action needs to be taken to rectify the variation.
  o If the cause for the variation is unknown, then the new variation needs to be analysed using the HPVA process.
- Update or create processes and standards to include the corrective actions in the performer's daily work.

It would also be noticed in Figure 7.2 that this step in the Human Performance Management Model (Monitor and sustain the improvement) links back to the first step. This implies that the human performance management process is a continuous one, because work environments are hardly ever problem-free and, therefore, new performance problems need to continuously be identified and added to the list of human performance problems. Also, the list of human performance problems needs to be reprioritized every time, so that a new significant/priority problem can be identified and resolved through the process, as outlined in the Human Performance Management Model.

The above process leads to a situation whereby human performance problems are continuously identified and resolved. Ultimately, this then results in an environment and culture of continuous human performance improvement.

7.5.9   Capture organisational learning

As a second last step in the human performance management process, it is important to capture what has been learned through experience in a database. The database needs to contain information about the type of problem, the causes, the corrective actions taken and the results. The benefits of keeping a knowledge database of this nature are the following:

- When a similar problem arises, one does not always need to analyse it from scratch.
- One is able to answer any future questions about the incident.
- Although memories of the incident may fade over time, the database would preserve the details of the incident.
- It would prevent the organisation from losing information and knowledge when people leave the organisation, or when they are promoted to other departments or projects.

- It preserves a body of knowledge and experience that can be referred to and used in future.

7.5.10   Extend the solution into the future

"An ounce of prevention is worth a pound of cure" (Benjamin Franklin in Paradies & Unger, 2000:101).

Once the root cause of a human performance problem is known and understood, one can identify measures to prevent the same problem or a similar problem in other areas of the organisation. In other words, the solution can be extended into a search for potential problems of a like or similar nature. Doing this takes what the organisation has learned about the cause and effect into the future in an active way.

7.6   REFLECTION BY THE RESEARCHER

As researcher, I had to be very careful not to selectively notice only the results that are consistent with what I wanted or expected to find. One strategy to avoid this is called *reflexivity*, which is the self-reflection of the researcher on his/her biases and predispositions. The purpose of reflexivity is to see and attempt to minimize the influence of my personal biases during the study. My reflections are presented in the box below.

Greenwood and González (in Greenwood, 1999:123) report that "the professional action researcher operates in various roles: consultant, teacher, researcher, and team member". With my experience as Business Consultant and Trainer and my experience in product research and development, I felt very comfortable in all these roles during the study.

The iterative process followed during action research is very similar to the process that we follow in our organisation during new product development and, therefore, I also felt very comfortable with the action research process of

problem identification and *wondering*, followed by periods of collecting data, measuring evidence, reporting conclusions, and reflecting and revision.

Areas of concern for me were the small sample sizes during testing and not always having direct contact with all participants who tested the HPVA process. It was, however, reassuring that the participants were either master's degree students, or were very knowledgeable in the field of root cause analysis and could therefore make a valuable contribution to the study.

The most challenging aspects of the study were the following:

- Human performance could be influenced by a vast number of factors and it was difficult to incorporate *all* of them into the HPVA process as factors that could have potentially caused or contributed to the performance problem. I did, however, overcome this challenge by grouping the various factors into different categories, namely factors that related to the performer, the job/task, the undesired performance/behaviour, and the geographic location. These categories were then incorporated into the HPVA process.

- Very few root cause analysis techniques include an objective base against which a comparison can be made. This is essential for testing possible causes. If not present in the root cause analysis process, it leads to a trial-and-error approach, which becomes time-consuming and costly. I managed to overcome this challenge by incorporating an "is-is not" matrix into the HPVA process. This way, the HPVA process demonstrates (on paper) how well each possible cause fits the human performance variation.

7.7   CONCLUSION

This chapter gives a detailed discussion of the root cause analysis process, namely the Human Performance Variation Analysis (HPVA) process, as developed by this study. Although the HPVA process can form part of any performance management model that includes cause analysis, the chapter also discusses a Human Performance Management Model that has been

developed on the basis of the findings of this study. The following conclusions can be drawn regarding the HPVA process and the Human Performance Management Model discussed in this chapter:

- The HPVA process provides a systematic way of analysing and finding the root cause of an uncontrolled variation in human performance.

- With a realistic standard as anchor, and a valid, observed human performance variation, the HPVA process can help an organisation to find the cause for the variance, as well as devise a plan that would bring together the standard and the observed performance.

- The HPVA process allows the best thinking from everyone involved in the situation, by using both rational thinking and intuitive thinking as valid sources of information. Rational thinking follows a "show me the evidence" approach, while intuitive thinking allows the reasonable use of experience, informed judgement, "gut feelings", and accumulated wisdom.

