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Applying Attribution Theory to Perceptions of Maintenance Error

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A dissertation submitted to the Discipline of Psychology, Faculty of Humanities, University of the Witwatersrand, Johannesburg, in partial fulfilment of the requirements for the Degree of Masters of Arts (Industrial Psychology)

August, 2005

Declaration

I, Muhammad Yousuf Cajee, declare that this dissertation is my own unaided work. It is submitted for the degree of Masters in Psychology (Industrial) at the University of the Witwatersrand, Johannesburg. It has not before been submitted for examination, to any other University or for another degree.

_____

Muhammad Yousuf Cajee

On this the 20th day of August 2005

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All praises are due to God. The Lord of the Worlds.
Thee alone do we worship, and thee alone do we ask for help.
Show us the straight path, The path of those who earn they favour.
Not the path of those who earn they anger,
nor of those who go astray.

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Abstract

Before this study took place, the social psychology perspective of Attribution theory was yet to be fully utilised in South African research within the maintenance error landscape.

Attributional approaches see the person on the street operating like a scientist, obtaining information from his or her social surroundings and discerning the causes and consequences of ongoing behavioural and environmental events (Harvey et.al.,1976). It is very possible that due to the unique South African socio-political and economic landscape, strongly influenced by Apartheid, new combinations of known and unknown error attributions are at play, that are unique to this landscape and have not yet been studied or uncovered. Thus, a better understanding of the South African landscape, through a study such as this, could have serious cost benefits to maintenance companies, benefits to staff in terms of reduced risk of injury, as well as form the basis of improved policies, procedures and equipment.

Twenty-five team leaders and 125 minor maintenance staff at a South African Aircraft Maintenance Company formed the population group from which the sample for this study was drawn. Within each group, 5 individuals were interviewed on a personal basis. Further, for each group, one focus group was carried out consisting of two and four individuals respectively. The individuals who participated in the focus groups were different to those who participated in the interviews. In total 28 percent of team leaders participated in the study and 7 percent of maintenance staff, which calculates to just over 10 percent of minor maintenance employees at the organisation involved.

The Qualitative data acquired through this in-depth interview and focus group discussion process, and subsequent transcription was coded and analysed using Thematic Content Analysis. Content analysis is a research technique for making replicable and valid inferences from data to their context (Krippendorf, 1980).

The discussion of primary error attributions comparing maintenance staff and team leaders, focussed on the predominant primary error attribution theme and related attributions under the descriptor Organisational Culture which included both the dimensions of employee motivation and managerial culture. Finally, results of secondary error attributions comparing maintenance staff and team leaders raised the discussion around the theme, Tools and Equipment.

This research is an exploratory study that brings together the field of attribution theory and maintenance error. Its main strength is that it provides a theoretical framework, upon which is based a methodology that explores the primary and secondary error attributions made by employees for maintenance errors in their work environment. In other words, it is felt that this methodology can be implemented in a range of maintenance environments to unearth the error attributions of staff in that environment. Information such as this is very beneficial to companies and organisations in their planning, strategising, problem solving and general organisational development.

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Chapter 1 – Introduction

Airline safety depends on a multitude of individuals and professions, but there are three groups that stand in the forefront of this task: the pilots who fly the aircraft, the air traffic controllers who direct and choreograph flights, and the aviation maintenance technicians who keep the aircraft maintained and flying. Internationally, much attention has been given to pilot and air traffic controller fatigue and error-making since they interface directly with the actual flight.

However, comparatively little attention has been focused on the aviation maintenance technicians, whose work directly interfaces with each and every flight (Bosley, Miller and Watson, 1999). Further, within the South African landscape, very little research has been carried out with maintenance technicians, taking into cognisance the unique South African socio-politico-economic circumstances.

Maintenance errors have been reported as a contributing factor in 15% of major aircraft accidents from 1982 to 1991, at a cost of over 1400 lives (Boeing/ATA, 1995). Maintenance error also contributes considerably to operational costs. Rankin, et al. (1995) state that 50% of flight delays due to engine problems are maintenance error related and cost the airlines $10,000 per hour. At least 20-30% of in-flight error shutdowns are similarly related at a cost of $500,000 per shutdown, and 50% of flight cancellations due to engine problems are caused by maintenance errors at a cost of $50,000 per cancellation. In addition, on-the-job injuries in one airline during 1994 alone resulted in 785 reported injuries at a cost of $1.2 million, a figure that excludes costs of lost productivity and other related issues (Wenner and Drury, 1997)

Thus, the magnitude of the impact of maintenance error begins to take on major financial and human significance. It is very possible that due to the South African socio-political and economic landscape, new combinations of known and unknown factors could be at play, that are unique to the South African aircraft maintenance landscape. An understanding of this landscape could have serious

cost benefits to maintenance companies, as well as benefits to staff in terms of reduced risk of injury, and better policies, procedures and equipment.

Considering the many causes of errors and the many possibilities of combinations of errors due to different equipment, tools, environments, as well as the layout of workshops, policies and supervision, that are substantially different to other operations on which studies have been carried out; there is a strong possibility that every country could have unique characteristics, or even every airline maintenance operation.

A study reported by Veinott and Kanki (1995) found that 60% of errors were related to procedures; 27% of the errors were related to practices; at least 50% of the cases implicated more than a single individual and 39% resulted in an air return. Further, they found that human errors typically stem from multiple, interrelated sources; some of which are relatively easy to assess; such as workplace conditions or adequacy of resources; while others are more indirect in their effect; such as organisational culture and communication barriers. Consequently, the conclusion is that the process of managing error may involve multiple and diverse interventions (Kanki, Blankmann-Alexander and Barth, 1998)

Researching and understanding the various factors that have influence over maintenance error in the South African scenario is the first step to be able to make adequate interventions, with the implication of human and financial cost benefits to all involved.

Further, the social psychology perspective of Attribution theory is yet to be fully utilised in South African research within the maintenance error landscape. Attributional approaches see the person on the street operating like a scientist, obtaining information from his/her social surroundings and trying to discern the causes and consequences of ongoing behavioural and environmental events (Harvey et.al., 1976). These causal explanations of lay people have been central to attribution theory and are one of the cornerstones of contemporary social

psychology. People interpret behaviour in terms of its causes and these interpretations play an important role in determining reactions to these behaviours. Overlapping attribution theory literature and maintenance error literature is largely exploratory.

Finally, the lay person (the technician in the case of maintenance errors) is most often central to investigations and surveys into maintenance error. The possibility also exists that previous findings, that have not taken attribution theory into account, could be skewed by the “attributions” that are given by employees to investigators for errors, since investigations and surveys are in actual fact asking lay people to make attributions for incidents, events and errors that take place.

To attempt to address all the above, and relate the relevant findings and observations of this study to the reader, this dissertation consists of six chapters; Introduction, Literature Review, Methodology, Results, Discussion and Conclusion.

The literature review chapter which follows this introductory chapter, seeks to provide a comprehensive understanding of attribution theory to the reader, whereby important and relevant concepts are defined and understood, then applied to maintenance error literature for the purpose of understanding it, and drawing from it possible error attributions that could be made by participants during the fieldwork.

The methodology chapter then describes in as much detail as possible the specific methodology used to collect data for this thesis, since a thorough understanding of this would impact on the replicability of the study, as well as assist in identifying the biases which are introduced into this study through the choice of methodology. Choice of sample, procedure, instruments used, data analysis theory and implementation, as well as ethical considerations are discussed in turn.

Next, the results chapter describes the taxonomy on Incident on Duty Investigations, and reports on the results of the study generated by thematic content analysis of the In-depth Interviews; and Focus Group Discussions. It is structured according to the two research questions, and looks at the various themes that emerged through the data analysis process. The research questions are:

A) What are the predominant primary error attributions during the minor maintenance of aircraft, comparing maintenance staff and team leaders?
B) What are the predominant secondary error attributions during the minor maintenance of aircraft, comparing maintenance staff and team leaders?

In staying with the broad, exploratory nature of this study, the structure of the discussion chapter is one whereby a predominant attribution theme that emerged under each research question in the results chapter is contrasted with reference to the attribution theory framework provided in the literature review. This is done with the aim of drawing out significant aspects that can be beneficial to knowledge in error investigation, error intervention and attribution theory. The chapter concludes with a discussion of the theoretical and practical implications of the study, as well as its limitations; and recommendations for future research.

The final chapter consolidates, synthesises and concludes the presentation of the study through this dissertation.

Chapter 2 - Literature Review

2.1 Introduction

“Applying Attribution Theory to Perceptions of Maintenance Error” is an exploratory study in the area of maintenance error, since it takes a strong social psychology element from “Attribution Theory”, and overlaps this with the Human Factors element of “maintenance error and error investigation”; in effect, researching maintenance error from an attribution paradigm. For this to be successful, it is felt that a comprehensive understanding of attribution theory is required, whereby important and relevant concepts are defined and understood then applied to maintenance error literature with the intention of understanding this literature, and drawing from it possible error attributions that could be made by participants during the fieldwork.

Understanding the maintenance error literature from an attribution perspective provides a reference point from which error attributions made by participants can be distinguished in the maintenance environment. Further, a thorough understanding of attribution theory provides the tools necessary to distinguish attributions from the data that emerges during the fieldwork and explain these attributions in terms of attribution theory and maintenance error literature.

This is the primary purpose of the literature review. However, as with most exploratory studies, the difficulty is that there is little specific published literature where Attribution theory has already been applied to Maintenance error, and thus, the onus is on the author to carefully and adequately identify, sift, and describe important areas from the vast amounts of literature, then relate relevant findings to the reader.

To this purpose, the author first focuses on the domain of Attribution Theory, beginning with the three core theories that form the basis of attribution theory, providing definitions and broad overviews. The author next focuses on the antecedents and consequences of attributions. This section is much more detailed, and in essence reorganises the core theories as well as other literature

into antecedents and consequences, which promotes integration between theories, rather than a silo approach where the theories are dealt with separately from each other. Here, relevant theories and findings are discussed which can then be applied to the domain of Maintenance Error.

Maintenance Error falls into the realm of Human Factors. The intention of the author is not to revisit and challenge the findings in this area, but rather look at them from a different paradigm, that of Attribution theory. Thus, varieties of error and error provoking factors are drawn out of the maintenance error literature, but discussed as attributions.

It is felt that this approach best allows the reader to fully understand the subsequent research methodology, results and discussion chapters of this research report; and simultaneously gives the author a framework within which the literature can be presented in a coherent, understandable manner. While much can be included and presented as concisely as possible, it is inevitable that much also has to be left out at the risk of not contributing to the study.

2.2 Attribution Theory

Research on Attribution theory reached its peak in the late 1970's and early 1980's with the domain twice being covered in the Annual Review of Psychology, first in 1980 and later in 1984. Similarly, much of the theoretical literature; books and journal articles have been published in this era.

Towards the late 1980's and beyond, it seems that attribution research has branched out into a more specific application of the theory in studies that include diverse topics such as rape survival in the counselling domain (see Workman and Freeberg, 1999; Wakelin and Long, 2003; and Heaven, Connors and Pretorius, 1998); achievement and intentions for further academic study in the motivation domain (see Hall et.al, 2004; Georgiou, 1999; and Bong, 2004); smoking reduction, and insomnia in the clinical domain (see Furnham et. al., 2000); as well organisational related studies looking at the causal attributions and organisational behaviour (see Barry and Crant, 2000); organisational stress (see

Perrewe and Zellars, 1999); managerial performance (see Schaffer, 2002); supervisor and subordinate perceptions of psychological contract breech (see Lester et. al, 2002); success attributions within organisations (see Rogoff, Lee, and Suh, 2004, and O'Neill, Bilimoria, and Saatcioglu, 2004); and so on.

What is common within these diverse studies is that they use as their basis the core attribution literature and theory reviewed in the early 1980's (see Silvester and Chapman, 1997; Schaubroeck, 1999; Schaffer, 2002; Gronhaug and Falkenberg, 1994; and Lester et al, 2002). A reason for this may be the nature of attributions; that attributions are made by people who come from different backgrounds and in different circumstances involving various variables; meaning, that while people make attributions, the patterns of attributions would be more coherent at a very specific level where variables are limited.

It would be very difficult, or take a significant body of research to draw coherent patterns between these specific and diverse studies of attributions and consolidate them into one theory that encompasses the human attribution process, possibly explaining why further reviews have not taken place post 1984. Further, some of these variables may change, or be time bound, and mean that the related attribution research would be in regular need of renewal. Thus, "core" theories that are more resilient to the influence of time, and form the basis of attribution theory, seem to be the foundation upon which the contemporary attribution research is based.

Attributional approaches grew out of work on person perception, which refers to the conditions associated with an individual's attempt to find structure in his/her own behaviour and the behaviour of others. In essence, attributional approaches see the person on the street operating like a scientist, obtaining information from his/her social surroundings and trying to discern the causes and consequences of ongoing behavioural and environmental events (Harvey et.al., 1976).

This "person on the street" could be anyone, including ourselves, from our families, friends, or colleagues. According to attributional approaches, every

human being seeks to discern the causes and consequences of environmental and behavioural events, be they at work, or at home, partaking in a variety of activities. Human beings are diverse in their upbringings, their social relationships, their work environments and the variables that impact on their lives and the decisions they make.

Considering this, there are an infinite number of combinations of variables that lead to situations which prompt specific attributions. Following the trend in contemporary attribution research, this study specifically focuses on a group of individuals working in the South African aviation maintenance environment, studying to what they attribute errors in this environment.

Causal explanations such as these have been central to attribution theory and are one of the cornerstones of contemporary social psychology. The study of perceived causation is identified by the term “attribution theory”, attributions referring to the perception or inference of cause (Gronhaug and Falkenberg, 1994)

The term refers to several different kinds of problems, and according to Martinko (1995) there is no single or dominant theory of attribution, but rather a variety of perspectives that address how individuals assess behaviours and other actions. In other words, it is not a “monolithic theory” but rather a set of loosely structured propositions making up a conceptual framework (Semin, 1980). It should be noted that from 1980 to 1995 a single dominant theory of attribution was yet to be formed; and this single theory is yet to be achieved. Possible reasons for this have been discussed earlier.

This lack of a dominant theory creates substantial difficulty in accurately relating the field of attribution theory to the reader. The reason for this being that the only way of accurately relating the entire field, is to mention all the differing approaches and theories that have been conducted, which is impossible within the constraints of time and space. Thus, it was thought best to concentrate on the common ideas that have emerged and been consolidated within the field

(forming the core basis), and thus be consistent with the approach of a bulk of contemporary attribution research (see Silvester and Chapman, 1997; Schaubroeck, 1999; Schaffer, 2002; Gronhaug and Falkenberg, 1994; and Lester et al, 2002).

Kelley and Michela (1980) made the distinction between “Attribution” and “Attributional” research; which is covered in further detail in the second half of this chapter. The first involves systematic assessment or manipulation of antecedents. There is no interest in consequences beyond the attributions themselves, and they are generally measured directly by verbal report; while attributional research is concerned with the consequences of attributions. It entails assessment or manipulation of perceived causes and the measurement of their effects on behaviours, feelings and expectancies.

The common interest between these two types of research is the causal explanations given by ordinary people. In both cases, causal attributions are assumed to play a central role in human behaviour. They constitute the person’s understanding of the causal structure of the world and are therefore important determinants of his or her interaction with that world (Kelley and Michela, 1980). In order to operate, human beings are inclined to seek causal understanding, as understanding is needed to operate purposefully. Central to the concept of attribution is the inferred relationship between cause and consequence. By making such inferences, people are assumed to achieve greater understanding of and hence greater control over their environment (Gronhaug and Falkenberg, 1994).

Hewstone (1983) has suggested that the core of attribution literature has been provided by four authors; Heider (1958), Jones and Davis (1965), and Kelley (1967). He has noted that commonalities between these theories include the mediation between stimulus and response; active and constructive causal interpretation; and the perspective of the naïve perceiver or layperson. All share a concern with common sense explanations and answers to the question “why?”. His literature makes it clear that researchers show a general interest in the

common-sense explanation, or in how and why ordinary people explain events (Hewstone, 1983).

This general interest in the common sense explanation, and the perspective of the naïve perciever is still found in contemporary studies such as Silvester and Chapman (1997) and other authors such as Gundlach, Martinko, and Douglas (2003); Gibson and Schroeder (2003); Weber et. al (2002); and Martinko (1995); make constant and significant reference to Heider (1958), Jones and Davis (1965), Kelley (1967) and/or Kelley, (1971) as well Hewstone (1983) and/or Kelley and Michela (1980). Thus it can be inferred that these relatively dated studies still hold relevance and are of importance to this study.

2.2.1 Heider's theory of the "naïve analysis of action"

Heider's (1958) monograph has become a core reference for attribution researchers. His "naïve psychology" attempted to formulate a process by which an untrained observer (naïve psychologist) makes sense of the actions of others. He believed that people have two behavioural motives: (a) the need to understand the world around them, and (b) the need to control their environment. He proposed that people act on the basis of their beliefs whether or not these beliefs are valid.

In his early work, Heider, (1944) introduced the important notions of unit formation and people as the prototype of origins (in Hewstone, 1983). Unit formation refers to the process whereby cause (origin), and effect, actor and act were seen as the parts of a causal unit.

Heider was particularly interested in the varying degrees of similarilty between the two parts of the causal unit. Thus, factors such as similarity and proximity were seen as determining the locus of attribution. If two events were similar to each other, or proximate, then the one was likely to be seen as the cause of the other. A "bad" act is more easily connected with a "bad" person. Heider cites Fauconnet (1928) in noting some of the serious social implications of these

tendencies - such as the varying standards of evidence used to evaluate people with good and bad reputations.

The most important consequence of this link between actor and act is that, in general, a person attribution is more likely than a “situation” one, as people are seen as the “prototype of origins”. But Heider also recognised the functions served by this tendency, namely, that people can be punished and hence some control over the cause can be affected. A further point that deserved mention is the “ego-protective” tendency to attribute one's failures to others (Gronhaug and Falkenberg, 1994).

Heider proposed that causal analysis is in some respects similar to the perceptual process. An object “out there” and with objective properties is the distal stimulus, but what is psychologically important is the proximal stimulus, the way the object appears to the perceiver. For social perception, Heider suggests that the important distal stimuli, dispositional properties linked to the proximal act, often refer to psychological states. It is these invariant dispositional properties that are needed to explain the behaviour of others and render the perceiver's world stable, predictable and controllable (Schaffer, 2002).

When we observe an individual's behaviour, we attempt to determine whether the behaviour was internally caused (i.e. by the person), or externally caused (by the context or the situation) (Moss and Martinko, 1998; Ferris et al., 1995; Markus and Zajonc, 1985; Heider, 1958). This internal-external distinction is central to most attribution models.

It is a fundamental activity that enables individuals to create organisation from chaos and relate continuously changing stimuli into stable properties of the environment (Heider, 1958). Internal causes are factors within the person (e.g. effort, ability and intention), while external factors lie outside of the person (e.g. the difficulty of the task, and luck). Understanding which set of factors should be used to interpret the behaviour of another person will make the perceiver's world more predictable and give a sense of control (Schaffer, 2002).

For example, If Sizwe expects Mpho to drive him to work, and Mpho calls at the last minute to tell him that she cannot, then Sizwe will develop attributions of cause for Mpho's unexpected behaviour. On the other hand, if Mpho had driven Sizwe to work (as expected), then Sizwe would probably not feel the need to develop specific attributions of cause for Mpho's behaviour.

Research has demonstrated that people generally attribute favourable performance outcomes to causes internal to themselves, and unfavourable outcomes to causes external to themselves (Schaffer, 2002; Gronhaug and Falkenberg, 1994; Bettman and Weitz, 1983; Lau and Russell, 1980). These types of attributions have been called "self-serving" or "motivational" attributions (Schaffer, 2002; Gronhaug and Falkenberg, 1994; Bettman and Weitz, 1983).

Heider is unquestionably the founding father of contemporary attribution theory and his insights provided the blue-print for succeeding theories. Heider saw the analogy between causal analysis and experimental methods, which led to Kelley's work. He also considered the importance of intentionality in assessing personal causality, which was taken up by Jones and Davis, and is dealt with next. By virtue of other theorists building on Heider's work, it can be deduced that his theory was not all encompassing, taking into account the complexity of the human being and the different situations and circumstances in which people make attributions. However, Heider did give the basis upon which other theorists and researchers could expand.

2.2.2 Jones and Davis's theory of "correspondent inferences"

Jones and Davis's (1965) theory advances on Heider (1958) by formalising how individuals make inferences about a person's intentions and in turn dispositions, since intentionality would reflect an internal attribution. They provide a set of ideas concerning how a perceiver searches for the dispositional cause of an intention and are concerned with how perceivers make the inferential leap "from acts to dispositions". This approach has stimulated, and been supported by, many empirical studies (Gibson and Schroeder, 2003; Hewstone, 1983).

The perceiver's problem is to decide which effects of an observed action, if any, were intended by the actor. Two essential criteria for making this judgement concern the knowledge and the ability of the actor. To infer that any of the effects were intended, the perceiver must believe that the actor “knew” the consequences of his or her action. In addition, the actor must be seen to be “capable” of intentionally producing the observed effects. These then are the preconditions for the assignment of intentions, which themselves are prerequisites for inferences concerning underlying personal dispositions of the actor (resulting in an internal attribution to the person versus an external attribution to the environment).

The aim of correspondent inference theory is to construct a theory which systematically accounts for a perceiver’s inferences about what an actor was trying to achieve by a particular action (Jones and Davis, 1965). The central concept of the theory, the correspondent inference, refers to the perceiver’s judgement that the actor's behaviour is caused by or corresponds to a particular trait. Thus underlying dispositions are directly conveyed in behaviour. A simple example of such an inference would be to ascribe someone’s aggressive behaviour to the trait “aggressive”.

First, the principle of “non-common effects” suggests that any characteristics shared between two choices do not help to explain why one alternative, rather than the other, was chosen. It is non-common effects, characteristics that differentiate between the two alternatives that are important. These should guide the perceiver to the dispositions, or the intentions, of an actor. The fewer such differentiating characteristics, the less ambiguous is the attribution.

The second principle of the theory, “social desirability”, concerns the perceiver's beliefs about what other actors would do in the same situation. Although Jones and Davis acknowledge that effects that are normally desirable to actors are more diagnostic of their intentions, they also realise that universally desired effects tell the perceiver little about an individual's unique characteristics. Thus in a study by Jones, Davis and Gergen (1961), an interview candidate's behaviour

that was at variance with the interviewer's ideal (i.e. “out-of-role”) was seen as more informative than socially desirable (i.e. “in-role”) behaviour. It is behaviour that conflicts with expectations that tells us most about an actor.

Two further factors which influence correspondent inferences concern rewarding or punishing implications of an action for the perceiver. “Hedonic relevance” refers to the positive and negative effects of an actor's choice for the perceiver Gronhaug and Falkenberg, 1994). The authors predict that the more relevant an act is for the perceiver, the stronger will be the correspondence between act, intention and disposition (Jones and De Charms, 1957).

“Personalism” refers to the actor's intention to benefit or harm the perceiver specifically. This variable is introduced to distinguish between cases where an actor's behaviour has general (positive or negative) relevance, and those where the behaviour is directed towards the perceiver. Both these additional factors appear to be an extension of Heider's view that the perceiver's needs and values may distort attributions.

Jones and Davis (1967) have added more depth to the internal and external distinction provided by Heider (1958). They have given a framework that assists in determining how perceivers assign intentionality to a person performing an act, and if the act was seen as intentional, an internal attribution to the actor would be assigned. Jones and Davis (1967) chose to concentrate and expand on a component of Heider’s work, giving a framework to explain the assignment of intentionality. This is an important and robust contribution to attribution theory.

2.2.3 Kelley's theories of “covariation and configuration”

Kelley's contributions to attribution theory build on Heider's proposal that understanding of the distal environment is gained by means of a causal analysis that is similar to the experimental method. He begins with the question of what information is used to arrive at a causal attribution and goes on to ask in what way it is used. Two different cases are outlined, which depend on the amount of

information available to the perceiver (Schaffer, 2002; Ashkanasy, 1989; Hewstone, 1983).

In the first case, the attributor has information from multiple sources and can perceive the covariation of an observed effect and its possible cause. For example, a person who has electricity knows that a light should come on when the switch is flicked “on”. This happens the majority of the time, unless there is a fault, which could either be that the bulb has fused, or the electricity is disconnected

In the second case, the perceiver is faced with a single observation (e.g., a car is seen to knock down a pedestrian). Here the perceiver must take account of the “configuration” of factors that are plausible causes for the observed effect, such as a wet road surface, whether the driver was drunk, whether the pedestrian was careless and so on (Schaffer, 2002; Ashkanasy, 1989; Hewstone, 1983).

In outlining attribution in the case of covariation, Kelley (1967) followed Heider in the use of a naive version of J.S. Mill's “method of difference”: an effect is attributed to a condition that is present while the effect is present, and absent when the effect is absent.

Kelley's (1971) theory of attribution states that individuals attribute behaviour to internal or external causes, depending on three basic informational cues (Schaffer, 2002; Ashkanasy, 1989; Kelley, 1971). First, “consistency” refers to the generality of the behaviour across different time periods. If the present behaviour is characteristic of previous behaviours in the past, then it would be considered consistent. This informational cue introduces the variable of time, which had not been seen in Heider’s (1958) or Jones and Davis’ (1967) theories.

Second, “distinctiveness” refers to whether the behaviour "is expressed toward a specific target only or is used generally across all potential targets" (Ferris et al., 1995, pp.231-251). If the present behaviour in the current situational context is not likely to occur in other contexts, then the behaviour is said to be distinctive. Similarities can be drawn between the cue of “Distinctiveness” and Jones and

Davis (1967) principle of “non-common” effects. Both seek to differentiate what is different in behaviour to explain the underlying nature of the attribution, whether internal or external. These similarities can also be drawn back to Heider’s (1958) concept of similarity.

Finally, “consensus” refers to the generality of the behaviour across a number of different individuals. If the present behaviour is evident in other individuals in the same setting, then the behaviour is said to have a high level of consensus. A similarity can be drawn to Jones and Davis (1967), in the principle of “social desirability” since social desirability concerns beliefs about what other actors would do in the same situation. Both “consensus” and “social desirability” look at the behaviour of multiple individuals in a similar situation.

Kelley (1971) brought his informational cues together, introducing the concept of observing behaviour over time, and suggesting a model of interaction between these cues to determine how internal or external attributions are inferred.

Empirical studies showed that generally, a person will attribute a behaviour to internal (or personal) causes, if that behaviour has low distinctiveness, high consistency, and low consensus. Alternatively, external (or situational) attributions will be made, if the behaviour has high distinctiveness, low consistency, and low consensus (Schaffer, 2002; Martinko and Thompson, 1998; Ivancevich and Matteson, 1999). An example used in the literature to illustrate this process involves a supervisor's reaction to an employee's tardiness.

The supervisor, Themba, could attribute the behaviour to either internal or external factors. If a late employee, Sizwe, has demonstrated responsibility and competence in other aspects of his job (high distinctiveness), if he has never been late to work before (low consistency), and if other employees were also late during the same time period (high consensus), then Themba is likely to attribute the tardiness to external factors (perhaps the weather or traffic). On the other hand, if Sizwe is generally incompetent and/or irresponsible in other aspects of the job (low distinctiveness), if he has arrived late to work many times prior to this incident (high consistency), and if no other employees were late to work during

this particular incident (low consensus), then Themba is likely to attribute the tardiness to internal (or personal) factors related directly to Sizwe. Importantly, Themba's decision as to whether or not the tardiness is Sizwe's fault depends, to a large extent, on these three factors of distinctiveness, consistency, and consensus.

Kelley (1972) acknowledges that this model is idealised and that there are occasions in which the perceiver lacks the information, time or motivation to examine multiple observations. In these cases, incomplete data attributions are made on the basis of a single observation using causal schemata. These schemata are beliefs concerning how certain kinds of causes interact to produce a specific kind of effect.

One of the simplest causal schemata is the Multiple Sufficient Cause (MSC) schema (Kelley, 1972), which considers that different causes (e.g. adverse home background, poor school environment and lack of individual effort) produce the same effect (e.g. exam failure). The operation of this schema is seen in studies demonstrating the "discounting principle" (Thibaut and Riecken, 1955). Given that different causes produce the same effect, the role of a given cause (e.g. lack of effort) in producing the effect (failure) is discounted if other plausible causes are present (e.g. problems at home) (Gronhaug and Falkenberg, 1994).

Causes may, however, facilitate or inhibit an effect. For example, to succeed in an exam, poor social background would be seen as an inhibiting cause. In this case the "augmentation principle" might be used. The role of certain causes (e.g. individual effort) is augmented, because the presence of a poor social background would be seen to inhibit the effect. Thus, a student from a relatively poor background who succeeds in an exam may have his or her success attributed more to internal factors (such as effort and ability) than would a student from a well-off home (Kelley, 1972).

There are many other kinds of causal schemata, ranging from simple to complex, available to the lay person. Although the exact details of how and when

schemata are used remain unclear, there is evidence that lay people sometimes make attributions as if they were using schemata to meet the need for fast and economical analysis (Gronhaug and Falkenberg, 1994; Surber, 1981).

This basic idea of attribution theory can be applied to organisational settings (Martinko, 1995). For example, when errors take place (a discrepancy), team leaders are likely to develop attributions of cause, ultimately attributing responsibility for poor performance to either personal or situational factors (Schaffer, 2002; Martinko, 1995).

Theorists have generally been divided on whether it is management, or environmental and industry forces, that determine the firm's fate (Walsh and Seward, 1990; Astley and van de Ven, 1983). A manager whose department performed significantly better than established benchmarks is likely to attribute the good performance to internal personal factors, such as his or her own planning skills, interpersonal skills, flexibility, and/or expertise. On the other hand, if the department has performed suboptimally, the manager will likely attribute the poor performance to situational factors, such as a lack of support from other departments, a lack of funds, or problems with outside vendors (Schaffer, 2002; Walsh and Seward, 1990; Astley and van de Ven, 1983).

While Heider (1958) introduced the internal and external distinction to attributions of behaviour, Jones and Davis (1967) introduced the element of intentionality; whereby the assignment of intention to a person was seen to assist in making an internal attribution and visa versa. Kelley (1971) took elements of Jones and Davis (1967) theory, introduced the variable of time, and complexity to the interaction between these principles (informational cues); proposing an interactive model of how these cues interact to lead to an internal or external attribution. He thus brought the elements of intentionality; information and situation together in his model.

2.3 Antecedents and Consequences of Attributions

This approach of antecedents and consequences, allows for theories and research findings to be integrated with one another under common headings, rather than be limited to the theories themselves. The three core theories of Heider (1958), Jones and Davis (1965), and Kelley (1967), described in detail above, provide a good basis for grasping the findings related here.

On the antecedents side, certain information about behaviour and the circumstances of its occurrence are used by the subject to infer its cause. “Antecedents of attributions” research has no interest in consequences beyond the attributions themselves, and they are generally measured directly by verbal report. While, the “consequences of attributions” literature deals with the consequences of the subjects making a particular attribution. It entails assessment or manipulation of perceived causes and the measurement of their effects on behaviour, feelings and expectancies (Gronhaug and Falkenberg, 1994; Kelley and Michela, 1980).

A general critique of this section is that some of the research used to illustrate the antecedents and consequences of attributions are dated. The principle intention of these examples is to define and understand antecedents and consequences so as to provide the tools to distinguish attributions from the data that emerges in the fieldwork; rather than to make empirical comparisons between the findings of this study and previous studies. This understanding is also necessary to interpret maintenance error literature from an attribution theory perspective. Considering this, and the lean amount of attribution research in the maintenance environment (research in other areas is arguably not generalisable to the maintenace environment) , the use of dated research as examples, rather than empirical studies for comparison is justified.

2.3.1 Antecedents

Three main classes of antecedent have been identified. First, the attribution is affected by Information. It is likely that the link between information and attribution involves a variety of processes (Kelley and Michela, 1980). At one

extreme are those of logical analysis (eg. Non-common effects and co-variation). These entail the use of a broad set of information and selection among a sizable set of causal explanations (see Gibson and Schroeder, 2003; Schaffer, 2002). At the other extreme (eg. Salience and primacy effects) are those processes that are more selective in their operation, relying heavily on the earliest or most salient information and settling for the first adequate explanation consistent with it (see Gronhaug and Falkenberg, 1994).

Secondly, attributions are affected by beliefs. At a simple level, an observed effect is directly explained on the basis of existing suppositions about the causes for various effects. In other cases, the effect is explained indirectly by comparing it with expected effects (Kelley and Michela, 1980). As a consequence, explanations can often be given for events without analysing information in the more complex ways that information and attribution are analysed. If processing does occur, it rarely takes place without some influence from pre-existing suppositions and expectations (see Lester et al, 2002).

Finally, attributions are affected by motivation. As would be expected, a person's interests become relevant to and entangled with an attribution in a variety of instances. They determine when he/she will become motivated to make attributions, and if so motivate whether he/she seeks causal understanding in an open ended way or is preoccupied with a particular causal question (Kelley and Michela, 1980). Because self-esteem, social standing, sense of competence, etc. are affected by the attributions one makes, concerns about these matters may render the search for explanation less than completely objective (see Gronhaug and Falkenberg, 1994).

Information

Jones and Davis' theory (1965), described in the previous section of this chapter, postulated that information about the consequences of alternative actions is used to infer the intention behind a particular act (Gibson and Schroeder, 2003; Schaffer, 2002). Empirical support has been provided for the principle of *non-common effects* (that the intention underlying a voluntary act is most clearly

evident when it has a small number of effects that are unique to it) by Newtson (1974), who studied the “number effect“ of the principle and found that fewer non-common effects resulted in more confident and extreme inferences about the actor. The uniqueness aspect of the hypothesis was studied by Ajzen and Holmes (1976). They found that attribution of behaviour to one of its effects was a linear function of uniqueness, being greatest when the effect was unique, and decreasing as it was common to one, two or three alternative acts.

Kelley’s (1967) model of *co-variation* and configuration, also discussed in detail above, states that a given person’s response to a certain stimuli on a particular occasion depends on the perception of the degree of its consensus with other peoples’ responses to stimuli; its consistency with this person’s responses to stimuli at other times; and its distinctiveness from the person’s response to other stimuli (Schaffer, 2002).

One issue that has developed around consensus information concerns its importance relative to other information. McArthur (1972) found that consensus had less effect than did consistency and distinctiveness. Another issue is Ross et al’s (1977) research on the false consensus effect - the overestimation of the importance of the dispositional causes of behaviour. They provide confirming evidence for Heider’s (1958) suggestion that a consequence of the tendency to assume that others generally share our reactions is a tendency to attribute differing views to the personal characteristics of their holders. These studies show that one’s own reaction takes precedence over externally provided consensus information and forms the basis for beliefs about consensus (Kelley and Michela, 1980).

Regarding consistency, a person is known by the behaviour he or she displays consistently. In an experiment by Himmelfarb (1972), he makes the important point that consistency in another persons’ characterisations of an actor carries more weight if they are based on observations in dissimilar rather than similar situations. In other words, a person’s inconsistent behaviour is attributed not to him but to circumstances.

By the rule of *similarity*, properties of the cause are assumed to be similar to properties of the observed effect, so the latter can be used to infer the former. For example, a major consequence such as an assassination seems to require a greater cause then one man acting alone (McCauley and Jacques, 1979).

According to the spatial contiguity principle, there should be some point of contact between an effect and its cause. Temporal contiguity, implicit in the co-variation principle, specifies that the events to be distinguished as cause and effect occur at essentially the same point in time. Ambiguities between causes and effects are resolved by the rule of temporal precedence in which cause is assumed to precede effect (Michotte, 1963). Studies of children's use of temporal contiguity information show greater imputation of causality to an event when the preceding event appears closer in time to the subsequent effect (Shultz and Ravinsky, 1977).

With *salience*, an effect is attributed to the cause that is most salient in the perceptual field at the time an effect is observed. This principle has been applied to the question of whether an actor's behaviour will be attributed to him/her or to the situation within which it occurs (Gibson and Schroeder, 2003; Gronhaug and Falkenberg, 1994; Kelley and Michela, 1980). Some interpretations of salience effects have assumed that they are mediated by superior memory for the salient cause. The principle suggested here is that an effect is attributed to the first cause that comes to mind when the attribution question is raised, or at least the first one that provides a sufficient explanation (Gibson and Schroeder, 2003; Gronhaug and Falkenberg, 1994).

When a person scans and interprets a sequence of information until he or she attains an attribution from it and then disregards later information or assimilates it to his/her earlier impression, this is known as *primacy*. Jones et. al (1968) compared ascending and descending orders of performance and obtained a primacy effect: higher ability was attributed when correct answers were given by the person mainly during the first 15 of 30 problems rather than during the second 15 problems. A possible explanation for this is a process of assimilation

of later trials to earlier ones through the cognitive distortion of later trials to make them seem more similar to the earlier ones.

Beliefs

Among the studies of causal suppositions, those concerning the *causes of success and failure* are the most frequent. These studies show that relative to failure, success is attributed more to the person, (ie. ability, effort, stable traits etc.) Further, with few exceptions, the success of unspecified or unknown persons is attributed to factors within the person (see Silvester and Chapman, 1997; Schaubroeck, 1999; Schaffer, 2002; Gronhaug and Falkenberg, 1994; and Lester et al, 2002; Kelley and Michela, 1980).

Expectations about actors, specifically the effects associated with an actor (person who carries out an observed action), such as the likelihood of success, probable attitude, and behaviour, reflect beliefs about past consistency (Schaffer, 2002; Kelley and Michela, 1980). Therefore, consistent with Kelley's (1967) model, behaviour consistent with what is expected would be attributed to a stable property of the actor, and behaviour that departs from what is expected, to a temporary or causal factor, such as circumstances or states (Deaux, 1976). The good behaviour of a liked person and the bad of a disliked person are attributed to personal factors, whereas inconsistent behaviour is attributed to situational factors (Bell et al, 1976).

Expectations about behaviour in situations, are base rate expectations about the likelihood of the occurrence of a particular behaviour in a particular situation. These expectations constitute assumptions about consensus, therefore we would expect behaviour consistent with the expectations to be attributed to situational constraints, the external stimulus, etc. and behaviour that departs from what is expected, to something about the person, either stable or unstable (Schaffer, 2002). Ajzen (1971) and Trope (1974) studied expectancies associated with particular situations. Situational requirements were varied by the relative attractiveness of alternative behaviours (Ajzen, 1971) and by degree of choice (Trope, 1974). In both studies, behaviour out of keeping with the situation was

found to provide a greater increase in perceived likelihood of the actors holding a behaviour-correspondent attitude than did situation-appropriate behaviour (Kelley and Michela, 1980).

The *Discounting* Principle (Kelley, 1972) predicts that there will be less attribution of a behaviour-correspondent disposition to the actor when his/her behaviour is that expected in a situation than when the same behaviour occurs without constraint. The expected behaviour is discounted as an indication of disposition because it may plausibly have been caused by situational pressures (Schaffer, 2002; Gronhaug and Falkenberg, 1994). The *Augmentation* Principle (Kelley, 1972), states that there will be more attribution of a behaviour-correspondent disposition for the contraindicated behaviour than for similar unconstrained behaviour. Occurring in the face of demands, the contra-indicated behaviour is taken as revealing a stronger correspondent disposition than does similar behaviour that occurs without constraints (Schaffer, 2002; Gronhaug and Falkenberg, 1994).

Jones (1979) calls attention to an apparent *failure of discounting*. He found that there is a failure to fully discount unexpected actions, even though external pressure would seem to provide sufficient explanation for it. These results are taken as evidence of what Heider (1958) referred to as “behaviour engulfs the field” and what Ross et al (1977) termed the fundamental attribution error.

A *causal schemata* is a description of the lay person’s conception of how two or more causes combine to produce a certain effect (see Gibson and Schroeder, 2003; Gronhaug and Falkenberg, 1994. For example, he or she may believe that either cause A or cause B suffices to produce a given effect (schema for multiple sufficient causes) or that both A and B are necessary (schema for multiple necessary causes). These and other possible schemata and their implications are presented by Kelley (1972).