- The HPVA process is transparent and highly participative – it involves all stakeholders and data is collected directly and indirectly from everyone who is involved in the human performance problem.

- The HPVA process should only be applied to uncontrolled performance variations. Less intensive approaches and less effort would be applied to day-to-day human performance variations. Trying to apply the HPVA process to every human performance variation every day would be overkill and management often does not have the time or resources to do it effectively.

- The Human Performance Management Model assists in the identification of which problems are worth spending time on, evaluating the results, and sustaining the performance improvement.

- The Human Performance Management Model also shows what should be done if the corrective actions do not solve the problem, or if the same problem recurs.

- The Human Performance Management Model can be used to create an environment and a culture of continuous human performance improvement.

- The Human Performance Management Model can be used to encourage problem preventive thinking, by constructing measures that would prevent similar problems in future or in other areas of the organisation.

In the last chapter, the study's final conclusions in terms of realising the research objectives set in Chapter 1 and recommendations are presented.

CONCLUSIONS AND RECOMMENDATIONS

8.1   INTRODUCTION

"To put it bluntly, if you're not a problem-solver, your career potential is limited" (Hoenig, 2002:338). According to Hoenig (2002:338), "improved problem-solving capability is the ultimate competitive advantage, and the best organisations are increasing the sophistication with which they systematise their problem-solving processes". Furthermore, a survey of 1 000 executives conducted by Caliper Associates, reported in the *Wall Street Journal* by Hal Lancaster, indicated that problem-solving ability is now the most sought-after trait in up-and-coming executives (Hoenig, 2002:338).

The main aim of this research was to develop a root cause analysis process that would assist managers and supervisors to uncover and solve the root causes of uncontrolled variations in human performance and thus become effective problem-solvers of human performance problems.

People do not purposefully attract negative attention, or arrive at work with the intention of performing poorly. The reality, however, is that people are human and make mistakes. Therefore, performance problems are likely to occur. A performance problem occurs when the performance is not what it should be; there is a performance variation from the norm or standard.

With straightforward, common performance problems – for example, issuing the wrong application form to customers – it is common sense to try a series of quick and tested solutions starting with the most simple and the most inexpensive before moving on to those that take longer and cost more. However, when performance problems of greater complexity occur – for example, a sudden increase in report mistakes – it may not be as simple or easy as applying a quick fix solution. In fact, the quick fix may do more harm

than good. In these instances, a systematic process – such as the Human Performance Variation Analysis (HPVA) process – is needed to analyse the human performance problem. Only once the root cause has been identified can the most appropriate solution to the problem be developed.

8.2 OVERVIEW OF THE RESEARCH

8.2.1 Overview of the thesis

Chapter 1 explained the difference between controlled and uncontrolled variations and argued that traditional problem-solving tools and techniques are not sufficient to uncover the root causes of uncontrolled human performance variations. The chapter also outlined the most suitable research methodology. The researcher used a qualitative approach; and an action research framework was applied in the study.

Chapter 2 was the first of three chapters devoted to the review of the relevant literature. This chapter covered the fundamentals of human performance. It discussed eight human performance models and also indicated that a vast number of variables influence human performance.

Chapter 3 explained the goals of analysing and managing human performance problems, as well as some of the methods and tools that are used. The chapter also gave an overview of techniques that could be used to manage performance problems pro-actively. Lastly, it discussed the role of human error in performance problems.

Chapter 4 was the last of the three chapters devoted to a review of the relevant literature. The chapter looked at the key concepts of root cause analysis as a systematic process that focuses on data collection, information analysis, the identification of root causes, and the development of a solution that would fix the problem.

Chapter 5 justified the choice of a qualitative research approach in general, and action research in particular, as the research approach to be used in this study. The chapter focused on the action research process and plan, as well as on the ethical considerations relevant to qualitative studies and action research.

Chapter 6 outlined the characteristics of action research as applied in this study. It discussed the three iterative cycles that were followed during testing – the process started with the identification of the research problem and then each cycle followed the same sequence, namely planning, action, feedback, reflection and revision. Finally, the chapter also outlined the ethical standards applied in this study.

Chapter 7 gave a detailed description of the phases and steps of the Human Performance Variation Analysis (HPVA) process, as well as of the Human Performance Management Model developed in this study. The main purpose of the HPVA process is to uncover the root causes of uncontrolled variations in human performance. The Human Performance Management Model helps to sustain the performance improvement and ultimately helps to create an environment and culture of continuous performance improvement.

8.2.2 Overview of the research methodology

The main objective of this study was to *develop a root cause analysis process that would uncover the root cause(s) of uncontrolled variation in human performance and prevent the recurrence of events causing the variation*. In addition to this main objective, the study aimed to use the root cause analysis process to *develop a human performance management model* that would help to sustain the new, improved performance; prevent the same or a similar performance problem in other areas of the organisation; and ultimately, create an environment and culture of continuous performance improvement.

The following research methodology (nine steps) was followed to achieve the above objectives (see Figure 1.2):

Step 1

This study involved two fields that are very different and are seldom integrated, namely human performance and root cause analysis. The first step was therefore to complete a literature review that covered the central concepts of both these fields to gain a better understanding of these two fields.

Step 2

Relevant information from the literature review was used to develop the following set of performance areas. These areas were used to develop a root cause analysis process for human performance problems:

- the performer's level of competence;
- the performer's capacity to perform;
- the performer's motives;
- the performer's suitability to perform the job/work;
- job design;
- job complexity;
- workload;
- workflow;
- availability and type of information;
- policies;
- procedures;
- supervision;
- expectations;
- consequences;
- feedback;
- physical working conditions;
- resources; and
- job aids.

A root cause analysis process was developed by incorporating the above elements into an "is-is not" matrix. The initial process was tested by applying it to two consultation sessions and a case study. Based on the feedback, the process was refined and subjected to further real-life testing.

Step 3

During Step 3 a feedback guide (see Table 6.2) was designed to gather the opinions and suggestions from participants who tested the root cause analysis process against real-life situations. This feedback played an important part in developing a quality root cause analysis process and in ensuring that the process is suitable to uncover the root causes of uncontrolled variations in human performance.

Step 4

The root cause analysis process was tested by 29 students who were completing their master's degrees in Counselling Psychology at the Consortium Institute of Management and Business Analysis (CIMBA) in Asolo, Italy. Mr Scott B. Newton, a Managing Partner at CIMBA Business Advisement srl., led the session and coached students while they applied the process to their own real-life situations.

Step 5

The CIMBA students completed the feedback guide that was developed in Step 3. Based on this feedback, the root cause analysis was refined further.

Step 6

After the process had been tested against real-life situations, the next step was to have different people test the root cause analysis process by applying it to a case study, to compare their outcomes. A case study was sourced from Thinking Dimensions International, which specializes in root cause analysis.

Step 7

Five consultants from Thinking Dimensions Group (South Africa) tested the root cause analysis process by applying it to the case study. These five consultants' root cause analysis experience ranged between five months and 25 years.

Step 8

The consultants from Thinking Dimensions Group (South Africa) completed worksheets and the feedback guide that was developed in Step 3. This feedback, as well as feedback obtained through informal discussions with the consultants, was incorporated to finalize the root cause analysis process for the purposes of this study.

Step 9

In Step 9, the root cause analysis process was incorporated into a performance management model that was developed using relevant information from the literature review completed in Step 1. The model assists to continuously manage the human performance situation, so that any occurrence (or recurrence) of a performance variation can be detected and addressed.

8.3 CHALLENGES

The two greatest challenges that were faced during this study were the following:

- As indicated in Chapter 1, the roots of root cause analysis can be traced to the broader field of TQM. Therefore, root cause analysis is part of a more general problem-solving approach and is also an integral part of continuous improvement. Although root cause analysis originated in the field of engineering, it has expanded its reach into fields such as aerospace, transportation, nuclear power, chemical processing, pollution control, information technology, manufacturing and health care over the last three decades (Cheryl Gray Instructional Design, n.d.).

The first challenge in this study was to integrate root cause analysis into the field of Human Resources Management, since it has not yet been widely used in the management of human performance. However, based on the researcher's 13 years of experience in the field of root cause analysis, she believes that human performance requires the same level of scrutiny and attention as applied in the fields mentioned previously. This belief motivated the researcher to undertake the study.

This challenge was overcome by identifying all factors that affect human performance, grouping them into categories, and then incorporating them into the root cause analysis process. Table 8.1 outlines the categories of variables that influence human performance, as constructed by this study.

Table 8.1 Categories of human performance variables

Category	Human performance variables/factors
Variables related to the performer	• Performer's competence • Performer's capacity • Motives • Suitability for the job/task
Variables related to the job or task	• Job design • Complexity of the job/task • Workload • Workflow • Information • Policies • Procedures • Supervision
Variables related to the performer's behaviour	• Expectations • Consequences • Feedback
Variables related to the location	• Physical working conditions • Resources • Job aids

The categories outlined in Table 8.1 are unique to human performance and the incorporation of these categories into an "is-is not" matrix is what makes the HPVA process unique, compared to other root cause analysis tools and techniques.