Cunningham and Kelley (1975) show that effects of moderate magnitude are in terms of the multiple sufficient cause schemata, but effects of extreme

magnitude, in terms of the multiple necessary cause schema. For example, success on easy tasks and failure on difficult ones can be explained in terms of either ability or effort, but success on difficult tasks and difficulty on easy ones require the invoking of both factors.

Beliefs not only affect the attributions made for events, but also affect the intake and use of *causally relevant information*. The interplay between prior beliefs and new information involves sequential processes in which the prior structures both affect the information and are affected by it. Golding and Rorer (1972) have shown that suppositions about the causes of specific behaviours lead observers to see nonexistent covariation in data and to overlook true covariation. Ajzen (1977) found that use of covariation in prediction depends on its fit with prior causal beliefs. Of further interest, Zadny and Gerard, (1974) showed that the understanding of an actors intention strongly affects memory for what he/she is observed to do.

Motivation

One of the conditions that may instigate the attribution process is dependence of the perceiver on another person (Lester et al, 2002; Kelley and Michela, 1980). In a study by Berscheid et al (1976), who studied the *motivation to make attributions*, each subject was made dependent on another person of the opposite sex, by assigning that person to be the subject's date for a future social outing. The subject then observed a videotaped group discussion in which the future date was one of the participants. The results showed that the future date was attended to more than the non-date, and more details were remembered about the future date.

Furthermore, in analyses which supported the Jones and Davis (1965) hypothesis on "hedonic relevance", subjects were found to make more extreme and confident trait inferences about the future date than about the other people. Thus it appears that subjects were motivated by their greater dependence on the future date to do more attributional work, such as information search and trait inferences, with respect to that person.

Kassin and Hochreich (1977) studied the effect of importance of accuracy in attribution. They presented subjects with brief stories about events and measured attributions to the person, stimulus, situation, or combination of these factors. The experimental group, which was told that their responses would indicate their social intelligence, made more attributions to the combination category than did the control group. These results may suggest that when accuracy is important, the attributor produces more complex explanations.

A person's positive behaviour, including his/her success, has potential for the *enhancement of self esteem* if he or she is causally responsible for it. Thus, motivation for self-enhancement should result in self-attribution of positive behaviour. Similarly, since negative behaviour may have negative implications for self-regard, unless causal responsibility is attributed externally, such attributions should result from motivation for self protections (Gronhaug and Falkenberg, 1994; Kelley and Michela, 1980).

Reviews by Zuckerman (1979) of the research on attributions for success and failure show that, consistent with these assumptions, attributions for success are usually relatively internal and attributions for failure are usually relatively external. These findings however, do not necessarily demonstrate motivated biases in attribution (Kelley and Michela, 1980). Studies show a strong tendency for the successes of other people not known to the attributor, to be attributed to internal factors. Thus, there exists a general belief that success is internally caused and this belief alone may explain internal attributions for one's own successes (Kelley and Michela, 1980).

Another example is a study by Deaux (1976) where the inference of effort as an internal cause for success but not failure, is facilitated by the fact that co-occurrence of high effort and success implies effort as the cause, but co-occurrence of high effort and failure implies that some cause other than effort must be sought.

Attributions are an important part of what people communicate about themselves and their activities. These communicated attributions may be influenced by the actor's *motivation to present himself/herself in a favourable manner*. Self presentational concerns have been analysed in the context of attribution experiments. When reporting their attributions, subjects may be motivated to give explanations that make the most positive self-presentation to the experimenter (Kelley and Michela, 1980). The usual pattern of internal attributions for success and external for failure could be attenuated or reversed by such a motive, either to imply the attributor's modesty (Feather and Simon, 1971) or to avoid embarrassing invalidation of causal explanations in case outcomes should change in the future; or if another persons' attributions are to be compared with those of the subject (Bradley, 1978). It should be kept in mind that self-presentation occurs in many forms, and might therefore lead to attributions of success either to external factors, to appear modest, or internal ones, to appear competent (Kelley and Michela, 1980).

Attributions to controllable factors imply that the person can satisfy his/her goals through his/her own effort. Thus, such attributions should be beneficial in promoting expectations that the goals will be reached. It has been observed by Kelly (1972) that a bias toward *attributions to controllable factors* might yield an adaptive advantage by maintaining strivings toward goals. Most of the research relevant to this topic has been concerned with people's attempts to maintain expectancy that negative events will not happen to them.

The just world hypothesis, as described by Lerner and Miller (1978), is based on a need to believe that the world in general is orderly and that one's own strivings will not be blocked by chance interferences from the physical and social environment. Research on this hypothesis demonstrates that people derogate others who are victims of negative events. This derogation presumably follows from attribution to the victim for the negative event, thereby maintaining belief in an orderly and non-interfering world (Kelly and Michela, 1980). This relationship could be explained in non-motivational terms by the fact that severe events are

less expected and may require for their occurrence a greater causal role by the victim or perpetrator (Younger et al, 1978).

Actors' versus Observer's Attributions

In the comparison between actors' and observers' attributions, all antecedents come under scrutiny as possible differentiating factors, and questions are raised about the interplay among beliefs, information and motivation (Kelly and Michela, 1980). Jones and Nisbett (1972) identified two major categories of factors as likely to contribute to actor-observer differences: (a) cognitive factors, including informational, perceptual and processing differences; and (b) motivational factors, including differences in concerns about self evaluation and self presentation.

Regarding *cognitive factors*, the observer may know nothing more about the actor than his/her behaviour in a particular situation or in a limited range of situations, whereas the actor knows of his/her behaviour in many situations and is aware of its cross-situational variability. Thus, the observer may assume more consistency of behaviour and infer dispositional causality (Kelly and Michela, 1980). Several studies verify that actors perceive more cross-situational variability in their behaviour and observers make more trait ascriptions (Nisbett et al 1973). Storms (1973) found that when the actor was shown a videotape replay of his own behaviour in a discussion, the actors attributions became less situational, and when observers were shown a replay of the discussion made from the actors perspective, their attributions became more situational.

Motivational factors are another possible source of difference between actors and observers, whereby their different interests in how a given event is explained. In particular, the actor's concern to receive credit for the good consequences of his actions and to avoid blame for the bad consequences (Lester et al, 2002; Gibson and Schroeder, 2003; Kelley and Michela, 1980). If motivated in this egocentric way, actors' attributions for positive behaviour might be more internal than observers' attributions, contrary to Jones and Nisbett's (1972) hypothesis that there is a tendency for actors to attribute their actions to

situational requirements whereas observers tend to attribute the same actions to stable personal dispositions (Kelley and Michela, 1980).

Questions remain as to the precise conditions under which results concordant with or opposite to the hypothesis will be obtained. Monson and Snyder (1977) argue, it is possible that these tendencies relate to differences between actors and observers in the accuracy of their attributions. Actors have more and better information and therefore tend to make more accurate attributions.

2.3.2 Consequences of Attributions

As an intervening cognitive factor, attribution cannot be manipulated directly, so research on consequences always involves variation in the antecedents of attributions. Because the presumed mediating attribution usually goes unmeasured, there is often ambiguity as to the exact attribution involved, or whether attribution is the mediator at all (Kelley and Michela, 1980).

Actor versus Environment

Whether an action is attributed to the actor or to some aspect of the environment affects such things as liking for the actor, trust in him/her, and his/her persuasiveness. Kelley (1972) and Regan (1978) summarise some of the research that shows that a person's helpful act that can be ascribed to him is responded to more warmly than the similar act that is attributable to external pressure. On the other hand, the externally justified action that harms or frustrates a person is better tolerated and less reciprocated than a similar action attributed to the actor.

Strickland et al (1976) show the effect of a supervisor maintaining surveillance over a worker. A worker so monitored is trusted less than one who produces similar output without monitoring. It is presumed by them that the production of the worker who is monitored, is attributed to the external pressure, and following the discounting rule, his work motivation is less clear. Strickland et al (1976) also show that when the supervisor has a heavy schedule, he/she subsequently

monitors the previously monitored and now less trusted worker more than the previously unmonitored one.

Intrinsic versus Extrinsic Motivation

Some activities reflect intrinsic motivation, being done for the inherent satisfaction they yield; others reflect extrinsic motivation, being done for the external goals to which they lead. Attributional research on intrinsic-extrinsic causality identifies the consequences of shifting an actor's perception of his/her own motivation from the first to the second by attaching a reward to an initially attractive activity (Kelley and Michela, 1980).

Arousal

In general, interest in an activity is reduced by its performance in anticipation of positive incentives or under other conditions such as surveillance and deadlines, that give it the appearance of a task (Schaubroeck, 1999). These conditions have also been shown to reduce the quality of performance of the activity (Lepper and Greene, 1978).

Studies show the consequences of arousal being attributed to one or other cause, where the diverse consequences revolve around emotional experiences and evaluative reactions (Schaubroeck, 1999; Kelley and Michela, 1980). This line of research derives from Schachter's (1964) theory of emotion which, when cast in attributional terms, states that the emotion a person will experience upon his/her arousal depends on the explanation he/she has for it (Schaubroeck, 1999; Kelley and Michela, 1980).

Arousal by an unperceived cause can affect emotional behaviour through its attribution to some other cause, is well supported in research on aggression (see Schaubroeck, 1999). Rule and Nesdale (1976) surmise that the general paradigm is one in which the subject is badly treated by another person and also has heightened arousal from an extraneous source such as physical exercise, aversive noise, high temperature, erotic stimuli etc. Under these conditions, the provoked subjects are more aggressive, measured through the number of

electric shocks delivered to the recipient by the perceiver, and verbal hostility, than similarly provoked subjects lacking the extra arousal. The extra arousal does not have this effect when the subjects are led to attribute it to its true source.

Zillmann et. al. (1974), noted for their use of natural variations in the perceived causal linkage between the extraneous cause and the arousal, followed a sequence in which subjects were provoked by a confederate, engaged in strenuous, arousing, physical exercise, and then immediately or after a brief delay, were able to retaliate against the provocateur. The retaliation after a brief delay was greater than that immediately, presumably because even though the delay permitted the arousal to decrease somewhat, it sharply reduced its attribution to the exercise (Kelley and Michela, 1980).

Skill versus Chance

The effect of attributions upon achievement striving was first investigated in relation to a distinction between the perceived causes of skill and chance. Phares (1957) found that when subjects were told that their success on a judgement task was due to skill, expectancy of future success was higher than when success was due to chance, while on the other hand, failure due to chance rather than skill, yielded higher expectancy of future success.

Weiner et al (1972) proposed a two-dimensional classification scheme, with causes being cross-classified in terms of stability (stable-unstable) and locus of control (internal-external). In this scheme, ability (skill) is internal and stable while luck (chance) is external and unstable. The remaining causes in the 2 x 2 classification are effort which is internal and unstable, and task difficulty which is external and stable .

Weiner (1979) holds that the expectancy shifts found to be a consequence of skill-chance manipulations are determined by the stability of the perceived cause, rather than its internal or external locus. In support of this, Weiner et al (1976) found that expectancies for continuing success on a block design task were

higher among subjects making attributions to stable causal factors rather than to unstable ones, but were not affected by locus of causality. Further, Weiner et al (1972), predicted that internal attributions, relative to external, heighten affective reactions such as pride for success and shame for failure.

Carroll (1978) proposed that parole would be a consequence of attributing a crime to unstable factors, thereby rendering future crime less likely, and to external factors rendering the criminal less deserving of punishment. His results revealed that stability of attribution and especially expectancy for future crime was among the significant predictors of decision to parole (Kelley and Michela, 1980).

Intentional versus Unintentional

When a person's actions are seen as intentional, they are evaluated quite differently than when they are unintentional. Work based on Heider's (1958) levels of responsibility for actions has shown that a person is more praised for positive outcomes when these are produced intentionally rather than unintentionally, and negative outcomes elicit more blame when produced intentionally (see Schaffer 2002; Martinko, 1995; Kelley and Michela, 1980).

Tedeshci et al (1974) claim that behaviour comes to be labelled as aggressive partially on the basis of intentionality and that this labelling of behaviour in turn has consequences such as rendering acceptable acts of retaliation. Ickes and Kidd (1976) hypothesised that more help is given to people whose need is attributed to unintentional factors rather than intentional ones.

2.3.3 Summary

The author has discussed the core theories that form the basis of attribution theory. These and other studies were then integrated under the headings of antecedents and consequences of attributions which has achieved the first purpose of this literature review; a thorough understanding of attribution theory that provides the tools necessary to distinguish attributions from the data that could emerge during the fieldwork and explain these attributions in terms of

attribution theory. The next step is to take this attribution paradigm and examine maintenance error literature from this social psychology perspective; with the intention of understanding this literature, and drawing from it possible error attributions that could be made by participants during the fieldwork. Understanding the maintenance error literature from an attribution perspective provides a reference point from which error attributions made by participants can be distinguished in the maintenance environment.

2.4 Maintenance Error

Maintenance error forms a category under the broader discipline of Human factors. Taking into consideration time and space constraints, the most relevant topics of interest within maintenance error to this research, are those of Error Varieties, and Contributing Error Factors. Some basic background information, as an introduction to Human Factors is covered, after which much of the focus is on placing the above mentioned topics in an appropriate framework of primary and secondary error attributions, since they are fundamental to the data analysis and interpretation of the results.

In this step, “error varieties” and “contributing error factors” in maintenance error literature (see Reason and Hobbs, 2003, Hobbs, 2001,and Hobbs and Williamson, 2002) is organised into primary and secondary error attributions that participants could make during interviews and focus groups. Sampled participants are not expected to make a differentiation between error varieties and contributing error factors, since in essence, they are both errors to the lay person. Thus, the onus is on the researcher, to extract the possible attributions that could be made by participants from maintenance error research, and place them in a framework within which the data that is acquired through fieldwork can be coded, interpreted and discussed, to produce knowledge that can be beneficial and useful in the future.

While specific maintenance error research using attribution theory as the foundation has not taken place, “error varieties” and “contributing error factors” that have been identified in maintenance error literature (see Reason and Hobbs,

2003, Hobbs, 2001,and Hobbs and Williamson, 2002) can be seen as attributions themselves; since the majority of these emerged through error investigations at organisations, in most cases utilising interviews with maintenance staff and managers; or similar research, predominantly quantitative questionnaires. Research on error attributions in other contexts, such as workplace safety, has taken place (see Dejoy, 1994).

Farr (1977) argued that the results of the common research procedure in which respondents give what they see to be the causes for positive and negative events should not be taken at face value because they reflect an attribution artefact, that good outcomes are attributed to the self and bad ones to the environment. Interpreting this in terms of the present research, responses by participants during error investigations or similar research are in fact attributions (suggesting that they hold inherent belief, motivational, informational biases). Thus, reorganising “error varieties” and “contributing error factors” in maintenance error literature, into primary and secondary error attributions that participants could make during interviews and focus groups is justified.

2.4.1 Human Factors and Maintenance Error - Background

Human factors is understood as the study of human beings in their interaction with products, environments, equipment and machines in performing tasks and activities with the objectives of maximising human and system efficiency, human well-being and quality of life (Meister, 1991; Sanders and McCormick, 1993). This field uses the knowledge of human abilities and limitations to the design of systems, organisations, jobs, machines, tools, and consumer products, for safe, efficient and comfortable human use (Chapanis, 1995); thus reducing maintenance errors, as well as improving productivity and psychological well being; by virtue of human beings not being required to perform jobs or tasks for which we are not suited.

A basic tenet of human factors is that the optimisation of human and system efficiency requires the adoption of the systems approach; where all major system components are given adequate consideration throughout the system design

process. Designs that do not consider the human element will not achieve the desired level of performance. Thus a central activity of human factors is the application of information regarding human performance to all phases of system development and design (Czaja, 1997).

A human-machine system is some combination of one or more humans and one or more physical components to transform inputs into desired outputs. This interaction takes place within an environment. The environment encompasses the specific task environment (eg. lighting, or temperature etc.) and the social and organisational environment. The system may be simple, such as a human interacting with a tool, or it may be more complex, such as a human monitoring an automated process. In all cases, human factors is concerned with the optimisation of the interaction between the human and the physical component; to reduce negative outcomes such as maintenance errors in the case of this research, and produce more positive outcomes, such as improved productivity, concentration, quality of work and so on (Czaja, 1997).

The systems concept implies that components or elements of a system are only meaningful in terms of the whole system. Specifically each element of a system must be viewed in terms of its interaction with other elements of the system. The reductionist approach focuses on a particular system component or element in isolation. This approach has traditionally been the most popular approach to system design where the focus has been on the physical or technical components of the system with little regard to the behavioural component (Czaja, 1997). This approach places strain on the human being operating the system and makes him other more prone to error, since the system is not designed within the physical and cognitive limitations that are inherent in a human beings.

Applied to the field of human factors, the systems concept infers that performance must be evaluated in terms of the context of the human-machine system; equipment, environment, operating procedures, and goals. Human factors engineers generally agree that the overall efficiency of a system is determined by optimising the performance of both the human and physical

components. Traditionally the design engineer focuses solely on the technical component of the system, and the behavioural scientist focuses solely on the performance component. Human factors is unique in that it is concerned with both the behavioural and physical domains (Meister, 1989).

To define maintenance error, it is first helpful to define "human error." Human error, defined in a social sense (as compared to technical), would be as follows: "When there is general agreement that a person should have done other than what they did, then the person has committed an error" (Marx 1998, pg. 10). What can be seen in this definition is that "human error" is not really the determination of the erring individual, but of others looking in, hence attributing the error to someone.

Maintenance error, as an extension, is where there is general agreement that the maintenance system (made up of people) should have done other than what it did. Historically this meant that the technician should have done differently, but the term is now used to include error by any human in the chain of events, whether it is the technician, the maintenance planner, the manager, or the CEO (Marx 1998). Further, by virtue of being a system, it is not limited to human errors, but all elements of the system.

Maintenance error includes such actions as the backward installation of a hydraulic valve, the failure to tighten an oil filler cap, or missing a crack during inspection of an engine disk. These are the types of events that this research report addresses: human errors within a maintenance organisation that might ultimately lead to an on-aircraft discrepancy, injury, or financial losses

Further, critical incidents like the aircraft accidents at Tennerife in 1977, the United DC8 fuel exhaustion accident off the Oregon coast in 1978, and the nuclear plant Three Mile Island in 1979, focused considerable attention on the study of human factors, such as training, communication, procedures, situation awareness, and crew resource management. For the purposes of this study,

human factors findings such as these are all considered, when compiling the possible error attributions (Johnson, 1999).

In 1988 the Aloha Airlines 737 encountered the famous “convertible aircraft” phenomenon. This accident placed focus on the aging aircraft fleet, but just as much attention was focused on maintenance human factors. The Aloha Accident report identified numerous human factors issues including, training, use of procedures, and the misuse of a manufacturer’s service bulletins as the cause of an accident (National Transportation Safety Board, 1989).

Since the ALOHA accident in 1988, the FAA, labour unions, aircraft and engine manufacturers, and the U.S. air carrier industry have been working together in a project called maintenance human factors. With the growing recognition that many accidents may involve maintenance error, the industry has turned to the science of human factors to provide answers to why a technician, ground crew agent, or storeroom clerk could have made an unthinkable accident-causing error. Through human factors, we are able to take a new look at technician performance, a look that would lead us to error-provoking factors that, if properly managed, would result in a large reduction in maintenance error (Marx, 1998).

In determining what human factors, error varieties or contributing error factors are at play, an error investigation is utilised. In a majority of the cases, this error investigation method is one that is based on an interview format, whereby the staff member responsible for what is perceived to be an error (based on the rules, regulations and legislation of the company as well as damages, financial and other losses) is interviewed to gather information regarding the error. In more advanced error investigation methods, witnesses, team leaders, as well as the staff member involved are interviewed to determine the human factors and contributing errors involved in causing the particular error (Reason and Hobbs, 2003).

This method introduces the attribution artefact as described by Farr (1977) since those people that participate in the investigation process, both the interviewer

and interviewee's could introduce attributions with their own informational beliefs, motivation, or other biases, by virtue of them communicating their attributions for an error rather than concrete evidence that takes into account "all" possible variables for an error.

Reason and Hobbs (2003), two of the foremost experts in this field, define an error as the failure of planned actions to achieve their desired goal, where this occurs without some unforeseeable or chance intervention. The rider distinguishes controllable or voluntary actions from those shaped by mere luck, either bad or good. All errors involve some kind of deviation—the departure of actions from their intended course, or the departure of planned actions from an adequate path towards some desired goal, or the deviation of work behaviour from appropriate operating procedures.

By nature, this definition leaves much room for interpretation and relativity. What one person may see as an error, and understand to be an error, could be different to another person who may not have the same knowledge, exposure, experience, information etc. Further, and rightly so, this definition does not make the differentiation between error varieties and contributing error factors. An error to one person, could be seen as a contributing factor to an error by another person.

These complexities, in defining what an error is, are taken into account when putting forward the framework that follows, which consists of primary and secondary errors as possible attributions, that reorganises error varieties and contributing error factors, as laid forward by Reason and Hobbs (2003), into primary and secondary error attributions. What should be noted of utmost importance is that this forms the reference point for the later coding and interpretation of data into primary or secondary errors.

2.4.2 Primary and Secondary Error Attributions

In building this attribution framework, the terminology of primary and secondary errors is seen as most appropriate. To the lay person, an error is an error;

whether it makes his or her life more difficult, or whether it causes millions of rand of damage it is still an error. Thus, the chosen framework cannot be too complex, and inevitably inapplicable to coding and interpretation of acquired lay attributions.

Firstly, this researcher has defined primary error attributions as those attributions to an error that would typically have an impact on the person, but not cause financial losses, physical injury, or damage; and are typically not visible since they have to do with more behavioural and biological elements such as organisational culture, circadian rhythms, work motivation etc. The origin of this definition is from what Reason and Hobbs (2003) called “local contributing error factors”, which they refer to as the factors that are present in the immediate surroundings at the time of the error; and included documentation problems, time pressure, poor housekeeping, environment, and tool control.

Secondly, this researcher has defined secondary error attributions as those attributions that are made to visible errors. Those errors that have already been manifested due to a single or number of primary errors and possibly even secondary errors. Typically this would include error attributions that cause financial loss, damage, or physical injury; such as damage to equipment, equipment not available, lack of tooling etc. The origin of this definition, is also from Reason and Hobbs (2003), but what they described as “error varieties”. In their description of error varieties, Reason and Hobbs (2003) identified three basic error types, including skill-based errors, mistakes, and violations. These definitions should be seen as guidelines that cover the majority of error attributions, rather than all attributions, since it can be expected that there will always be exceptions to the rule.

Thirdly, since certain secondary errors could be contributing factors to other primary errors within the event chain (Kanki, 2000), the context within which certain attributions are made should be taken into account in any framework put forward to define or label attributions that are made. Maintenance error literature has identified many potential “error varieties” and “contributing error factors”

(attributions) that can affect worker performance for good or ill. The International Civil Aviation Organisation (ICAO) lists over three hundred such influences ranging from heat and cold, through to boredom, nutritional factors and even dental pain (ICAO, 1993). Experience shows that a relatively limited number of factors, and thus possible attributions, appear over and over again in maintenance accident and incident reports (Reason and Hobbs, 2003).

What then definitively differentiates error attributions from being primary or secondary error attributions is also the context within which they are portrayed (whether they were primary errors that contributed to other secondary errors, or were the secondary errors themselves), coupled with how they fulfil the criteria listed in the definitions above.

As an example, if a person gets injured using a stand which is unserviceable, the injury is a secondary error attribution, since it is visible and may result in the loss of a human resource for the period of recovery as well as insurance and medical costs. However the unserviceable stand in this instance is the primary error attribution since it was seen as the underlying cause of the injury. But, should the unserviceable stand have been a result of an attribution to an overworked equipment manager who has not fulfilled his or her duty to service the stand, then work overload would be an additional primary error attribution, to the secondary error attribution of an unserviceable stand.

Thus, it has been illustrated that an error factor, such as an unserviceable stand could be attributed as both a primary error and a secondary error depending on the context of the situation recorded by the observer. For this reason, it is difficult to pigeon-hole errors at the onset into one of the two attributional groupings, but must be examined in terms of the definitions of primary and secondary errors, and the context within which they occur.

For this reason, the categories that follow, form the reference point for this study to differentiate an error attribution; and have the ambiguity of possibly being both primary and secondary attributions, since what is of interest from this research

perspective are the attributions of the actors themselves, what they are, and how they pan out in comparison to attribution literature. Attributions that are identified in the data analysis can then be differentiated into one of these categories; and whether they fall into a primary or secondary attribution based on the definitions above.

This approach allows for the flexibility that exploratory attribution research such as this study requires, since what is important is accurately recording what attributions lay people make and examining these within some framework that allows differentiation and comparison, allowing relationships and patterns to emerge; rather than shoehorning their attributions into predefined and preconceived relationships and patterns that would produce little new information due to the exploratory nature being lost in the coding and analysis, by virtue of this shoehorning.

Documentation

Maintenance jobs typically start and finish with documentation. Documents convey instructions about task performance, and also play an important part in communication, by recording the completion of tasks and the extent of system disturbance (Reason and Hobbs, 2003).

Much of an airline maintenance personnel's time is spent using fiche readers, technical logs, task cards and maintenance manuals, or signing off tasks (Hobbs and Williamson, 2002). The more unfamiliar the task, the more time is spent dealing with documentation. Documentation may guide performance on new or unfamiliar tasks, but as people become more familiar with a task they are less likely to refer to the paperwork. This has its risks, particularly if procedures change.

Poorly designed documents lie at the heart of many incidents. Procedures that are ambiguous, wordy or repetitive are likely to promote errors. Procedures that are unworkable or unrealistic are likely to promote violations. Simplified English can make the language of maintenance documentation clearer and more

accessible, particularly in the case of staff for whom English is a second language (AECMA, 1989).

Small improvements in page layout, diagrams and warnings can help to reduce errors. Replacing blocks of upper case text with normal mixed-case text can increase reading speed by 14 per cent (Drury et al, 1997).

Making an attribution to documentation as an error, essentially says that the information available on which to perform an action was incorrect. Fundamentally, this is an external attribution from the employees perspective (to situational factors) since the person involved denies intentionality for the act; however it could be an internal attribution to the organisation, since someone in the organisation would be responsible for ensuring that documentation is up to date, formatted correctly and in an understandable manner. Further, an attribution to documentation from an organisational perspective could indicate an external attribution if documentation provided by international aircraft manufacturers is utilised, which may not be culturally sensitive due to the use of language for example.

Time Pressure

As operators strive to reduce the amount of time that aircraft spend out of service, time pressure has become a fact of life for most maintainers. A particular risk is that maintenance personnel faced with real or self- imposed time pressures will be tempted to take shortcuts to get an aircraft back into service more quickly (Hobbs and Williamson (2000).

Hobbs and Williamson (2000) found in their study that thirty-two percent of respondents, reported that there had been an occasion when they had not done a required functional check because of a lack of time.

Constantly being under time-pressures has implications of stress and associated emotions. In relation to attribution theory, Schaubroeck (1999) states that emotions are determinants of information processing; for example, anxiety

activated memories that focus on threats, which in turn facilitate processing environmental information in terms of threatening cues and threat schemata. People often make inaccurate attributions in their attempts to explain their arousal to themselves; for example, high levels of noise, temperature variation, and spatial density may directly promote certain kinds of arousal, and people can misattribute this arousal as reflecting their own anger or anxiety (Schaubroeck, 1999).

Noise, temperature variations, time pressures and working in confined spaces is common place in the maintenance environment. The implication of Schaubroeck, (1999) is that maintenance staff, under these conditions may misattribute their arousal to their own internal anxiety and anger; which in turn determines their information processes and decision making at that point.

Housekeeping and Tool Control

Housekeeping, including the way tools and equipment are tracked, is a fundamental factor that can increase or decrease the chances of errors. It extends to keeping track of items used in maintenance, such as rags and removed or disassembled components (Reason and Hobbs, 2003).

Ultimately, the housekeeping practices of an organisation reflect beliefs about people and how they do their jobs. Behaviour consistent with what is expected would be attributed to a stable property of the actor, and behaviour that departs from what is expected to a temporary or causal factor such as circumstances or states (Schaffer, 2002; Kelley, 1971). Poor housekeeping practices reflect an expectation of tardiness and untidiness within the organisation rather than the individual. They increase the chances of mistaken assumptions and memory lapses. The way tools and components are arranged and stored is not just a matter of convenience. It is an important form of communication that provides situational awareness and reduces the chances of error (Reason and Hobbs, 2003).

Coordination and Communication

Some of the most serious maintenance errors have had their origins in poor communication practices. In a recent survey by Predmore and Werner (1997) senior US maintenance mechanics were asked to identify the most challenging part of their job. Their most frequent answer was “human relations or dealing with people”.

Performing in a team requires technical know-how, as well as communication and people skills. Taylor and Christensen (1998) have observed that maintenance managers and technicians possess highly technical skills, but sometimes lack the communication skills to ensure safety in today’s complex operations. They go on to suggest that what is needed is a better balance of technical skills and social skills.

In the Australian maintenance survey, 12 per cent of reported occurrences featured coordination problems such as misunderstandings, poor teamwork or communication, or incorrect assumptions (Hobbs, 2001). Coordination breaks down when people make unspoken assumptions about a job, and fail to communicate with one another to confirm the situation.

Most major airlines now provide flight crew with training in non-technical skills such as delegation of tasks, communication, management and leadership (Weiner, Kanki and Helmreich, 1993). There is an increasing recognition in crew resource management literature and practice, that non-technical skills such as these are as important within maintenance operations as they are for flight crew (Taylor and Christensen, 1998).

Tools and Equipment

Among the most influential conditions influencing work quality are the tools and equipment available to do the job. In the Hobbs (2001) survey, the second most commonly cited contributing factor was equipment deficiency, most often a lack of correct ground equipment or tools. For example, a required tool may not have been available, leading to an improvisation. Many of the equipment problems

resulted in hazards to maintenance workers themselves. The non-availability of tools and equipment can be powerful initiators of human error as workers struggle to perform their tasks in the face of obstacles and frustration, and the associated time deadlines.

In other cases, the design of ground equipment or tooling is partly responsible for an incident or error. The maintenance of maintenance equipment is itself a crucial task for management, yet one that sometimes does not get the attention it deserves. The very adaptability of maintenance workers is part of the problem. If the right stand is not available, another can be made to fit, if the correct tool is not available, perhaps one can be made. Clearly, equipment deficiencies breed violations, because there are few alternatives if the job is to be done. If maintainers stopped work when a piece of equipment was not available, the problem would be more obvious to management, but a “can do” attitude often prevents this (Reason and Hobbs, 2003).

Fatigue

A range of bodily functions undergo 24-hour circadian rhythms, linked to the night/day cycle. As night sets in, several changes occur in the human body. Body temperature decreases, the levels of various body chemicals change and alertness begins to reduce. Statistics from a range of industries reveal that errors are more likely to occur in the early hours of the morning than at any other time (e.g. Mitler et al, 1988).

Recent research has shown that moderate sleep deprivation of the kind experienced by shift workers can have consequences that are very similar to those produced by alcohol (Dawson and Reid, 1997). After 18 hours of being awake, mental and physical performance on many tasks is affected as though the person had a blood alcohol concentration (BAC) of 0.05 per cent i.e. 0.05 gram per 100 millilitres of blood. Boring tasks that require a person to detect a rare problem (like some inspection jobs) are most susceptible to fatigue effects. After 23 hours of being continuously awake, people perform as badly on these tasks as people who have a BAC of 0.12 per cent i.e. 0.12 gram per 100

millilitres of blood (Dawson and Reid, 1997). Placing this in context, South Africa's legal driving under the influence of alcohol limit, is 0.05 gram per 100 millilitres of blood; Sweden's is 0.02 and the UK and US is 0.08 gram per 100 millilitres of blood.

One in five of the engineering personnel who responded to the Australian survey said that they had worked a shift of 18 hours or longer in the last year while some had worked longer than 20 hours at a stretch (Hobbs and Williamson, 2002). Like drunks, fatigued individuals are not always aware of the extent to which their capabilities have degraded (Dinges et al, 1998).

Fatigued workers can become more cranky and irritable; but perhaps most importantly for maintenance is the fact that they have trouble controlling their attention. Information slips out of short-term memory more easily, and memory lapses become more likely (Reason and Hobbs, 2003).

Shift-Work

It used to be thought that night workers adjusted and that their body rhythms became inverted, or synchronized so that, for them, the early hours of the morning were like the middle of the day, and the middle of the day was their period of greatest fatigue. We now know, however, that even permanent night-work only results in a general flattening of the 24-hour body cycles. Night workers are not quite as fatigued in the early hours of the morning as a day worker would be, but neither are they able to obtain completely refreshing sleep during the day (Reason and Hobbs, 2003).

The duration of the shift and the quality of sleep that the person has obtained are also crucial. While some shift-workers claim to be able to get adequate sleep during daytime hours, the sleep obtained during the day is generally briefer and less refreshing than night time sleep. Maintenance workers may be sleep-deprived at the start of a shift, and the circadian dip in arousal and performance will be even more serious than usual (Reason and Hobbs, 2003). Maintenance

work at night can present problems other than fatigue. Technical support may be unavailable or else hard to obtain, and supervision may be reduced.

Knowledge and Experience

A lack of knowledge or experience is one of the most obvious factors leading to maintenance errors. Most maintenance personnel have had the experience of carrying out a new task, while not being entirely sure whether they were doing it correctly. Such trial-and- error performance is by definition prone to being unreliable. Younger workers, in particular, need to know about the traps lying in wait for them, yet too often they are allowed to discover these for themselves (Reason and Hobbs, 2003).

The way a maintainer approaches a task will be greatly influenced by whether it is one that he or she has done many times before or is performing for the first time. It is well established, for example, that the time taken to perform a maintenance task decreases the more often it is carried out (Dhillon, 1986).

While routine and boring jobs carry special dangers, including a greater risk of absent-minded slips and lapses, tasks requiring knowledge-based problem solving are much more error prone than tasks that are well understood. This applies regardless of whether it is an apprentice performing a routine task for the first time, or a senior mechanic performing an unusual modification or check. The lesson is that tasks that take workers into unfamiliar territory need to be managed with particular care (Reason and Hobbs, 2003).

Bad Procedures

Poorly designed procedures are a common source of maintenance error (Kanki et al, 1997). In the nuclear industry, nearly 70 per cent of all human performance problems have been traced to bad procedures. These procedures gave the wrong information, were inappropriate or unworkable in the situation, were not known about, were out of date, could not be found, could not be understood or simply had not been written to cover the job (INPO, 1985). Poor procedures

breed mistakes, and are major factors leading to violations (Reason and Hobbs, 2003).

Situational or necessary violations (violations where the end justifies the means to get there) arise because people want to get the job done, but the tools or the situation makes it impossible to do the job and comply with the procedures. In the study of European airlines, it was found that unclear task cards or vague procedures were among the main reasons for deviations from maintenance procedures (McDonald et al, 2000).

Violations are deliberate acts. People weigh up the costs and benefits of non-compliance and when the perceived benefits exceed the perceived costs, they are likely to violate. For many acts of non-compliance, experience shows that violating is an easier way of working and brings no obvious bad effects. In short, the benefits of non-compliance are often seen to outweigh the costs (Battman and Klumb, 1993). The study of European airline mechanics found that the most common reason for non-compliance with procedures was that there was a more convenient or quicker way of working (McDonald et al, 2000).

The challenge is not so much to increase the costs of violating by stiffer penalties, but to try to increase the perceived benefits of compliance, and that means having procedures that are workable and that describe the quickest and most efficient ways of doing the job. Any lack of trust caused by inappropriate or clumsy procedures will increase the perceived benefits of violating. The job can only be done in some cases by deviating from the procedures, particularly if the formal procedure cannot be followed in the time allowed (Reason and Hobbs, 2003).

Even if everybody knows that the procedures need to be improved, the formal change system may be so slow and unwieldy that it is more expedient to turn a blind eye to the inevitable violations (McDonald et al, 2000a).

Procedure Usage

There are many reasons why people choose not to use written procedures; the least of which is that it is very hard to read and do the job at the same time. It also depends on how the workforce perceives the risks associated with a particular task (Reason and Hobbs, 2003).

In a procedure usage survey by Embrey (1998), safety and quality critical jobs were associated with a high usage, while solving problems (including safety-critical ones) and maintenance work involved a much lower usage. Only 58 % of the people surveyed (n=4000+) said that they have the procedures open and in front them while they carrying out jobs (Embrey, 1998).

In many highly proceduralised industries, it is common for the workforce to write their own procedures as to how jobs should be done. These are guarded and passed on to new members of the work group. They are known as “black books”. The procedure-usage survey of Embrey (1998) found that 56 % of operators used informal procedures, as did 51 % of managers.

The survey also sought the reasons why people chose not to comply with procedures. The principal factors are that if followed to the letter, employees felt that the job would not get done. Further, employees stated that they were not aware that a procedure existed; that they preferred to rely on their own skills and experience, and assumed that they knew what was in the procedure (Embrey, 1998).

Personal Beliefs

Unlike mistakes or skill-based errors, violations involve deliberate deviations from procedures or safe practice. Research on driving violations by Reason et al, (1993) suggests that non-compliance is directly related to a number of potentially dangerous beliefs or illusions.

Firstly, the “illusion of control”; violators overestimate the extent to which they can govern the outcome of risky situations. Secondly, the “illusion of invulnerability”;

where violators underestimate the chances that their rule breaking will lead to bad outcomes. Skill, they believe, will always overcome hazard. Thirdly, the "illusion of superiority" which comes in two forms. Violators believe themselves to be more skilled than other people and they do not regard their own tendencies to violate as being worse than those of other drivers (Reason et al, 1993).

Fourthly, violators often feel that the temptation to bend or break the rules is irresistible; they do not see their infringements as wrong or dangerous and explain their behaviour by saying that they are simply doing what everyone else does. This is called a "false consensus". High violators overestimate the proportion of other drivers who also violate (Reason et al, 1993).

Finally, and specifically related to maintainers, they often feel themselves to be in a "double bind". They are told not to break the rules, but are also expected to get the job done quickly. Many resolve this conflict by seeing management's insistence on their compliance as hypocritical, that they'll turn a blind eye so long as the job gets done quickly, but little mercy can be expected if the violations cause an accident (Reason et al, 1993).

Errors and Error-provoking Conditions

An analysis of over 600 maintenance incidents reported in the Australian survey by Hobbs (2001) showed that certain errors and factors tend to go together.

Memory lapses, the most common type of maintenance error, are closely associated with time pressure and fatigue. Rule-based errors are linked with inadequate procedures and coordination, while knowledge-based errors show a strong association with training. Slips are most closely related to equipment deficiencies and violations are linked with time pressure. Further, violations occur in response to inadequate procedures as discussed earlier (Reason and Hobbs, 2003).

Organisation and Environment

Maintenance errors have their origins in the work environment, and some of these have their origins in *inadequate system design* (Reason and Hobbs, 2003). Most maintainers can list examples of components that can be installed in a multiple of ways, systems that are difficult to access and tasks that have been designed without taking into consideration the human limitations (Majoris and Boyle, 1997).

Issues such as *housekeeping practices* are powerful indicators of the culture of an organisation. If materials, tools, off cuts and components are left lying around then the environment is likely to be one in which errors are more frequent and severe in their consequences. Poor housekeeping constitutes a clear sign of system malaise when it has been present for a long time without the adequate interventions been made to rectify it (Reason and Hobbs, 2003).

A safe *culture* is an informed culture. The workforce culture should be one whereby low-cost events are reported in sufficient detail and sufficient numbers to be of use. For this, trust and convenience of reporting is essential. Trust depends crucially on everyone understanding the difference between acceptable and unacceptable actions. Ninety percent of maintenance actions fall into the blameless category and should incur no sanctions if reported. However, this information is of no use, if it is not adequately analysed and evaluated to draw out where and what kinds if interventions are required (Reason and Hobbs, 2003).