- Because the variables that influence human performance were grouped into a few main categories, the second challenge in this study was to ensure that the specific variable that is causing the performance problem would be uncovered by the HPVA process. This challenge was overcome by searching for discrepancies and/or changes when comparing the following:
  - the performer to an exemplar;
  - the job/task in which undesirable behaviour is noticed to other jobs/tasks that the performer performs without any problems;
  - the undesired behaviour to the desired behaviour;
  - the location where the undesired behaviour is noticed to other locations where desired behaviour is noticed;
  - the date and time when the undesired behaviour was noticed for the first time to the dates and times before or after this time; and
  - the times or frequencies at which the undesired behaviour is displayed to other times or frequencies.

8.4 CONCLUSIONS

This research was conducted over a period of two and a half years. During this period, the HPVA process was tested in the following situations:

- a one-on-one consultation with the manager of a sales consultant who was not growing the business through existing and new customers;
- a one-on-one consultation with the supervisor of a front-line employee who was tardy at doing certain jobs and following work procedures;
- a case study of a repairman who was not following the company's sales lead programme;
- 29 master's degree students who applied the HPVA process to their own situations; and
- five root cause analysis consultants who applied the HPVA process to a case study.

The following conclusions can be made, based on the feedback from the above applications and testing:

8.4.1 The effectiveness of the HPVA process

- The HPVA process will successfully reveal the causes of poor performance.
- If different people apply the process using the same set of data, they will reach the same conclusion.
- The HPVA process assists organisations in analysing the performance situation effectively before identifying possible solutions, thus addressing the human performance problem in the most effective way.

8.4.2 The performance situations

There seem to be three potential situations in which the HPVA process can be applied, namely:

- *a friendly, cooperative and collaborative situation* ("let's sit down together and resolve this problem");
- *a neutral situation* ("one way or another, I have to solve this problem to keep things going"); and
- *a hostile situation* ("somebody messed up and heads are about to roll") – in this case, it can be expected that stakeholder involvement will be defensive with excuses and different kinds of evasive tactics. In this instance, using the HPVA process to prove the cause objectively will be vital.

8.4.3 Lessons learned

The following lessons were learned during the applications and testing:

- No two people share the same reality; they have different perspectives about the performance situation that must be respected.

- It is important that both the manager/supervisor and performer know the HPVA process, its purpose and structure.

- It is important that the performer be put at ease, so that he/she can freely share information. The HPVA session must be treated as an information-gathering session, not an interrogation.

- Good questioning and interviewing skills are crucial in gathering all the relevant information.

- It is crucial to develop a shared understanding about the performance situation. If necessary, pictures or diagrams must be used, or the work station must be visited to understand fully what is being described, or to help visualize the performance situation.

- Both the manager/supervisor and performer must stay on track, follow the HPVA process, and work together towards uncovering the root cause of the uncontrolled variation in human performance.

8.4.4 What the research outcomes offer

8.4.4.1 What the HPVA process offers

- It provides a systematic map to uncover and solve uncontrolled variations in human performance.

- It provides a tool that helps determine what information is relevant, how to make sense of all the information coming our way, and how to organise the information in a sensible manner.

- It does not solve human performance problems by fixing blame or pointing fingers, but by following a collaborative, cooperative process.

- It gives the performer a vehicle through which he/she can actively participate in his/her performance discussion in an open and honest way.

- It focuses on information-gathering and cause-identification, so that organisations can avoid the trap of being too solution-oriented.

- It provides a tool that creates a shared understanding and common reality based on all the available perspectives of the human performance problem.

- It brings together different people from different levels and/or areas to discuss human performance problems, learn, create a factual basis, and make progress in analysing a variation in human performance.

- It provides a testing base against which possible causes can be evaluated, to confirm which one is the root cause.

- It provides a tool to develop an action plan that would solve the root cause and prevent the source(s) of uncontrolled variation from recurring.

- It provides a tool to avoid any negative consequences due to the corrective actions taken.

- It could empower managers and supervisors and increase their confidence in dealing with human performance problems. During the author's 13 years of root cause analysis experience, she encountered many engineers who did not feel comfortable addressing human performance problems, because they did not have the same structure and process that they have when faced with a technical problem. The HPVA process eradicates this fear experienced by managers/supervisors in technical fields.

8.4.4.2 What the performance management model offers

- It helps organisations to focus only on the relevant human performance problems – the significant problems for which the standard is known and the cause is unknown.

- It focuses on the results of the solution, as well as on monitoring and sustaining the performance improvement.

- It can create an environment and culture of continuous human performance improvement that would benefit all.

- Instead of focusing on performance evaluation, the model focuses on performance improvement and developing the performer through well-prepared and open discussion.

- It will ensure that the intellectual capital around the HPVA process is captured, so that it is available for all to learn from. This will ensure that the intellectual capital of the organisation is optimized through the HPVA process.