Further, without examining literature on *employee motivation* in depth, it is common knowledge that employees who are not motivated are not as productive and efficient as those who are well motivated and have a high sense of morale. Herzberg's (1959) two factor theory of hygiene and motivator needs highlights the factors that should be present in a work environment to ensure motivated and satisfied employees. These include a pleasant work environment, the nature of job tasks, reward, organisational commitment, employee attitudes, recognition,

achievement and numerous others that subsequent research has uncovered (Herzberg et al, 1959).

The nature of the South African socio-political history, means that within the workplace, racism is very much still a part of working life. Coupled to this are the perceptions of government legislation such as affirmative action. Equity theory is an approach in motivation that is concerned with individuals' beliefs about how fairly they are treated compared with their peers, based on their relative levels of inputs and outcomes. When people perceive that they are being treated unfairly, they are likely to look for justifications for the treatment. Failing to find any, they may behave in ways which harm the organisation (Helriegel, Jackson and Slocum, 1999). This is not only relevant to racism, but other issues of fairness and unfairness.

Managerial Skill

Aviators have concluded that management errors are one of the most serious threats to safety (Weiner et al, 1993). These include: the failure to delegate tasks and responsibilities adequately or efficiently; the failure to set priorities; inadequate monitoring and supervision; excessively authoritarian leadership styles; and the failure to detect or challenge non-compliance with standard operating procedures (Weiner et al, 1993).

Increasingly airlines are introducing Crew Resource Management training for maintenance personnel (sometimes known as Maintenance Resource Management) as a strategy to deal with managerial shortcomings (Sian et al, 1998). Planning, and budgeting are essential managerial tools, since inadequacies in these two areas would most probably have the effect of placing maintenance personnel under severe and unreasonable time pressures due to poor scheduling for example, as well as impacting on the availability of serviceable and available tools and equipment in the longer term (Sian et al, 1998).

2.5. Rationale and Research Questions

At the outset, this literature review aimed for a thorough understanding of attribution theory which provided the tools necessary to distinguish attributions from the data that would emerge during the fieldwork, and explain these attributions in terms of attribution theory and maintenance error literature. Further, it aimed to review maintenance error literature from an attribution perspective; in this way providing a reference point from which error attributions made by participants could be distinguished in the maintenance environment.

This has been achieved for the specific purpose of exploring the unique South African maintenance error landscape through this overlap of attribution theory and maintenance error literature in exploratory research; unearthing and considering the many possibilities of combinations of errors in this landscape so as to contribute to the body of attribution theory and maintenance error literature; as well as inform the planning, strategy and intervention of maintenance related organisations.

Data for this research is derived from two sources, maintenance staff and team leaders. Maintenance staff and team leaders; while involved in achieving the same tasks, perform different roles during those tasks. Team leaders hold a managerial role and supervisory role, while maintenance staff perform the role of skilled labour. Thus, they are two distinct groupings exposed to the same variables within their environment. This provides an ideal opportunity for between group comparisons of attributions (where attributions of staff are compared to team leaders); while these attributions can also be looked at holistically (where attributions of staff and team leaders are combined).

The research is structured by two research questions, within a qualitative research paradigm, the same method utilised to conduct error investigations. They are as follows:

A) What are the predominant primary error attributions during the minor maintenance of aircraft, comparing maintenance staff and team leaders?

B) What are the predominant secondary error attributions during the minor maintenance of aircraft, comparing maintenance staff and team leaders?

2.6. Summary

A thorough literature review is in many ways the cornerstone of accurate and focused research. Within the constraints of time and resources, it is felt that this review is of a significantly high calibre. While it does have certain shortcomings, one of which being the datedness of some attribution theory literature and another being the integration between attribution theory and maintenance error literature; it still provides a powerful springboard for the steps in the research process which follows, represented in the next chapters.

When embarking on an investigation of this topic it was already expected that a very limited amount of studies that integrated the two domains of attribution theory and maintenance error existed. While the difficulty of this exploratory study could have acted as a deterrent weighed up against the relative ease of repeating a study in an already established field, the challenge of breaking new ground for others to follow and build upon seemed the most fulfilling option, irrespective of the numerous possibilities for failure in an exploratory study such as this one.

The result of this exploratory challenge is a literature review that brings together the two domains of attribution theory, and maintenance error, in a format that it understandable to readers on all levels, while maintaining and communicating the essences and frameworks of both domains, thus allowing future researchers to simply advance what has already been done by integrating the two, rather

than having to spend many hours delving into decades old literature building the foundations.

None the less, the review that has been presented here is sufficiently robust to appropriately inform the research questions, aspects of the methodology, as well as uncover and support significant findings in the discussion chapter.

Chapter 3 – Methodology

The type of methodology utilised to collect data introduces biases into the findings of any research project. This chapter describes in as much detail as possible the specific methodology used to collect data for this thesis, since a thorough understanding of this would impact on the replicability of the study, as well as assist in identifying the biases which are introduced into this study through the choice of methodology. Choice of sample, procedure, instruments used, data analysis theory and implementation, as well as ethical considerations are discussed in turn.

3.1. Method

3.1.1. Sample and Sampling

The volunteer sample was drawn from the population groups of 25 team leaders and 125 minor maintenance staff at a South African Aircraft Maintenance Company. Within each group, 5 individuals were interviewed on a personal basis. Further, for each group, one focus group was carried out consisting of two and four individuals respectively. The individuals who participated in the focus groups were different to those who participated in the interviews. In total 28 percent of team leaders (P=7) participated in the study and 7 percent of maintenance staff (P=9), which calculates to just over 10 percent of minor maintenance employees.

It is felt that the final sample size provided sufficient qualitative data for adequate analysis; and is adequately generalisable to the minor maintenance staff and team leaders of this company, especially in the location where the research took place. It was originally intended to have 12 percent of maintenance staff (16 percent of employees in minor maintenance) participate in the study; however the major limiting factor preventing this was the time available to replace staff that chose not to participate, since interviews and focus groups were conducted onsite and dependent on access and assistance provided by the company concerned.

Further, it is thought that more interviews and focus groups would have uncovered very little new information, but would have significantly emphasised the themes that emerged. Interviews and focus groups were utilised due to the different perspectives from which they allowed the researcher to engage with the sample and collate data. An interview allows the researcher to engage with a participant on an individual level, whereby the participant passes on his/her own thoughts and opinions to the researcher to collate as data. Focus groups, in the context of this research were utilised after the interviews, to triangulate into attributions collated from the interviews, and explore them in more detail. The focus groups also introduced a group dynamic, whereby individual attributions could be challenged by other participants in the focus group, who due to their different specialities and experiences would see things from a materially different perspective, and in expressing this, open up new perspectives for the researcher to collate as data, which he probably would not have uncovered on his own.

According to Krippendorf (1980); each additional unit in a sample adds to the costs of an analysis, but there comes a point at which a further increase will not appreciably improve the generalisability of the findings. This is the point at which the sample size is most efficient.

The population of staff that the sample was drawn from consists primarily of White Afrikaans males, with a minority being African and Indian males. African females are predominantly cleaners, found in the appearance section (the section tasked with ensuring that aircraft are kept clean). The population of team leaders is fundamentally the same, with a small minority of emerging African and Indian team leaders. No women participated in the study, however the sample is still seen to be representative of the population, since women form a very small minority of maintenance staff. We next describe the sample in detail.

Sample: In-depth Interviews (P=10)

Of the participants interviewed, number one, four, six, nine and ten were team leaders.

Participant number one was thirty seven years old. He had been in the employ of the company for six years and was a Team Leader/Supervisor in the Appearance section. Participant number one was a married, African Male, with an Undergraduate degree and spoke Sepedi as his home language.

Participant number four was a married white male who speaks English and Afrikaans as home languages. His highest qualification was matric with numerous training courses. He was a fifty two year old team leader in the Mechanics Section, with 31 years of experience in the employ of the company.

Participant number six was a fifty three year old team leader with a tenure of twenty seven years with the company. He was a married white male, with matric and technical courses as his highest qualifications and English as his home language. He was a team leader in the In Flight Entertainment Section.

The ninth participant was a fifty year old team leader with a tenure of thirty years. He was in the position of team leader in the Departures Section, held a diploma as his highest qualification, and spoke English and Afrikaans as home languages. This participant was a married white male.

Participant number ten was a thirty five year old acting team leader in the Avionics Section, who had a tenure of ten years and six months. He was a married Indian male, who held a diploma as his highest qualification and spoke English as his home language.

The remaining five participants, numbers two, three, five, seven, and eight were maintenance staff.

Participant number two was thirty years old. He had been in the employ of the company for three years as a worker in the Appearance section. Participant number two was a married African male, with a Matric and a N2 in Electrical Engineering. His home language was Sesotho.

Participant number three was a married white male, who spoke Afrikaans as his home language and had numerous technical training courses as his highest qualifications. He was twenty four years old, and had been in the employ of the company for five and a half years. He held the position of a senior aircraft technician in the Mechanics Section.

The fifth participant was a fifty nine year old married white male, with thirty nine years of experience in the employ of the company. He was a senior aircraft technician in the In Flight Entertainment section, with matric and numerous technical courses as his highest qualifications. His home language was Afrikaans.

Participant number seven was a twenty eight year old technician in the Avionics section with a tenure of three and a half years. He was a married white male who spoke English and Afrikaans as home languages and had completed a diploma as his highest educational qualification.

The eighth participant had a tenure of seven years and three months with the company. He was a thirty six year old married white male, and was in the position of maintenance engineer in the Departures Section. Participant number eight had completed a matric and other technical courses and spoke English and Afrikaans as home languages.

Table 1: Summary Table of sample for In-Depth Interviews

Participant Number	Race	Position	Tenure (years/months)	Age (years/months)	Highest Qualification	Section
1	African	Team Leader	6 yrs	37	Bachelors Degree	Appearance
4	White	Team Leader	31 years	50	Technical Courses	Mechanics
6	White	Team Leader	27 years	53	Technical Courses	IFE
9	White	Team Leader	30 years	50	Diploma	Departures
10	Indian	Acting Team Leader	10 yrs 6 mnths	35	Diploma	Avionics
2	African	Worker	3 yrs	37	N2 (Electrical Engineering)	Appearance
3	White	SAT	5 yrs 6 mnths	24	Technical Courses	Mechanics
5	White	SAT	39	59	Technical Courses	IFE
7	White	Technician	3yrs 6 mnths	28	Diploma	Avionics
8	White	Maintenance Eng.	7 yrs 3 mnths	36	Technical Courses	Departures

Sample: Focus Group Discussions (P=6)

Four maintenance staff participated in the first focus group discussion. The first participant was a thirty five year old senior licensed technician in the Avionics Section, with nine and a half years in the employ of the company. He was an English speaking, married Indian male, who held a diploma as his highest qualification.

Participant number two was a twenty seven year old, married Indian male who spoke English as his home language and held a diploma as his highest

qualification. He was a senior licensed technician in the In Flight entertainment Section.

The third participant was a married white male who spoke Afrikaans as his home language and held a diploma as his highest qualification. He was thirty years old with a tenure of nine and a half of these. He was in the Mechanics Section.

The final participant in the first focus group was a twenty nine year old single African male who had a tenure of six years and one month with the company. He was a cleaner in the Appearance Section, who held a matric certificate and spoke Sesotho as his home language.

Two supervisors/team leaders participated in the second focus group. It could be argued that two participants does not form a focus group, however the information derived from this discussion was still informative, and has been included in the study. The first of these participants was a forty eight year old Afrikaans speaking married white male with seven years and nine months in the employ of the company. He held a diploma as his highest qualification and was based in the Mechanics Section.

The second participant was a forty eight year old married African male who's tenure with the company was twenty four years and three months. He held a standard eight school leaving certificate and spoke Tshvenda as his home language. He was in the Appearance Section.

Table 2: Summary Table of sample for Focus Group Discussions (FGD's)

Participant Number	Race	Position	Tenure (years/months)	Age (years/months)	Highest Qualification	Section
1 (FGD 1)	Indian	SLT	9 yrs 6 mnths	35	Diploma	Avionics
2 (FGD 1)	Indian	SLT	Not Completed	27	Diploma	IFE
3 (FGD 1)	White	Mechanic	9 yrs 6 mnths	30	Diploma	Mechanics
4 (FGD 1)	African	Cleaner	6 yrs 1 mnth	29	Matric Certificate	Appearance
1 (FGD 2)	White	Team Leader	7yrs 9 mnths	48	Diploma	Mechanics
2 (FGD 2)	African	Team Leader	24 yrs 3 mnths	48	Standard 8 Certificate	Appearance

3.1.2. Procedure

A random generator was used to randomly select from a list of team leaders and maintenance staff on shift at the times that access was granted; 5 individuals in each group (one per specialty) for the in-depth interviews and 5 individuals in each group (one per specialty) to jointly participate in a focus group discussion. Considering that participants were chosen per specialty within each group, no two participants came from the same work team.

These individuals were then invited to meet the researcher at a confidential venue based on the company site, which was a closed sound proof room away from the specific workplaces of the participants. Here they were given full information about the study both verbally and through a Subject Information Sheet (see Appendix A) and asked to participate in the study. All those who turned up at the venue participated in the study. When those invited to the venue did not arrive or refused to attend, the same random selection process was used to reselect another potential participant.

Having no one refuse to participate in the study after they arrived at the venue raised questions as to whether the maintenance staff and team leaders felt obliged to participate in the study, possibly since the in-depth interviews and focus group discussions took place on the company premises. No one from the company management was present or in close proximity to the venue, and the data collection took place in a closed room.

The in-depth interviews used the information gathered from a taxonomy on some of the company's Incident on Duty (IOD) reports and sought to investigate both primary and secondary error attributions. The focus groups built on this, by delving a level deeper through discussing, critiquing and investigating further, the initial attributions collated from the in-depth interviews.

Both the In-depth Interviews and Focus Group Discussions were semi-structured along a set of predefined questions (found in Appendix B). While the interviews followed these questions more rigidly, the focus groups were more flexible in that they utilised the information gathered in the in-depth interviews to facilitate a discussion.

Generally, when interview participants answered the initial predefined questions, raising attributions in their answers, the impromptu questions that followed from the researcher, asked participants to explore these attributions, often uncovering other linked attributions. Once all attributions were explored fully through this impromptu questioning, the researcher returned to the semi-structured interview schedule and repeated the process.

Due to the focus groups having more than one participant, interaction was much more diverse. Initial predefined questions asked by the researcher usually raised attributions from more than one participant. These were then explored and commented on, or added to by the other participants with the researcher facilitating the process by asking impromptu questions when necessary. After attributions were explored fully, the researcher returned to the predefined questions and repeated this process.

The author felt that asking the same questions in a semi-structured format brings some level of validity and comparability into the responses of participants, while having the flexibility to leave the structured format and use impromptu questioning allows for responses that would have went unheard to be recorded.

Participants were open and frank in their responses, willing to give up as much information as they could, in ten out of twelve cases taking up more than the allotted time of an hour each. Interviews ranged from 35 minutes to one hour and twenty minutes in length while the focus groups lasted fifty minutes, and an hour and fifteen minutes respectively.

Confidentiality was regularly reiterated throughout the data collection process. Participants were addressed by a number, example participant number 1; and were not required to write their name on the Biographical or Consent Forms (to be interviewed and be recorded). This was explained to them before they were given these forms. The emphasis on confidentiality and the thorough and open discussion with each participant about the research before beginning the data collection may have served to put their fears at ease and win their trust.

Recording took place on a laptop computer through a programme called Audacity and an omni directional microphone placed on the table. The audio waves were clearly visible to the participants on the monitor throughout the in-depth interview or focus group discussion. The audio files were then copied to CD's from which transcriptions were made. After transcriptions were made, they were independently cross checked for accuracy.

The accuracy checking process matched the transcripts to the audio for five minutes at the beginning, middle and end of the focus group discussion or in-depth interview. A score was then allocated between 0 and 4 (0 – Very Poor; 1 – Poor; 2 – Good; 3 – Few Words Missing; 4 – Verbatim) for each segment and a total score calculated for the full transcript. Transcripts that scored below six altogether were rectified, then rechecked for accuracy. The end result was that

two transcriptions scored seven (out of a total of twelve), five scored eight, four scored nine, and one transcript scored eleven. Transcriptions that scored seven and eight are good, with no change in the meaning; while those that scored nine and eleven are very close to verbatim with a few missing words. Sections that scored below 2 were revisited.

Table 3: Description of Transcription Accuracy Scores

Transcript	Begin Score	Middle Score	End Score	Total Score
Interview #1	3	2	3	8
Interview #2	3	3	3	9
Interview #3	3	3	2	8
Interview #4	2.5	2	2.5	7
Interview #5	2.5	2	2.5	7
Interview #6	3	3	3	9
Interview #7	3	3	3	9
Interview #8	3	3	2	8
Interview #9	4	3	4	11
Interview #10	3	3	3	9
Focus Group #1	3	3	2	8
Focus Group #2	3	3	2	8

The in-depth interviews and focus group discussions took place between Eight AM and Three PM, in early December 2004 over five consecutive days, which were the times allocated for the research by the company involved. The in-depth interviews and focus group discussions took place in a medium-small air-conditioned room, with the participants and researchers seated on chairs in a circle for the focus group discussions and next to each other for the in-depth interviews. While a poster indicating the meanings of certain safety signs was mounted in the room, it was behind the backs of the participants. Further, posters such as this could be found on many walls of the organisation.

There were no tables or obstructions between the participants and researcher in both cases. The reasoning behind this was to create an open and consultative atmosphere. In most cases after the in-depth interviews and focus group discussion was completed, the participants were accompanied out of the venue.

3.1.3. Instruments

Taxonomy was carried out on 48 Incident on Duty investigation reports and coded into themes. This provided the framework and input to the design of the schedules that were used during the interviews and focus groups. A sample Incident on Duty investigation report is found in Appendix C. All Incident on Duty reports from the beginning of January to the end of November for the year 2004 were provided by the organisation concerned for this purpose. An incident on Duty report is typically completed by an investigator, who in most cases is a manager or risk officer. In some cases it is a supervisor or team leader. This investigator would use the questions on the Incident on Duty report to interview the person involved in the incident and in this way complete the report. The report records the details of an incident; the investigation of the incident by the designated investigator; recommended actions to be taken by the employer; and remarks by the organisation's safety and health committee.

In designing the questions for the in-depth interviews and focus group discussions, great care was taken to keep into consideration the ideas and input of other researchers that were reviewed in chapter 2, the research questions, as well as the aims of this study. Questions were worded in ways that ascertained both primary and secondary error attribution in various ways, while being careful not to lead the participants to particular answers or groups of answers. This was done through the use of different wordings and a range of perspectives to the same outcome as can be seen in Appendix B.

3.2. Data Analysis

3.2.1. Theory

The qualitative data acquired through the in-depth interview and focus group discussion process, and subsequent transcription was coded and analysed using Thematic Content Analysis. Content analysis is a research technique for making replicable and valid inferences from data to their context (Krippendorf, 1980).

As a research technique, content analysis involves specialised procedures for processing scientific data. Like all research techniques, its purpose is to provide knowledge, new insights, a representation of facts, and a practical guide to action (Krippendorf, 1980). A further purpose of content analysis is to be replicable, since at different points in time and under different circumstances, if other researchers want to apply the same technique to the same data, then the results must be the same.

According to Glaser and Strauss (1967), content analysis is the most deductive of all forms of data analysis. Deductively derived theory and deductively driven data analysis work down from pre-existing theoretical understandings. Categories of analysis are developed through logical deduction from the pre-existing theory, here maintenance error and attribution theory. In this way, pre-existing theory is tested against empirical data.

Content analysis is a useful way of confirming or testing a pre-existing theory. When the research question is clearly defined, and the categories of analysis have been well established by pre-existing research, content analysis may be an extremely useful method of data analysis. It is however, not a very useful way of building new theory; and is thus well suited, since this study aims to compare its findings to findings in previous research without developing new theories (Ezzy, 2002).

In another definition, by Berelson (1952), content analysis is defined as a research technique for the objective, systematic and quantitative description of the manifest content of communication, communication in this research being in-

depth interviews and focus group discussions. For a process to be replicable, the rules that govern it must be explicit and applicable equally to all units of analysis. The rules utilised for this study are covered in the next section headed “Implementation”.