- It promotes pro-active management, by identifying measures that would prevent the same or a similar human performance problems occurring in other areas of the organisation.

8.5 CONTRIBUTIONS OF THIS RESEARCH TO THE BODY OF KNOWLEDGE

8.5.1 At an individual level

- The research provides managers/supervisors with a tool to uncover the root causes of uncontrolled variations in human performance effectively and consistently.

- The research provides a root cause analysis tool that will, first, allow managers/supervisors and performers to formulate ideas and conclusions from not only the facts, but also their knowledge and experience (the process will lead them to apply their own thinking to find the cause and the best solution); and, second, bring different

people from different levels and/or areas together to discuss human performance problems and create a shared understanding and common reality based on their different perspectives of the performance problem (performers will become partners in sharing information, finding the cause, and developing the best solution).

- The research provides a root cause analysis tool and human performance management model that can be used to identify measures to solve the root cause, prevent it from recurring, and sustain the new, improved level of performance.

- Technical experts who have advanced to a managerial or supervisory level no longer need to fear or steer clear of human performance problems. The research provides them with a human performance management tool that has the same structure as the cause analysis techniques they apply to technical, machine-related problems.

8.5.2 At an organisational level

- The research provides a root cause analysis tool with which human performance management can be standardized throughout the organisation.

- The research provides a human performance management model that
  - o will focus the organisation on only the relevant or significant human performance problems;
  - o incorporates pro-active performance management, by identifying measures that would prevent the same or similar performance problems occurring in other areas of the organisation;
  - o ensures that the intellectual capital around root cause analysis is captured and available for all to learn from;
  - o could be used to create a culture of continuous performance improvement that would benefit all.

8.6 LIMITATIONS OF THE STUDY

As much as possible was done during the study to identify potential limitations and to do whatever was possible to compensate for them. The study did, however, suffer from the following limitations:

- The HPVA process was tested by 29 Master's degree students, five consultants, and two consultation sessions with clients. Although the process was tested using both real-life situations and case studies, it should be applied to many more situations before it can be regarded as truly reliable. Testing the process in as many real situations as possible will provide further teachings faster than any other method. "Experience can be the best teacher, if one wrings the meaning out of what has happened" (Kepner, 2008:2).

- While developing the HPVA process and the Human Performance Management Model, the researcher applied much of her own experience in root cause analysis, which has taught her over a 13-year period some of the weaknesses of many of the existing problem-solving techniques. This might, however, raise a question of objectivity towards certain root cause analysis tools and techniques. However, as indicated in Chapter 6, the rationale for including the "is-is not" matrix into the HPVA process was the fact that it is one of the few methods available to establish an objective data point that indicates the relevant information needed and against which the conclusions can be evaluated.

- In all instances, judgement sampling was used. When selecting the students, the researcher was looking for a group of people who would all have real-life situations to apply the HPVA process to. When selecting the group of consultants, the researcher was looking for people who have root cause analysis experience. In both instances, the aim was also to protect the confidentiality and uniqueness of the HPVA process. Because people were used who were conveniently available to test the process, this might affect the degree of generalizability of the HPVA process.

- When the group of 29 master's degree students tested the HPVA process, Mr Scott B. Newton, a Managing Partner at CIMBA Business Advisement srl., led the session and coached the students during their applications.

Although Mr Newton is a highly skilled and experienced consultant and root cause analysis facilitator, the researcher did not have direct access to the students. As a result, some information might have gone missing in the feedback.

8.7 RECOMMENDATIONS FOR FURTHER RESEARCH

Some people believe that action research generates more questions than answers (De Jager, 2002:14). Also, the development of a root cause analysis process such as the HPVA process evolves from continuous testing and refinement. Therefore, this study should not be regarded as the end of the road, but merely as the start of a lifelong journey.

The following may be regarded as further research opportunities:

- research on the degree of success the HPVA process would have as a performance improvement tool, by focusing on and solving causes of controlled variations in human performance;
- research on managers/supervisors' and performers' trust in the HPVA process as a fair and reliable root cause analysis tool;
- research on the success rate of the HPVA process – the number of human performance problems solved first time around;
- a scientific measurement of the benefits reaped from applying the HPVA process and the Human Performance Management Model;
- research to determine in which dimension(s) of the HPVA process – the performer, job/task, geographic location, or time – most of the root causes of performance variations fall;
- research on the extent to which the HPVA process adds credibility for fairness and increases loyalty and commitment to both the manager and company;
- research to determine whether the HPVA process would enhance positive future collaboration between the manager/supervisor and performer;
- research to determine whether the HPVA process with its openness and inclusion of broader sources of information would create trust and better

working relationships between the manager/supervisor and the performer; and

- research to determine whether the HPVA process would boost the performer's morale and motivation and enhance cooperation.