Henning et. al. (2004) however cite some warnings about content analysis. They see it as method of analysis that could lead to superficial and naively realistic findings because it captures what is presumed to be the real world, through the eyes of the research participants, in a straightforward, direct and formulaic way. The data is not interrogated, and the assumption is often made that you arrive at a set of valid findings, due largely to stringent application of the method of coding and categorising. It is logical that the application of method per se, does not constitute good findings.

In contrast thematic content analysis is part of the early procedures of data analysis in grounded theory, but grounded theory goes beyond thematic analysis. Grounded theory is only used to refer to studies in which data collection and data analysis are conducted concurrently alongside theoretical sampling and other techniques distinctive of grounded theory (Strauss and Corbin, 1990).

Both thematic content analysis and grounded theory employ similar techniques for analysing data. One difference between the two is that grounded theory utilises theoretical sampling in which emerging analysis guides the collection of further data. Thematic analysis can be employed either as part of grounded theory analysis or for the analysis of data that have already been entirely collected.

Thematic content analysis, however, aims to identify themes within the data. It is more inductive than classical content analysis because the categories into which themes are sorted are not decided prior to coding the data. These categories are induced from the data. While general issues of interest are determined prior to the analysis, the specific nature of the categories and themes to be explored are

not predetermined. This means that this form of research may take the researcher into issues and problems he or she had not anticipated (Ezzy, 2002).

Coding during thematic analysis begins with what is often described as open coding, where data is inspected to elicit the conditions that underlie life events, interactions with others, strategies and tactics that are adopted by respondents, and consequences. Transcripts are scrutinised line by line or word by word, by looking for in-vivo codes, terms used by respondents, and by making comparisons for similarities and differences between events and incidents (Crisp, 2000).

Strauss and Corbin (1990) describe open coding as the part of the analysis that pertains specifically to the naming and categorising of phenomena through close examination of the data. Thus, open coding is a way to generate an emergent set of categories and their properties.

Open coding often involves considerable experimentation. Experimenting with a variety of conceptual labels, categories or codes, until codes that seem to fit the data are found. It requires considerable effort and reflection; sitting with transcriptions for days absorbing them into the consciousness and exploring ideas that emerge (Orona, 1990).

Henning et. al. (2004) suggest that open coding should start with the analyst reading through the entire text in order to get a global impression of the content. Some themes will then already be observed. Since open coding is an inductive process, whereby codes are selected according to what the data mean to the researcher, the researcher needs to have an overview of as much contextual data as possible, before any formal meaning is given to a single unit. Strauss and Corbin (1990) suggest experimenting with coding lines, sentences, paragraphs and whole documents.

They also describe a process of constant comparison as integral to the coding process. As an incident is noted, it should be compared against other incidents

for similarities and differences. Comparisons allow data to be grouped and differentiated, as categories are identified and various pieces of data are grouped together. Through the comparative process, events that at first seemed entirely unrelated may be grouped together as different types of the same category, or events that seemed similar may be categorised differently. Codes have properties and these properties have dimensions (Strauss and Corbin,1990).

The ensuing categories are again named inductively, using the data as a guide in deciding what a category should be called. The knowledge of the theory, in this case Attribution Theory and Maintenance Error, should seep into the process here. Knowledge of social science assists in systemising thinking about possible names for groups of codes that have been categorised together. If data is grouped strictly empirically, then theory is supposed not to be of much guidance (Henning et. al., 2004). Exploring the properties and dimensions of a code can lead to the code being broken into two separate codes, or it may lead to its being amalgamated with a similar code.

This is, in Ezzy's terms (2002) Axial coding. The aim of axial coding is to integrate categories around the axes of central themes, finally identifying the major themes to which the open codes fall under. The danger of course is that the researcher may decide to focus on issues related to his or her own interests rather than that of the participants (Ezzy, 2002).

Once all the sets of data have been coded and categorised, the researcher is left with the important task of seeing the whole (Henning et. al., 2004). The questions asked at this point are:

What are the relationships in meaning between all these categories?
What do they say together?
What do they say about each other?
What is missing?
How do they address the research questions?
How do these categories together link with what the researcher already knows about the topic?

What has been foregrounded in the analysis?
What has moved to the background?
What additional data gathering/analysis have to be completed?

When a researcher is satisfied that the themes represent a reasonably researched chunk of reality, each theme can be used as the basis of an argument in a discussion around them. Processed data do not have the status of findings until the themes have been discussed and argued to make a point, and the point that is to be made comes from the research question(s). This is the time to use the worked data as evidence in the continuing arguments and sub-arguments about the researchers point of view or emerging knowledge claims (Henning et. al., 2004).

3.2.2. Implementation

As stated earlier, the completed transcripts were coded using thematic content analysis. This decision was influenced especially by the research questions and nature of the aims of the study, whereby the data analysis needed to be less rigid and prescriptive, but still have a reasonable amount of replicability. Further, thematic content analysis, being more inductive than classical content analysis allows themes to be induced from the data, possibly guiding the researcher to issues and problems that were not anticipated. This lack of rigidity however, does result in the researcher introducing his/her own biases into the study either consciously or unconsciously due to his/her knowledge as well as background. Being exploratory in many respects, this strength of thematic content analysis technique is ideally suited to the study.

For any researcher, time and resources are limitation factors to the choice of data analysis technique, and thematic content analysis is relatively economical in that respect. Added to that, thematic content analysis as a technique is simple to apply and simple to understand, which extends the study’s accessibility to a broader audience.

The researcher familiarised himself fully with the collected data, including transcripts, field notes, Incident on Duty reports and biographical forms before formal tagging, by reading through the data numerous times. The researcher then proceeded through each transcript, tagging serially, i.e. one at a time, beginning with the last focus group discussion and ending with the first in-depth interview.

Tagging focused on phrases, rather than lines or words, seeking out primary or secondary error attributions for each phrase; strongly informed by the available theory. This initial labelling can be said to have a moderate abstraction from the data, since tags did not use words directly from the transcripts, but linked these phrases to previous theoretical findings, and in many cases used terms already found in the literature.

The codes were then grouped together, after much thought into comparing similarities and differences between codes. Groups and the codes forming these groups were further contrasted, assimilating some into themes, and in other cases dividing them up. It is felt that these themes and categories fully exhausted all salient data, assisted by the fact that the semi-structured format of data collection did not produce much non-salient data.

The researcher reduced the data to approximately five themes for both, primary and secondary error attributions, grouping them by team leaders and maintenance staff, for in-depth interviews and focus group discussions. The aim in categorising the data into themes was to ensure that a majority of trends were included in the themes, while not going into too much detail; as well as ensuring that the views of all respondents were included. It emerged that in most cases, five themes fulfilled these aims. Multiple researchers were not used due to resource constraints. The resulting themes and subsequent comparisons between the themes for the groupings are found in the chapters that follow.

3.3. Ethics

Maintenance staff and team leaders were interviewed once, or involved in a focus group once. Participants were first briefed about the research, through a subject information sheet (Appendix A) and by being verbally told that the study is of the human factors present in the minor maintenance of aircraft, with an appropriate explanation of human factors.

Next, they were informed that participation was voluntary and that they would not be advantaged or disadvantaged in any way by their participation or non participation. Then they were requested to sign a consent form to be interviewed and a consent form to be recorded (Appendix A); as well as a biographical from that gathered non-identifying demographic information about them (Appendix D). Participants could choose not to be recorded or to withdraw at any time.

Participation was voluntary and no person was advantaged or disadvantaged in any way for choosing to participate or not participate in the study. While questions were asked about personal demographics, no identifying information such as name or identity number was asked for (participants were told that they could choose not to write their names on the consent forms, and sign in a manner that only they would recognise).

Due to the interview process anonymity could not be guaranteed, however the confidentiality of the participants was, and regularly reiterated during the in-depth interviews or focus group discussions. Participants were referred to by a number and not their names. The completed focus groups and interview transcripts were not seen by any person in the organisation at any time and were processed by the researcher.

Responses are only looked at in relation to other responses, and feedback is given to the organisation in the form of a research report of group responses and not individual perceptions. Individuals who require feedback are provided with a one-page summary on request.

Due to a non-disclosure contract with the company involved, confidentially of company identifying information was also of a very high priority, and has tempered the depth of discussion and results in certain respects.

3.4. Summary

As with all research, this methodology too has introduced certain biases. Events, conditions, participants, as well as the researcher introduce their own paradigms and perspectives that influence the data collected. This chapter has described as fully as possible the methodology and related decisions and conditions that surrounded data collection for this theses, with the intention of making as clear as possible to the reader the biases as well as strengths introduced into the data; thus putting forward a case for the reader to consider this data of a suitably high integrity to extract results and findings that are applicable to industry and academia.

Chapter 4 – Results

This chapter first summarises the taxonomy on Incident in Duty Investigations for information purposes, since this taxonomy informed the schedules for the Interviews and Focus Groups. The chapter then reports on the results of the thematic content analysis of the In-depth Interviews; and Focus Group Discussions. It is structured according to the two research questions, and looks at the various themes that emerged through the data analysis process.

In forming these themes and as stated in the literature review, primary error attributions are those attributions to an error that would typically have an impact on the person, but not immediately and directly cause financial losses, physical injury, or damage; and are typically not visible since they have to do with more behavioural and biological elements such as organisational culture, circadian rhythms, work motivation etc.

Secondary error attributions are defined as those attributions that are made to visible errors; those errors that have already been manifested due to a single or number of primary errors and possibly even secondary errors. Typically this would include error attributions that immediately cause financial loss, damage, or physical injury; such as damage to equipment, equipment not available, lack of tooling etc.

The context in which an attribution is made also has an influence over whether it is a primary or secondary error. Since certain secondary errors could be contributing factors to other primary errors within the event chain (Kanki, 2000), the context within which certain attributions are made is taken into account in each case. It should be noted that these definitions are guidelines that cover the majority of error attributions, rather than all attributions, since it can be expected that there will always be exceptions to the rule.

4.1. Taxonomy: Incident on Duty Investigations

The taxonomy of Incident on Duty (IOD) Investigations was carried out on 48 Incident on Duty Reports, which raised five “Suspected Cause and Recommendation” themes, namely Carelessness and Rule Breaking; Knowledge and Technique; Environment; Supervision; and Equipment; and three “Error” themes, namely, Bumps and sprains; Environmental exposure; and Equipment. The themes are named as “Suspected Cause and Recommendation” themes or “Error” themes based on the categories in the IOD Report, under which the codings were found.

Table four below, depicts the codings that make up these themes, which are derived from suspected causes and recommendations as recorded in the IOD reports. “N” represents the instances in which a suspected cause or recommendation was extracted from the IOD reports and coded. Where suspected causes or recommendations were found verbatim in the IOD reports, this is depicted by an “X” and the number of times it appeared in brackets after the relevant coding.

Table 4: Incident on Duty Investigation – "Suspected Cause and Recommendations" Themes(N=48)

Suspected Cause and Recommendation	Coding	Theme
Be more careful	Carelessness (X 5)	Carelessness and Rule Breaking (N=16)
Tell staff to be more cautious	Carelessness	
Don't run	Not obeying rules	
Memo to staff regarding importance of safety shoes	Not obeying rules	
Inform people about policies regarding driving	Not obeying rules	
Disciplinary Hearing	Not obeying rules	
Ensure proper ventilation	Not following regulations	
Stay clear of spill area	Not obeying rules	
Not wearing correct equipment	Not obeying rules	
Ensure proper ventilation	Not following regulations	
Use proper safety equipment	Not following regulations	
Place Decal Reminder at Lid Handle	Lack of communication	
Lid not secured	Lack of Knowledge	Knowledge and Technique (N=13)
Lack of experience	Lack of Knowledge	
Continued on the job training	Lack of Knowledge (X2)	
Apply less safe craft on cloth	Poor technique	
Training in good technique	Poor technique (X2)	
Apply less aero wax to prevent splashing	Poor technique	
Unsafe technique	Poor technique	
Change technique to push instead of pull	Poor technique	
Bend for shorter periods of time	Poor technique	
Change technique to carry heavy ladder	Poor technique	
Misjudgement	Poor judgement	
Nature of work	Work environment (X2)	Environment (N=6)
Observe Area for obstructions	Lack of situational awareness	
Avoid Distraction	Distraction	
Mechanically sweep roadway	Debris on Roadway	
Concentrate more on task	Lack of concentration	
Enforce Wearing of Hearing Equipment	Poor supervision (X 5)	Supervision (N=7)
Enforce the use of proper equipment	Poor supervision	
Enforce wearing of Equipment	Poor supervision	
Wear boot type safety shoes	Inadequate Equipment	Equip. (N=6)
Inferior safety shoes	Inadequate Equipment	
Cable broken	Wear and Tear	
Issue better quality shoes	Inadequate Equipment	
Faulty toilet tank drain valve	Equipment failure	
Issue with skull caps	Inadequate equipment	

Carelessness and Rule breaking, is a "Suspected Cause and Recommendation" theme made up of recommendations in the IOD reports such as:

"be more careful",
"take more care" and
"Tell staff to be more cautious".

These phrases refer to carelessness on the part of the worker. Further, the rule breaking component is formed by recommendations in the IOD reports such as:

"not wearing the correct equipment"
"ensure proper ventilation" and
"Inform people about policies regarding driving".

Similarly, these phrases refer to workers not obeying rules, or following regulations. It was felt that carelessness and rule breaking have some sort of relation since someone who is careless would be expected to contravene rule or regulations in their carelessness i.e. careless breaking of the rules, and thus they were combined into a larger theme.

The second "Suspected Cause and Recommendation" theme that emerged from the taxonomy was called, ***Knowledge and Technique***. Not having sufficient knowledge or experience about procedures would be related to a poor technique in carrying out a procedure, as well as a lack of judgement in choosing a specific procedure over and above a different one. This theme is formed by thirteen codings, that included recommendations in the IOD reports of:

"Training in good technique"
"Change technique to push instead of pull" and
"Continued on the job training" as well as

suspected causes in the IOD reports such as:

"Misjudgement"
"Unsafe technique" and
"Lack of experience".

The third “Suspected Cause and Recommendation” theme that emerged from the taxonomy is ***Environment***. This theme is largely made up of codings that relate to the work environment such as:

“Observe area for obstructions”

“Avoid distraction” coded as - distraction, as well as

“Nature of work”

A common thread that runs through the recommendations extracted from the IOD reports making up this “Suspected Cause and Recommendation” theme is that these codings emerged due to distractions and obstructions in the work environment.

“Suspected Cause and Recommendation” theme four was titled ***supervision***. It comprises of seven codings drawn from the Incident on Duty Investigation Reports, all coded as poor supervision since the enforcement of rules and regulations, in this case specifically related to safety equipment falls into the responsibility of the supervisor. These codings included phrases such as:

“Enforce wearing of hearing equipment”

“Enforce the use of proper equipment” and

“Enforce wearing of equipment”

Equipment is the last “Suspected Cause and Recommendation” theme drawn from the taxonomy and is formed by grouping six codings related to inadequate equipment or equipment failure. The word “inadequate” relates to the quality, rather than quantity of the equipment. These codings include:

“Wear boot type safety shoes”

“Inferior safety shoes” and

“Issue with skull caps”; as well as

“Cable broken” and

“Faulty toilet tank drain valve”.

Table five below, depicts the “Error” themes which are derived from suspected “errors” as recorded in the IOD reports. “N” represents the instances in which a

suspected cause or recommendation was extracted from the IOD reports and coded. Where suspected "errors" were found verbatim in the IOD reports, this is depicted by an "X" and the number of times it appeared in brackets after the relevant coding.

Table 5: Incident on Duty Investigation – "Error" Themes (N=29)

Description of Error	**Coding**	**Theme**
Door fell on Hand	Component Failure	**Equip. (N=3)**
Compartment Lid Fell on Hand	Component Failure	
Sewage drained onto person	Component Failure	
Exposed to aircraft engine noise	Noise Exposure (X5)	**Environmental Exposure (N=13)**
Exposed to Benzene or Toluene	Chemical Exposure (X3)	
Cleaning and splashed aero wax into eye	Eye Splash (X2)	
Splashed oil into eye	Splash	
Cleaning galley and splashed fluid into eye	Eye Splash	
Airborne Debris into eye	Eye splash	
Finger caught between door and frame	Bump	**Bumps and Sprains (N=13)**
Cut on top of head under Aircraft in rain	Bump	
Standing up and hit head on engine cover	Bump	
Grease gun slipped and pierced hand	Bump	
Finger got stuck in installation	Bump	
Standing up and banged head on engine cover	Bump	
Pulling step ladder and injured foot and nail	Bump	
Cleaning engine and sprained back	Sprained Back	
Climbing down stairs and fell on back	Sprain back	
Walking and sprained foot	sprained foot	
Walking on steps and slipped	sprained	
Carrying stepladder injured wrist	Sprained wrist	
Walking and twisted ankle	Sprained Ankle	

The "Error" theme, ***Bumps and Sprains***, is formed by thirteen codings found in the Incident on Duty Investigation Reports such as:

"Standing up and banged head on engine cover"

"Cleaning engine and sprained back" and

"Walking and twisted ankle"

This theme encompasses all errors that have resulted in some sort of physical injury to the worker. The distinguishing factor compared to the other two themes,

is that they are difficult to prevent, and have not resulted due to a failure of equipment, or an exposure to harmful environmental conditions.

The “Error” theme of, ***Equipment***, is encompassed by component failures that may have resulted in a physical injury, but not necessarily. Three codings were highlighted in the Incident on Duty Reports for this theme, namely:

“Door fell on Hand”

“Compartment lid fell on hand” and

“Sewage Drained onto person”

The final “Error” theme, described as ***Environmental Exposure***, is made up of codings extracted from the Incident on Duty Reports that alluded to the worker being harmed through exposure to predominantly noise and chemicals found in the immediate work environment. Thirteen were highlighted in the taxonomy, and were described by phrases such as:

“Exposed to noise”

“Exposed to benzene or toluene”

“Cleaning and splashed aero wax into eye” and

“Cleaning galley and splashed fluid into eye”

4.2. Research Question A

A) What are the predominant primary error attributions during the minor maintenance of aircraft, comparing maintenance staff and team leaders?

At the onset, it is important to note that “N” represents a cumulative figure of the number of instances an attribution relating to a dimension or theme occurred in the transcripts. Each error attribution made by participants was coded, thus participants could have made a specific attribution in a number of different ways, all of which were extracted from the transcripts, and analysed with respect to the relevant groupings.

4.2.1. Maintenance Staff Interviews- Primary Error Attribution Themes

The data analysis process of thematic content analysis conducted on the transcripts of interviews with maintenance staff highlighted four main primary error attribution themes, namely Employee Culture; Organisational Environment; Managerial Issues; and Employee Motivation; each made up of various dimensions. Table 6 is a summary of the full table (including participant attributions and related coding) available as Appendix E.

The format of relating these primary error attribution themes for maintenance staff interviews is the following. First, the summary table tabulates the themes identified through thematic content analysis; and how they are constructed, i.e. all dimensions and the number of instances that each dimension appears within the raw data, to make up each theme. Next, each theme is described fully, listing each dimension and explaining the relationship between the dimensions and the main theme. Extracts from the raw data are provided to illustrate how phrases were coded under selected dimensions, and finally, each dimension making up the main theme is described in further detail, by relating the types of codes that were grouped together to form each dimension.

Table 6: Maintenance Staff Interviews- Primary Error Attribution Themes (N=255)

Dimensions	Number of Instances (N)	Theme
Time Pressures	19	Organisational Environment (N=79)
Lack of Counselling Outlet	6	
Stress and Workload	11	
Lack of Career Growth	4	
Safety Equipment Design and Logistics	10	
Shortcomings in Disciplinary Process	10	
Inadequate Sanctioning	5	
Workspace	2	
Processes and Procedures	10	
Passengers	2	
Unpleasant Aesthetic Work Environment	5	Employee Motivation (N=22)
Class and Race Issues	6	
Shifts and Retrenchments	4	
Recognition and Reward	7	
Old Habits and Way of Work	5	Employee Culture (N=94)
Negative Attitudes	13	
Individualism	10	
Laziness	5	
Not Going the Extra Mile	8	
Dwindling motivation	11	
Vengeance	3	
Ego and Bravado	7	
Conflict	3	
Ignorance regarding safety	14	
Knowledge and Experience	7	
Human Factors	8	
Inadequate Planning	6	Managerial Issues (N=60)
Poor Communication and Consultation	9	
Management Motives	14	
Workload	2	
Managerial Skills	7	
Shortcomings regarding Supervision	17	
Outsourcing	5	

Employee Culture (N=94) is made up of twelve dimensions, which are: Human Factors (N=8); Knowledge and Experience (N=7); Ignorance Regarding Safety (N=14); Conflict (N=3); Ego and Bravado (N=7); Vengeance (N=3); Dwindling

Motivation (N=11); Not Going the Extra Mile (N=8); Laziness (N=5); Individualism (N=10); Negative Attitudes (N=13); as well as Old Habits and Way of Work (N=5).