8.8   CONCLUDING REMARKS

Findings in evolutionary psychology have documented a strong predisposition in humans to cooperate and work together to accomplish a common purpose (Kepner & Iikubo, 1996:200).

According to Kepner and Iikubo (1996:200), the problems we face today are so complex that no one person can be sure of having all the answers. Therefore, if we want to solve human performance problems, the manager/supervisor and the performer need to pool their best knowledge and ideas to find the cause(s) of a problem and develop solutions to the performance problem. *The HPVA root cause analysis tool will facilitate the sharing of information between the manager/supervisor and performer and will make the analysis of the human performance problem more collaborative*.

Facing a problem requires us to find out more, ask the advice of others, and gather suggestions. The challenge is to think deeper and further ahead. *The HPVA root cause analysis tool is an advance in the management of human performance and is that much sought-after ability for problem-solving, namely the ability to solve human performance problems. It is supported by a model that encourages the realization of opportunities…a model that could improve human performance beyond expectation*.

"*Each problem has hidden in it an opportunity so powerful that it literately dwarfs the problem.*
The greatest success stories were created by people who recognized a problem and turned it into an opportunity."

(Joseph Sugarman in Exley, 1993:13)

REFERENCES

4GM Consulting. n.d. *An introduction to understanding variation*. [Online] Available from: http://www.4gm.com/variation.htm [Accessed: 2006-07-04].

Adsit, D. n.d. *Cutting-edge methods help target real call center waste*. [Online] Available from: http://military.isixsigma.com/library/content/ c070611a.asp [Accessed: 2008-08-05].

Ammerman, M. 1997. *The root cause analysis handbook: a simplified approach to identifying, correcting and reporting workplace errors*. New York: Productivity Press.

Anon. 2004. *Safety and Swiss cheese*. [Online] Available from: http://homepage.mac.com/lesposen/iblog/B80495344/C840540124/E19 66059962/index.html [Accessed: 2008-02-13].

Andersen, B. & Fagerhaug, T. 2006. *Root cause analysis: simplified tools and techniques.* Milwaukee, Wisconsin: ASQ Quality Press.

Bacal, R. n.d. *Diagnosing performance problems*. [Online] Available from: http://www.work911.com/articles/diagper.htm [Accessed: 2008-02-13].

Bowling, M.A. 2003. *Root cause analysis: a systematic approach to managing risk*. [Online] Available from: http://www.ncchc.org/pubs/CC/rca.html [Accessed: 2008-06-08].

Boyd, M. 2002. Gap analysis: the path from today's performance reality to tomorrow's performance dreams. In: Piskurich, G.M. (ed.). *HPI essentials* (pp. 41-51). Alexandria, Virginia: American Society for Training and Development.

Burkett, H. 2002. Evaluation: was your HPI project worth the effort? In: Piskurich, G.M. (ed.). *HPI essentials* (pp. 153-175). Alexandria, Virginia: American Society for Training and Development.

Center for Industrial Research and Services. n.d. *Root cause analysis*. [Online] Available from: http://www.ciras.iastate.edu/quality/rootcauseanalysis. asp [Accessed: 2008-06-07].

Cheryl Gray Instructional Design. n.d. *A brief history of root cause analysis*. [Online] Available from: http://www.cherylgray.com/RCA/history.html [Accessed: 2008-06-05].

CHI Publishers. n.d. *Introduction to quality*. [Online] Available from: http://64.233.169.104/search?q=cache:ajlaM0fo5SUJ:www.chipublisher s.com/pdf/coq1_11.pdf+%22gitlow+et+al%22&hl=en&ct=clnk&cd=44&g l=za [Accessed: 2008-06-06].

De Jager, A. 2002. *An integrated and holistic approach to assessment in outcome-based learning in South Africa*. Unpublished doctoral thesis. University of Pretoria. [Online] Available from: http://hagar.up.ac.za/ catts/learner/de_jager_annette/phd/table_of_content.htm [Accessed: 2008-05-15].

Emory, C.W. & Cooper, D.R. 1991. *Business research methods*. Homewood, Illinois: Richard D. Irwin.

Encyclopedia of Small Business. n.d. *Total Quality Management (TQM)*. [Online] Available from: http://www.enotes.com/small-business-encyclopedia/total-quality-management-tqm [Accessed: 2008-06-07].

EQE International, Inc. 1999. *Root cause analysis handbook: a guide to effective incident investigation*. Rockville, Maryland: Government Institutes.

Exley, H. 1993. *The best of business quotations*. New York: Exley.

Franklin, M. 2006. Performance gap analysis. *Info line,* 0603, March:1-16.

Gabel, D. 1995. *An introduction to action research*. [Online] Available from: http://physicsed.buffalostate.edu/danowner/actionrsch.html [Accessed: 2006-07-27].

Gano, D.L. 1999. *Apollo root cause analysis – a new way of thinking*. Washington, DC: Apollonian.

Geis, G.L. & Smith, M.E. 1992. Transforming organizations through human performance technology. In: Stolovitch, H.D. & Keeps, E.J. (eds). *Handbook of performance technology: a comprehensive guide for analyzing and solving performance problems in organizations* (pp. 32-49). San Francisco: Jossey-Bass.

Greenwood, D.J. 1999. *Action research: from practice to writing in an international action research development program*. Amsterdam: John Benjamins.

Haddon, C. 2003. *One hundred lamps for the soul*. London: Hodder & Stoughton.

Halliday, S. n.d. *Understanding variation*. [Online] Available from: http://www.saferpak.com/six_sigma_art1.htm [Accessed: 2006-06-28].

Hoenig, C. 2002. Developing exceptional problem-solving skills. In: Glasspool, J. (ed.). *Business. The ultimate resource* (pp. 338-339). London: Bloomsbury.

Hoepfl, M.C. 1997. Choosing qualitative research: a primer for technology education researchers. *Journal of Technology Education*, 9(1):47-63.

JHPIEGO Corporation. 2003. *Frequently asked questions about performance improvement*. [Online] Available from: http://www.reproline. jhu.edu/english/6read/6pi/pi_FAQ.htm [Accessed: 2008-04-03].

Jones, S.R. 2002. (Re)writing the word: methodological strategies and issues in qualitative research. *Journal of College Student Development*, July/August:1-12. [Online] Available from: http://findarticles.com/ p/articles/mi_qa3752/is_200207/ai_n9121404 [Accessed: 2008-04-01].

Keller, J.M. 1992. Motivational systems. In: Stolovitch, H.D. & Keeps, E.J. (eds). *Handbook of performance technology: a comprehensive guide for analyzing and solving performance problems in organizations* (pp. 277-293). San Francisco: Jossey-Bass.

Kepner, C.H. 2006a. Correspondence with the author on 1 May. San Francisco. (Letter in possession of researcher.)

Kepner, C.H. 2006b. Correspondence with the author on 31 August. San Francisco. (Letter in possession of researcher.)

Kepner, C.H. 2008. Correspondence with the author on 21 April. San Francisco. (Letter in possession of researcher.)

Kepner, C.H & Iikubo, H. 1996. *Managing beyond the ordinary*. New York: AMACOM.

Latino, R.J. & Latino, C.L. 2006. *Root cause analysis – improving performance for bottom-line results*. Baco Raton, Florida: CRC.

Livingston, A.D., Jackson, G. & Priestley, K. 2001. *Root cause analysis: literature review*. [Online] Available from: http://www.hse.gov.uk/ research/crr_pdf/2001/crr01325.pdf [Accessed: 2008-06-25].

MacIsaac, D. 1996. *An introduction to action research*. [Online] Available from: http://physicsed.buffalostate.edu/danowner/actionrsch.html [Accessed: 2008-03-11].

Mager, R.F. & Pipe, P. 1997. *Analyzing performance problems*. Atlanta, Georgia: CEP.

Main, R.E. 2002. Designing and developing structure/process interventions. In: Piskurich, G.M. (ed.). *HPI essentials* (pp. 101-113). Alexandria, Virginia: American Society for Training and Development.

McKernan, J. 1996. *Curriculum action research: a handbook of methods and resources for the reflective practitioner.* London: Kogan Page.

McNiff, J. & Whitehead, J. 2006. *All you need to know about action research*. London: Sage.

Miles, M.B. & Huberman, A.M. 1994. *Qualitative data analysis*. Thousand Oaks, California: Sage.

Motley, B. 2005. *Introduction to variability and variation reduction*. [Online] Available from: https://acc.dau.mil/CommunityBrowser.aspx?id=23214 [Accessed: 2006-07-04].

Neal, L.A., Watson, D., Hicks, T., Porter, M. & Hill, D. 2004. Root cause analysis applied to the investigation of serious untoward incidents in mental health services. *Psychiatric Bulletin*, 28:75-77.

O'Brien, R. 1998. *An overview of the methodological approach of action research*. [Online] Available from: http://www.web.net/~robrien/papers/arfinal.html [Accessed: 2006-07-27].

Paradies, M. & Unger, L. 2000. *TapRoot – the system for root cause analysis, problem investigation, and proactive improvement*. Knoxville, Tennessee: System Improvements.