These dimensions are made up of attributions that relate behaviours, beliefs and attitudes which collectively form what has been termed employee culture. Attributions made by participants that have been associated with this theme include:

"…you not going to help him with his trouble, and he is going to take a very long time to do his job, you will not jump in and help him to quickly get the job done…"; which was placed under the dimension of "individualism".

"…it is not only my responsibility, there are other stake holders, that actually result in that lying there, but I'm expected because I'm taking charge of the aircraft to clean up the area. I know the people think that why should I do it, I didn't throw it there, so there again we have an attitude problem..."; which was placed under the dimension of "not going the extra mile".

"…I lost out, now they took somebody that didn't come to work, now next time I'm going to get his ass whipped because if there is something that has to be done I'm just going to not worry about it. I'm just going to leave it…"; which was placed under the dimension of "vengeance", and

"…if you have time to go to the locker to pick it up, now they push you for time, now what the guys do is to just throw the chemicals there and tell you now I feel like heaven and they'll laugh about it…"; which was placed under the dimension of "ignorance regarding safety".

Attributions of maintenance staff that indicated a resistance to changes within the environment, such as the introduction of new safety rules, and an attachment to old habits formed the Old Habits and Way of Work dimension.; while attributions relating to attitudes such as not taking responsibility, employee negativity, don't

care attitudes as well as negative motivation and attitudes fell under the dimension of Negative Attitudes.

The dimension Individualism was formed with codes of attributions relating to employees acting with their own interests in mind without giving consideration to the needs of their fellow workers. Laziness encompassed attributions to not wanting to exert energy to replace equipment, spares, and carry out basic activities; while the dimension Not Going the Extra Mile specifically includes attributions by workers to other workers not wanting to take initiative and go beyond the call of duty.

Dwindling Motivation encompasses attributions by workers to an environment and individual sense of employee unhappiness, reduced motivation and commitment, as well as frustration and a lack of pride. Vengeance includes attributions to workers wanting to get their own back due to being unfairly treated; Ego and Bravado is a dimension formed by grouping attributions with implicit or explicit reference to wanting to impress others or being worried about what impression others have; and Conflict is formed by attributions to interpersonal or domestic conflict.

The dimension Ignorance Regarding Safety is formed by the grouping of attributions to not being aware of the side effects of chemicals, superficial understandings of safety, as well as not being aware or understanding the implications of certain actions. The Knowledge and Experience dimension includes attributions with specific reference to shortcomings in training, experience and know how while the last dimension of Human Factors is a miscellaneous grouping, that broadly includes attributions to concepts such as situational awareness, concentration, and carelessness.

Organisational Environment (N=79) consists of the ten dimensions of: Time Pressures (N=19); Stress and Workload (N=11); Safety Equipment Design and Logistics (N=10); Shortcomings in Disciplinary Process (N=10); Processes and

Procedures (N=10); Lack of Counselling Outlet (N=6); Inadequate Sanctioning (N=5); Lack of Career Growth (N=4); Workspace (N=2); and Passengers (N=2).

These dimensions relate the nature of the environment within which employees must function and perform the duties and responsibilities encompassing their jobs, hence them being placed under the theme “organisational environment”. Some attributions made by participants, which have been included within this theme are:

“…I felt that he was overlooking the safety options in favour of getting the aircraft out on time, and not considering all the people around that were affected by his actions…”; which was placed under the dimension of “time pressures”.

“…stress in this place, what happens is some of the people because of the work that we do, you go home every night and there is 700 peoples lives you signed for and it does have some amount of stress on you…”; which was placed under the dimension of “stress and workload”, and

“…so he said, why must I go for the 400 and the 600 airbus, so that the team leader can sit on his ass and he must do he's job. He’s right. He's not interested anymore. I did the 400 avionics course, it is 14 weeks, they did the 400 course IFE, two days, and he get the same pay...” ; which was placed under the dimension of “lack of career growth”.

Time pressures, as a primary error attribution dimension is comprised of phrases that have some sort of attribution and reference to time and specifically a shortage of time which causes a pressurised situation leading to secondary errors. Next, Stress and Workload is formed by attributions made by maintenance staff to levels of stress as well as the feeling of a heavy or unreasonable workload. Codes that emerged from these attributions allude to management pressure, the effects of fatigue, commitment on the part of the workers to meeting unreasonable deadlines, long hours and the burden of responsibility.

The dimension, Safety Equipment Design and Logistics encompasses primary error attributions made by maintenance staff to equipment being cumbersome and uncomfortable. Included in this theme are the instances when maintenance staff pointed out deficiencies in equipment; that it hinders sight or is perceived as unhygienic, as well as faults in the logistical process, such as equipment not being issued as standard when collecting chemicals, and replacement safety equipment not being readily available but having to be ordered.

The dimension, Shortcomings in Disciplinary Process, is formed by a grouping of attributions that highlight the inadequacies and perceptions of the disciplinary process that could lead to it being ineffective. Codes that have been grouped to form this sub them include: fear of disciplinary action that deters workers from reporting secondary errors; lack of confidential and anonymous measures to complain that is related to a fear of victimisation; and a work now complain later philosophy. Processes and Procedures, is comprised of ten primary error attributions made by maintenance staff that specifically refer to organisational elements such as long procedures, outdated procedures, perceptions of irrelevant and inconvenient rules, as well as inadequate tracking processes.

Five primary error attributions dimensions that form the main theme of Organisational Environment remain. Firstly, maintenance staff have identified that staff do not talk about their issues to counsellors and that counselling is not available to them at the company (lack of counselling outlet)

Secondly, Inadequate Sanctioning, as a dimension is formed by grouping attributions made by maintenance staff to a lack of punishment for violations, and unsafe behaviours and practices. Thirdly, a dimension of Organisational Environment is Lack of Career Growth which emerges from maintenance staff attributions to a lack of reward from the company for them enhancing their qualifications and expertise. Fourthly, Workspace; and finally, Passengers; are formed by maintenance staff making the primary error attribution, lack of

workplace for the former, and that certain passengers are not patient or accustomed to technology, for the latter.

Managerial Issues (N=60) is formed by seven dimensions, namely: Outsourcing (N=5); Shortcomings regarding Supervision (N=17); Managerial Skills (N=7); Workload (N=2); Management Motives (N=14); Poor Communication and Consultation (N=9); and Inadequate Planning (N=6).

What is common between the dimensions that form this theme, is that they are all management related in some explicit way, which includes team leaders who are one of the lower levels of management. Phrases which have been placed under this theme include:

"…they all seem to do like chemical and maintenance applications at the same time instead of trying to stagger it a bit, the only people that are doing chemical applications are there at a certain time..." ; which was placed under the dimension of "inadequate planning."

"…management always want to dictate policies but they never ask the workers what do they think…"; which was placed under the dimension of "poor communication and consultation".

"…there is a book and the manager hides it away and doesn't say you know you have a right to see …if he doesn't tell you or you are not made aware of it you will never know…"; which was placed under the dimension of "managerial motives", and

"…a lot of times they have the attitude, the management, ought to be more careful because he doesn't do anything, like he doesn't want to go through the lengths of investigation or find a cause…"; which was placed under the dimension of "shortcomings regarding supervision".

Primary error attributions made to the inadequacies of outsourcing deals and contracts formed the dimension of Outsourcing. Next, Shortcomings Regarding Supervision, encompasses all attributions that refer to supervision being inadequate, including diminished supervisor authority, as well as supervisors not fulfilling their required responsibilities and applying insufficient pressure on workers to abide by rules, regulations and processes.

Managerial Skills as a dimension is formed by attributions to supervisors and managers delegating duties poorly, and not utilising staff to their full potential. Workload includes attributions to management being overworked, and Management Motives is a dimension formed with attributions that make reference to broken management promises, favouritism, unfairness, perceptions that management are serving their own interests and don't care about workers, as well as employees not being respected as a valuable resource.

Primary error attributions to insufficient communication, rumours, ineffective communication, and poor feedback were grouped together to form the dimension of Managerial Issues described as Poor Communication and Consultation. Lastly, the dimension Inadequate Planning, includes attributions to poor planning on the part of management in terms of work tasks, responsibilities, and decision making.

Finally, the theme ***Employee Motivation (N=22)*** consists of four dimensions. These include: Recognition and Reward (N=7); Shifts and Retrenchments (N=4); Class and Race Issues (N=6); and Unpleasant Aesthetic Work Environment (N=5). Dimensions making reference to an impact on employee motivation have been included within this theme. Some of these are:

"…the canteen that we have here is not all that clean, the food is not that good and the other thing is they are not open all the time, they work hours that suits themselves not the guys that work shifts…"; which was placed under the dimension of "Unpleasant Aesthetic Work Environment".

"…if you talk to the blacks now, you see how many rubbish bags you see at the side of the road, they too lazy to keep it at their place or they missed it, and now bump it at another place. They say its alright, it creates work for others, that's their mentality now..."; which was placed under the dimension of "Class and Race Issues", and

"…if the aircraft is out on time, you will never, ever, hear a manager come talk to us and say thank you for doing your work…"; which was placed under the dimension of "Recognition and Reward".

Primary error attributions made by workers to a lack of recognition for their efforts were grouped to form the dimension of Recognition and Reward. Secondly, references by workers to the impending retrenchments and company decision to change shifts were clumped under the descriptor, Shifts and Retrenchments. Thirdly, Class and Race Issues included attributions by maintenance staff to racism and racist attitudes as well as class issues between mechanics and cleaners, and the role modelling of perceived higher class trades. Lastly, the primary error attribution dimension of Unpleasant Aesthetic Work Environment encompasses attributions to the pleasantness, desirability, and comfort of the work environment.

4.2.2. Maintenance Staff Focus Groups- Primary Error Attribution Themes

Five main primary error attribution themes emerged through the data analysis of focus group discussion transcripts for maintenance staff. These were Stress; Management; Employee Motivation; Recognition and Reward; and Shift work. Table 7 is a summary of the full table (including participant attributions and related coding) available as Appendix F.

The format of relating these primary error attribution themes for maintenance staff focus groups is the following. First, the summary table tabulates the themes identified through thematic content analysis; and how they are constructed, i.e. all dimensions and the number of instances that each dimension appears within

the raw data, to make up each theme. Next, each theme is described fully, listing each dimension and explaining the relationship between the dimensions and the main theme. Extracts from the raw data are provided to illustrate how phrases were coded under selected dimensions, and finally, each dimension making up the main theme is described in further detail, by relating the types of codes that were grouped together to form each dimension.

Table 7: Maintenance Staff Focus Groups- Primary Error Attribution Themes (N=64)

Dimensions	Number of Instances (N)	Theme
Effects	3	Shift work (N=8)
Design	5	
Reward	4	Recognition and Reward (N=16)
Recognition	8	
Injustice	4	
Loyalty	4	Employee Motivation (N=20)
Environment	2	
Discrimination	7	
Perceptions	5	
Budget	2	Management (N=10)
Inefficiency	4	
Mistrust	4	
Illness	2	Stress (N=10)
Effects on Family	4	

The theme ***Shift work (N=8)*** comprises of two dimensions, namely: Effects (N=3); and Design (N=5). Effects represents attributions to the impact that shift work has on fatigue and the human immune system; while Design represents

maintenance staff primary error attributions to the perceived inadequate design of shift schedules based on the impact it has on the individual as well as his/her family life.

For example the phrase,
"…I'm expected to be wide eyed willy winky you know, it can't happen cause when you are expected to go to bed, I can tell you from experience that when I go to bed and put my head on the pillow, I don't fall asleep…" ; was placed under the dimension of "Effects of Shiftwork",

while the phrase,
"…this company doesn't cater for your family life, and that is within our section. I think that two in three people or four in five people are on their second wives because of divorce if that is an indication..." ; was placed under the dimension of "Design of Shiftwork".

The theme ***Recognition and Reward (N=16)*** consists of three dimensions. These are Recognition (N=8), Reward (N=4), and Injustice (N=4). Attributions made by maintenance staff to a lack of incentives, injustices in recognition, and a lack of recognition were placed under the dimension Recognition; while references to low rewards for enhancing skills and the perceived poor compensation for high levels of responsibility was placed under the dimension Reward; and attributions to perceived injustices regarding recognition or reward were placed under the descriptor, Injustice. These dimensions all relate to issues of recognition and reward and have thus been placed within this theme.

The following phrases are included to illustrate this.
"…sometimes you work your ass off and then there is a lazy there and a manager will give him a pat on the back, and no matter how hard you work it is only a certain blue eyed boy that will get the thank you for this…" ; was placed under the dimension of "Recognition".

"…then you hear of other sections like the pilots end up with salaries of 50 and 20 percent increases on their types of salaries and then you think hang on, the company is paying a lot more towards them at the drop of a hat…" ; was placed under the dimension of "Injustice", and

"…at the end of the day I'm putting my job on the line to say that is where I am going and yet you are not recognised…you are taking on further responsibilities and you should be getting compensated for that responsibility…" ; was placed under the dimension of "Reward".

The third main theme, ***Employee Motivation (N=20)*** is formed by four dimensions; perceptions (N=5), discrimination (N=7), Environment (N=2), and Loyalty (N=4). While the second theme above specifically highlighted the recognition and reward (motivator) dimensions of motivation, this theme encompasses the hygiene dimensions of motivation.

Some attributions made by maintenance staff that were included in this dimension are:

"…and favouritism as well, in this company. I noticed maybe in other companies as well, it's who you know. If you know somebody well you can get promoted without having the proper paperwork and without having the proper this and the proper that…" ; which was coded as nepotism and placed under the dimension of "Perceptions".

"…when you go to the tea room let it be neat and clean, let the toilets be working, you understand…paint the bloody walls, from white they going to like cream…I mean put a pot plant here and there, you know what I mean…" ; which was placed under the dimension of "Environment", and

"…if you don't know the person well, this person doesn't like you then you have to go learn it on your own and read it from a manual where if another guy comes

and they'll pump him with information…"; which was placed under the dimension of "discrimination".

Primary error attributions to poor qualifications, favouritism, nepotism and cultural differences fell under the first dimension of Perceptions. The next dimension described by the word Discrimination, includes primary error attributions made to racial discrimination, and discrimination with respect to training, selection and opportunity. Attributions to an unsatisfactory work environment was included under Environment, and primary error attributions to poor motivation and decreasing loyalty were placed under the descriptor, Loyalty.

Management (N=10) is the fourth main theme. It is formed by three dimensions relating to management, which are Budget (N=2); Inefficiency (N=4); and Mistrust (N=4), Budget was formed with attributions to managerial hypocrisy in budget policy and the perceived low priority of human factors in the budget allocations of management; Inefficiency was formed with attributions to management not applying thought to identify and rectify pressing issues, not considering limitations in their decisions and being generally inefficient; and lastly the dimension Mistrust was formed with primary error attributions that had a sense of suspicion to management and the motives behind managerial decisions.

The following phrases are included to illustrate this.

"…you don't have anything to show for your commitment and dedication and people were told sorry the budget does not allow us to spend 15 rand more…and they will spend a lot of money on other things that are totally unnecessary...";
which was placed under the dimension of "Budget" due to it being coded as hypocrisy in budget policy.

"We are technically oriented, that is why when we do aptitude tests it is a technical aptitude and we perform well in these tests...now you make me do the books, I can't do the books, it wasn't part of our natural thing, but with the proper

training I can make better…" ; which was placed under the dimension of "Inefficiency", and

"...the manager doesn't want to budget too much of money because then it looks bad on him that he doesn't want to budget..." ; which was placed under the dimension of "Mistrust".

The last main primary error attribution theme that emerged from the focus group discussions with maintenance staff is ***Stress*** ***(N=10).*** This theme is made up of two dimensions, Illness (N=2) and Effects on Family (N=4). Illness includes primary error attributions made to stress related illness, and Effects on Family represents attributions made to the effects of stress on family life. The remaining attributions could not be placed into an overarching theme, but it is felt that they fall within the broader theme of Stress. These include primary error attributions such as time pressure and second guessing pressure choices.

Phrases encompassed under this theme include:

"…because of a stressful life, that is why so many people get heart attacks and strokes here, you understand." ; which was placed under the dimension of "Illness", and

"…the highest divorce rate in this department, in this company most of the guys are on there second or third wives…If that is not an indication of the toll that it takes on your family life then I don't know what is!"; which was placed under the dimension of "Effects on Family".

4.2.3. Team Leader Interviews- Primary Error Attribution Themes

Transcripts of interviews with team leaders were organised into four primary error attribution themes using thematic content analysis. These themes are Discrimination; Ineffective Management; Organisational Culture; and Human Factors. Table 8 is a summary of the full table (including participant attributions and related coding) available as Appendix G.

The format of relating these primary error attribution themes for team leader interviews is the following. First, the summary table tabulates the themes identified through thematic content analysis; and how they are constructed, i.e. all dimensions and the number of instances that each dimension appears within the raw data, to make up each theme. Next, each theme is described fully, listing each dimension and explaining the relationship between the dimensions and the main theme. Extracts from the raw data are provided to illustrate how phrases were coded under selected dimensions, and finally, each dimension making up the main theme is described in further detail, by relating the types of codes that were grouped together to form each dimension.

Table 8: Team Leader Interviews- Primary Error Attribution Themes (N=196)

Dimension	Number of Instances (N)	Theme
On the Job Training and Supervision	6	Discrimination (N=27)
Training Selection and Opportunities	12	
Racial Attitudes	9	
Consideration for staff	4	Ineffective Management (N=29)
Management style and abilities	8	
Communication	6	
Inefficient Planning	11	
Poor Employee Motivation	14	Organisational Culture (N=85)
Perceived Injustices	13	
Lack of Rewards and Recognition	8	
Lack of Pride and Enthusiasm	9	
Growth Opportunities	7	
Self Discipline	9	
Selfishness and Individualism	7	
Work Ethic	12	
Weak Disciplinary Process	6	
Shift work	2	Human Factors (N=55)
Stress	6	
Heavy Workload	6	
Time Pressure	9	
Tools, Equipment and Nature of Work	12	
Human Limitations	12	
Weighed Benefits	4	
Risk taking and Role modelling	4	

The theme ***Discrimination (N=27)*** is made up of three dimensions, namely: On the Job Training and Supervision (N=6); Training Selection and Opportunities (N=12); and Racial Attitudes (N=9). The primary error attribution dimension, On the Job Training and Supervision, consists of attributions made to racial discrimination with respect to supervision, guidance, mentorship, encouragement and on the job training; while the next dimension, Training and Selection, has grouped together attributions made to discrimination in selection for training and training opportunities. The last dimension, Racial Attitudes, consists of primary

error attributions made by team leaders during the interviews to racism, racist attitudes, and a racially discriminating culture.

The common thread between these dimensions, are attributions to discrimination. The following phrases extracted from the interview transcripts of team leaders demonstrate this.

“…when you have direct aircraft related training and that is the reason errors occur, because junior guys obviously are the non-white people that walk into crews and they are not being trained, obviously not welcome and they are not being supervised” ”; which was placed under the dimension of “On the Job Training and Supervision”.

“…the white guys make a flop up and it is not seen, suddenly you didn’t hear it, you didn’t see it, and a non-white makes a mess up or a bugger up then the whole airline knows…”; which was placed under the dimension of “Racial Attitudes”, and

“…the training and development side of our company does not look at statistics when it comes to non whites, which is also one of the reasons why these non-white guys aren't being trained”. This phrase was placed under the dimension of “Training and Selection”.

The second main theme, ***Ineffective Management (N=29),*** is comprised of four dimensions, all of which refer to managerial ineffectiveness in terms of: Consideration for Staff (N=4); Management Style and Abilities (N=8); Communication (N=6); and Ineffective Planning (N=11).