Peterson, K. 2002. *Human reliability*. [Online] Available from: http://216.239. 59.104/search?q=cache:NbYCvmcRE7gJ:courses.washington.edu/kck apur/526/526projects/Kyle%2520Peterson.pdf+%22increasing+human+ reliability%22&hl=en [Accessed: 2005-01-30].

Pipe, P. 1992. Ergonomic performance aids. In: Stolovitch, H.D. & Keeps, E.J. (eds). *Handbook of performance technology: a comprehensive guide for analyzing and solving performance problems in organizations* (pp. 352-364). San Francisco: Jossey-Bass.

Piskurich, G.M. 2002. *HPI essentials*. Alexandria, Virginia: American Society for Training and Development.

Plant Maintenance Resource Center. 2001. *Root cause analysis survey results*. [Online] Available from: http://www.plant-maintenance.com [Accessed: 2005-08-29].

Ramolefe, E. 2004. *How secondary school educators experience principal support during the implementation of outcomes-based education*. Unpublished master's thesis. University of Pretoria. [Online] Available from UPeTD: http://upetd.up.ac.za/thesis/available/etd-12062004-102701/unrestricted/01 dissertation.pdf [Accessed: 2008-04-01].

Reason, J. 2000. Human error: models and management. *BMJ Journals*, 320(7237):768 (18pp). [Online] Available from: http://bmj.bmjjournals. com/cgi/content/full/320/7237/768 [Accessed: 2005-01-28].

Reason, J. & Hobbs, A. 2003. *Managing maintenance error*. Aldershot: Ashgate.

Rosenberg, M.J., Coscarelli, W.C. & Hutchison, C.S. 1992. The origins and evolution of the field. In: Stolovitch, H.D. & Keeps, E.J. (eds). *Handbook of performance technology: a comprehensive guide for analyzing and solving performance problems in organizations* (pp. 14-31). San Francisco: Jossey-Bass.

Rossett, A. 1992. Analysis of human performance problems. In: Stolovitch, H.D. & Keeps, E.J. (eds). *Handbook of performance technology: a comprehensive guide for analyzing and solving performance problems in organizations* (pp. 97-113). San Francisco: Jossey-Bass.

Rothwell, W.J. 2005. *Beyond training and development: the groundbreaking classic on human performance enhancement*. New York: Amacom.

Rothwell, W.J., Hohne, C.K. & King, S.B. 2000. *Human performance improvement*. Houston, Texas: Gulf.

Rummler, G.A. & Brache, A.P. 1992. Transforming organizations through human performance technology. In: Stolovitch, H.D. & Keeps, E.J. (eds). *Handbook of performance technology: a comprehensive guide for analyzing and solving performance problems in organizations* (pp. 32-49). San Francisco: Jossey-Bass.

Saleh, E. 2004. *7 Steps to negotiate a performance improvement intervention*. Paper presented at the ASTD International Conference and Exposition Conference, Washington DC, 23-27 May:1-15.

Social Assessment, LLC. n.d. *Uses and advantages of qualitative procedures*. [Online] Available from: http://www.socialassessment.com/toolpage. asp?2 [Accessed: 2008-02-27].

Stolovitch, H.D. & Keeps, E.J. 1992. What is human performance technology? In: Stolovitch, H.D. & Keeps, E.J. (eds). *Handbook of performance*

technology: a comprehensive guide for analyzing and solving performance problems in organizations (pp. 3-13). San Francisco: Jossey-Bass.

Strauss, A. & Corbin, J. 1998. *Basics of qualitative research: techniques and procedures for developing grounded theory*. Thousand Oaks, California: Sage.

Thomas, R.M. 2003. *Blending qualitative and quantitative research methods in theses and dissertations*. Thousand Oaks, California: Corwin.

Vanderbilt University. n.d. *Introduction to quality*. [Online] Available from: http://www.vanderbilt.edu/Engineering/CIS/Sloan/web/es130/quality/iqi1.htm [Accessed: 2006-06-28].

Web Center for Social Research Methods. n.d. *Action Research*. [Online] Available from: http://www.socialresearchmethods.net/tutorial/Sengupta/default.htm [Accessed: 2008-02-27].

Williams, T.N. 2001. *A modified six sigma approach to approving the quality of Hardwood Flooring*. Unpublished master's thesis. University of Tennessee. [Online] Available from: http://web.utk.edu/~tfpc/Intelligent/Publications/Tom%20Williams%20Complete%20Thesis.pdf [Accessed: 2008-06-06].

Wilson, B. n.d. *Root cause analysis*. [Online] Available from: http://www.bill-wilson.net/root-cause-analysis [Accessed: 2008-06-06].