Firstly, Consideration for Staff, includes attributions made to a lack of consideration for staff from management. Secondly, Management Style and Abilities, includes attributions made to a perceived unwillingness on behalf of management to accept or delegate responsibility, poor mentorship of employees,

and an inability on the part of some team leaders to cope with a more demanding and rapidly changing work environment.

Thirdly, the dimension Communication was highlighted by primary error attributions of team leaders to inefficient communication, a perceived dichotomy between management and employees, as well as the enforcement of decisions without consultation. The final dimension, Ineffective Planning, represents team leader attributions to poor and inefficient work task planning, as well as a lack of foresight. The following phrases are included to illustrate this.

“you need to have management that are capable of respect, and say I need to look after these people because they are going out of their way...” ”; was placed under the dimension of “Consideration for Staff”.

“…but you have got a lot of the old mentality here, where you have got some guys with twenty years experience and some guys with thirty years experience…they only had to come in and shift the radio and that was it.” ”; which was placed under the dimension of “Management Styles and Abilities”

“…there has always been a problem with work instructions, they just have never been able to…you always hear that there are your work instructions of management…” ”; which was placed under the dimension of “Communication”, and

“…planning is important, and planning is one of our biggest problems” ”; which was placed under the dimension of “Ineffective Planning”.

Organisational Culture (N=85) is the third theme, formed by nine dimensions titled: Poor Employee Motivation (N=14); Perceived Injustices (N=13); Lack of Rewards and Recognition (N=8); Lack of Pride and Enthusiasm (N=9); Growth Opportunities (N=7); Self Discipline (N=9); Selfishness and Individualism (N=7); Work Ethic (N=12); and Weak Disciplinary Process (N=6).

These dimensions are made up of attributions that relate predominant behaviours, beliefs and attitudes which holistically form what can be termed “organisational culture”. Attributions made by participants that have been associated with this theme include:

“…it demoralises you man, it demoralises you, because look what does it do, you feel inferior, you feel like you are scared, even if the guys offers you a course afterwards you think ah, I'm not capable…you scared…”; which was placed under the dimension of “Poor Employee Motivation”.

“…pilots fly first class, we fly closet class…so our perks, it sucks, bottom line” ”; which was placed under the dimension of “Perceived Injustices”.

“There is no knowledge improvement or nothing, they is no encouragement to do aircraft training, to say look, get your certifications, get licenses, there is nothing of that sort” ”; which was placed under the dimension of “Lack of rewards and Recognition”.

“…there's no pride in it, they don’t think, lets use a weird phrase, outside the envelope…I could show you when it comes to peoples general interest, how many people here are interested in aviation, how many of them are real aviation buffs…its not a passion anymore... ”; which was placed under the dimension of “Lack of Pride and Enthusiasm”, and

“…I'll take you to youngsters now, who are craftsmen now, who are capable of moving up the ladder, but there is no ladder for him to move, so he is going to be a craftsmen for the rest of his life ”; which was placed under the dimension of “Growth Opportunities”.

Primary error attributions made by team leaders forming the dimension Poor Employee Motivation, include those related to low employee motivation, demoralisation, demotivated attitudes, and worker unhappiness. The next dimension Perceived Injustices, is comprised of attributions associated with

perceived injustices regarding salary, benefits, travel facilities, retrenchments, and managerial spending priorities; and the dimension Lack of Rewards and Recognition, was produced by grouping attributions that expressed a lack of reward or recognition of employees, for enhancing skills, upskilling, sacrificing , or making a valuable contribution to the company.

Lack of Pride and Enthusiasm, is a dimension of organisation culture that is due to the grouping of primary error attributions made by team leaders to a loss of pride and passion amongst employees, reduced enthusiasm, and employee unwillingness to go beyond the call of duty; Growth Opportunities relates to primary error attributions made to a lack of career growth opportunities; and Self Discipline. It includes attributions that communicate either poor self discipline or a lack of discipline.

Three dimensions of the main theme Organisational Culture remain. Firstly, Selfishness and Individualism, that includes primary error attributions made by team leaders to a disregard for fellow workers in the work environment, and a sense of looking after one's own needs and interests first without consideration for the implications to others; secondly, Work Ethic, which includes primary error attributions made by team leaders to employees not fulfilling their responsibilities, job requirements, having irresponsible attitudes, being lazy and showing risk taking behaviours; and thirdly, Weak Disciplinary Process for which primary error attributions made by team leaders allude to managers and supervisors lacking the tools to discipline, complex dismissal processes, weak disciplinary procedures, and employees being overprotected by the country's labour laws.

The final primary error attribution theme for team leader interviews is headed ***Human Factors (N=55),*** which consists of eight distinct dimensions. These are: Shift work (N=2); Stress (N=6); Heavy Workload (N=6); Time Pressure (N=9); Tools, Equipment and Nature of Work (N=12); Human Limitations (N=12); Weighed Benefits (N=4); and Risk taking and Role modelling (N=4).

This theme encompasses dimensions which include attributions to factors that would directly affect human performance due to placing strain on the inherent limitations of the human being. Attributions made by participants that have been associated with this theme include:

"…I think that it takes me to come in from a night cycle, its taken at least two to three days to come out of that totally, because my mind and my body has become part of the night shift"; which was placed under the dimension of "Shiftwork"

"…but not once have you seen someone from within the company or outside the company come here and say, come to us, and said listen, we are going to come to you guys and see what is your stress levels like and see what is the pressure like in this place "; which was placed under the dimension of "Stress".

"…we used to have one aeroplane, maybe two aeroplanes in a week to do. Now in a normal shift I can have twelve aeroplanes and I will have to do them in the same time "; which was placed under the dimension of "Heavy Workload".

"They only got a certain number of things, let's take a ladder, they might only be three one metre step ladders or two one metre step ladders"; which was placed under the dimension of "Tools, Equipment and Nature of Work", and

"…the guy wouldn't have had to remember it. He would actually have read it and remembered or known he hasn't done it and he would have gone and done it"; which was placed under the dimension of "Human Limitations".

Firstly, the dimension Shift Work is formed by attributions made to the impact of shift work. Secondly, the dimension Stress is formed by attributions made to stress due to a heavy workload, poor person job fit, the expression of a need for counselling and the environment. Third, the primary error attribution dimension Heavy Workload consists of attributions made by team leaders in interviews to an increased workload, work overload, and the burdening of diligent employees.

Fourth, Time Pressure is produced by attributions with a sense of strain to time pressures and deadlines.

The fifth dimension, Tools, Equipment and Nature of Work, includes primary error attributions made by team leaders to tools, such as tool stores not being sufficiently stocked; the nature of the workplace, the distance to the tool store, and the perceived appearance and inconvenience of equipment. Sixth, Human Limitations is a dimension of the main theme Human Factors, that comprises of primary error attributions made to a lack of situational awareness or attention, fatigue and concentration fatigue, familiarity, poor judgement, and individual limitations.

Seventh, the dimension Weighed Benefits was formed by grouping primary error attributions made to employees weighing the relative time of setting up safety equipment with the consequences as well as the time taken to complete the task. The eighth and final dimension, Risk taking and Role modelling, has combined primary error attributions made by team leaders to risk taking behaviour, the role modelling of negative behaviours, and the disregard for danger.

4.2.4. Team Leader Focus Groups- Primary Error Attribution Themes

The team leader focus group discussions raised five main primary error attribution themes: Employee Unhappiness; Communication; Selection Processes; Tools and Equipment; as well as Management and Team Leaders Lack Skills. Where dimensions could be identified, attributions were organised into these within the main themes. Table 9 is a summary of the full table (including participant attributions and related coding) available as Appendix H.

The format of relating these primary error attribution themes for team leader focus groups is the following. First, the summary table tabulates the themes identified through thematic content analysis; and how they are constructed, i.e. all dimensions and the number of instances that each dimension appears within the raw data, to make up each theme. Next, each theme is described fully, listing

each dimension and explaining the relationship between the dimensions and the main theme. Extracts from the raw data are provided to illustrate how phrases were coded under selected dimensions, and finally, each dimension making up the main theme is described in further detail, by relating the types of codes that were grouped together to form each dimension.

Table 9: Team Leader Focus Groups- Primary Error Attribution Themes (N=55)

Theme	Dimensions	Number of Instances (N)
Management and Team Leaders Lack Skills (N=11)		
Selection Processes (N=6)		
Employee Unhappiness (N=18)	Poor Attitudes Racism Canteen	13 2 3
Tools and Equipment (N=8)		
Communication (N=12)	Safety Campaign Communication	4 8

The theme ***Employee Unhappiness (N=18)*** consists of three dimensions, namely: Poor Attitudes (N=13); Canteen (N=3); and Racism (N=2). The primary error attribution dimension of poor attitudes is formed by a grouping of attributions made by team leaders during the focus groups to employee frustration, low morale, employee negativity, disinterest, a lack of focus, demotivation, and the generalisation of blame. Attributions made, that form the dimension canteen relate to the canteen not catering for shifts and providing adequate services for employees while the dimension racism groups attributions related to racial attitudes. These dimensions relate the unhappiness of employees and have thus been placed under this theme.

The following phrases extracted from the interview transcripts of team leaders demonstrate this.

“…you know they also come out of a generation you know, they are old already and it is difficult for them to adapt to the new South Africa… ”; which was coded as old attitudes and methods, and placed under the dimension of “racism”.

“…if the team leader has got the right skills and stuff, to motivate his team, his crew. Sometimes what happens at this stage is that their morale is a bit low and the team leader himself is negative… ”; which was placed under the dimension of “Poor Attitudes”.

“When it comes in the night shift by ten o'clock, nothing to eat, nothing to buy, so you have to wait until seven o'clock the next morning and you knock off at six o' clock”; which was placed under the dimension of “Canteen”.

The next main theme, ***Communication (N=12),*** is formed by two dimensions Communication (N=8), and Safety Campaign (N=4). The primary error attribution dimension of communication is formed by attributions made to poor management feedback; broken channels of communication; poor management accessibility and visibility; as well as rumours causing negativity amongst employees. Safety campaign, as a primary error attribution dimension, relates to the communication campaign around safety. It is formed by attributions made by team leaders during the focus groups to safety reminders being far apart; the lack of awareness of safety hazards; as well as the attributions that safety is not habitual and there are insufficient fact based safety campaigns.

Phrases encompassed under this theme include:

“Give them the facts…you know 200 people got deaf here, you know and stuff like that, they can see it and that will make them aware of this safety…”; which was placed under the dimension of “Safety Campaign”, and

“...we don’t need to hear something about our company via the other section or via the newspaper. They need to come down and speak to us” ”; which was

coded as broken communication channels and placed under the dimension of "Effects on Family".

The primary error attribution theme ***Selection Processes (N=6)***, consists of attributions made by team leaders during the focus groups to people not being suited to the jobs that they perform; the subjective promoting by team leaders; unfair selection processes for promotion; the lack of training opportunities; and inadequate selection processes for training courses. Some of these attributions are:

"…choose a person for a promotion, the post must be advertised and each candidate, each and every candidate who applies for it must have the…so that is just not to take somebody and put him there that will be better" and

"…they'll go according to seniority, they take the guys with pension numbers and…you get the younger guy that is interested and he doesn't get the opportunity to go on course…"

Tools and Equipment (N=8) is a primary error attribution theme that is formed by attributions directed at the unavailability of tools and critical testing equipment due to tools not being purchased or budgeted for; as well as the inefficiencies in the outsource company. Some attributions drawn from transcripts of team leader focus groups which were placed under this theme include:

"…there is nearly two three four hundred metres back to the stores and you run to the stores, get to the store and find that there is no tool, and then you must run to another store or look for people who are using the tools" and

"…you change a certain component it will take you an hour because you haven't got that equipment you will end up sitting sometimes eight hours battling to change that component…"

The last primary error attribution theme that emerged from the team leader focus group is headed ***Management and Team Leaders Lack Skills (N=11).*** This theme consists of attributions made by team leaders to inefficient man power planning; poor budgeting; and that managers lack managerial skills and are not adequately skilled to do the job. Team leaders further expressed the attributions that they lack the required skills to motivate staff; and have insufficient training to perform the job adequately. The following phrases are included to illustrate this.

"..we got no training at this place at this stage for team leaders, because there is a certain way to handle people and speak to people and stuff like that. I think we got a lack of that," and

"…that manager who runs the store needs to be trained how to buy the tools because you walk around the store there is only one or two tools while there is 24-25 tools that need to be used on the aircraft..."

Table 10: Summary of Primary Error Attribution Themes for Maintenance Staff and Team Leader Interviews and Focus Groups

Maintenance Staff Interviews	**Maintenance Staff Focus Group**	**Team Leader Interviews**	**Team Leader Focus Group**
Organisational Environment (N=79)	Shift Work (N=8)	Human Factors (N=55)	Tools and Equipment (N=8)
Managerial Issues (N=60)	Management (N=10)	Ineffective Management (N=29)	Selection Processes (N=6)
	Recognition and Reward (N=16)	Discrimination (N=27)	Communication (N=12)
Employee Motivation (N=22)	Employee Motivation (N=20)	Organisational Culture (N=85)	Employee Unhappiness (N=18)
Employee Culture (N=94)			

4.3. Research Question B

B) What are the predominant secondary error attributions during the minor maintenance of aircraft, comparing maintenance staff and team leaders?

As a reminder, it is important to note that “N” represents a cumulative figure of the number of instances an attribution relating to a dimension or theme occurred in the transcripts. Each error attribution made by participants was coded, thus participants could have made a specific attribution in a number of different ways, all of which were extracted from the transcripts, and analysed with respect to the relevant groupings.

4.3.1. Maintenance Staff Interviews- Secondary Error Attribution Themes

The data analysis process of thematic content analysis conducted on the transcripts of interviews with maintenance staff highlighted four main secondary error attribution themes, namely Safety Culture; Employee Culture; Managerial Culture; and Inadequacies Regarding Tooling and Equipment; each made up of various dimensions. Table 11 is a summary of the full table (including participant attributions and related coding) available as Appendix I.

The format of relating these secondary error attribution themes for maintenance staff interviews is the following. First, the summary table tabulates the themes identified through thematic content analysis; and how they are constructed, i.e. all dimensions and the number of instances that each dimension appears within the raw data, to make up each theme. Next, each theme is described fully, listing each dimension and explaining the relationship between the dimensions and the main theme. Extracts from the raw data are provided to illustrate how phrases were coded under selected dimensions, and finally, each dimension making up the main theme is described in further detail, by relating the types of codes that were grouped together to form each dimension.

Table 11: Maintenance Staff Interviews- Secondary Error Attribution Themes (N=167)

Dimensions	Number of Instances (N)	Theme
Trading off Safety	10	Safety Culture (N=24)
Safety Equipment Unserviceable/accessible	8	
Unsafe Practices	6	
Not obeying policies, procedures, regulations	21	Employee Culture (N=44)
Poor Attitudes	9	
Human Factors	9	
Competition for Resources	5	
Inefficient Planning	8	Management Culture (N=54)
Management Injustices	3	
Communication	3	
Outsourcing	3	
Poor Decisions	4	
Supervision	15	
Inadequate Training	7	
Selection	3	
Discipline and Disciplinary Process	8	
Tools Disorganised	4	Inadequacies Regarding Tooling and Equipment (N=45)
Equipment Unserviceable/Unavailable	27	
Using Wrong Tools/Equipment	8	
Inefficiencies	6	

The secondary error attribution theme ***Safety Culture (N=24)*** is comprised of three dimensions. These are: Trading Off Safety (N=10); Safety Equipment Unserviceable or Inaccessible (N=8); and Unsafe Practices (N=6). This theme includes error attributions made by maintenance staff to the beliefs, attitudes and behaviours, forming dimensions related to safety, hence referring to a safety culture.

To form the first dimension, Trading Off Safety, attributions made by maintenance staff included instances of trading off safety to get the job done and supervisors forcing staff to work without equipment to get the job done. The second dimension, Safety Equipment Inaccessible, is made up of attributions to

obstructing fire equipment with stands; safety equipment not being available or accessible; and insufficient safety equipment. Thirdly, the dimension Unsafe Practices, consists of attributions to not wearing eye protection; not using safety equipment, and not cleaning up after working in an area.

Some attributions made by maintenance staff that were included in this theme are:

"…where they might say in a way, you know, listen, stuff that safety equipment, we need to get this done and over with…"; which was placed under the dimension of "Trading off safety".

"…We don't even have masks if we go in the fuel tank, they got this measurement, if it says six, you don't go in, if it is below six, you can go in. But now the fuel is still in, how can that be good for you"; which was placed under the dimension of "Safety Equipment Unserviceable or Inaccessible", and

"…if you are on a higher aircraft you can just jump on the stand and get through the over wing door, not like on the smaller aircraft where it is an emergency door, where you don't want to fiddle with it… "; which was placed under the dimension of "Unsafe Practicies".

The next secondary attribution theme drawn out of interviews with maintenance staff, ***Employee Culture (N=44)*** is formed by four dimensions, namely: Not Obeying Policies and Regulations (N=21); Poor Attitudes (N=9); Human Factors (N=9); and Competition for Resources (N=5).

These dimensions are made up of attributions that relate behaviours, beliefs and attitudes which holistically form what has been termed "employee culture". Attributions made by participants that have been associated with this theme include:

"…that is not reported is on paperwork, sometimes you do a job, a quick job, and you don't usually do all the right paperwork you should do, but the job is done…"; which was placed under the dimension of "Not Obeying Policies and Regulations".

"…he will not give it to you to use that key, he'll say I'm still using it, I'm using it for eight hours. And you suppose to use the overtime to finish out the work late…"; which was placed under the dimension of "Poor Attitudes".

"…some times a person take it for granted he never concentrate so not concentrating so you busy working talking to some body... "; which was coded as "lapses in attention" and placed under the dimension of "Human factors", and

"…they nearly bliksemmed the guy because they stole it man, if you got a GPU on your shift, how can these blokes take it… "; which was placed under the dimension of "Competition for Resources".

The first dimension of this theme, Not Obeying Policies and Regulations, comprises of attributions made by maintenance staff to not following or obeying procedures; ignoring regulations and legislation; shortcutting, and leaving required checks or paperwork incomplete. Next, Poor Attitudes, is a dimension consisting of attributions made by maintenance staff to racist attitudes, bravado, as well as clockwatching. The third dimension, Human Factors, encompasses attributions that refer to concepts such as a lack of situational awareness; and attention lapses. Lastly, Competition for Resources is a secondary error attribution dimension that includes attributions made by maintenance staff to a conflict between job tasks and the limited resources available; and the competition for time, system and space resources between staff.

Managerial Culture (N=54) is the third theme. It is made up of nine dimensions which include: Inefficient Planning (N=8); Management Injustices (N=3); Communication (N=3); Outsourcing (N=3); Poor Decisions (N=4); Supervision

(N=15); Inadequate Training (N=7); Selection (N=3); and Discipline and Disciplinary Process (N=8).

These dimensions are made up of attributions that relate behaviours, beliefs and attitudes which holistically form what has been termed “managerial culture”. Attributions made by participants that have been associated with this theme include:

“…planning could improve, that is another point which I feel if I had the power, I'd try and plan it properly, get people involved…”; which was placed under the dimension of “Inefficient Planning”.

“…there is a lot of time where shifts have changed and guys have lost allowances or they were in a position of authority and getting paid for it but in an acting post and then umm…they didn’t get a permanent post…”; which was placed under the dimension of “Management Injustices”.

“…we got four team leaders in the IFE crew, three team leaders sit in their office, my team leader watches TV. Every time I hear something, I hear it from other people but not him…”; which was placed under the dimension of “Communication”.

“…to repair our GP unit, they can't repair it anymore, now we run the APU from that aircraft for six hours undisturbed… …that’s a big error there and the company loses a lot of money… ”; which was placed under the dimension of “Poor Decisions”, and

“…we come in on shifts and the manager walks in here and you walk in here at ten past eleven, they will not even know, they don’t even know when you have to start your job…”; which was placed under the dimension of “Supervision”.

Inefficient planning is a dimension of the theme Managerial Culture, which is formed with secondary error attributions made by maintenance staff during

interviews, to poor planning and strategic decision making; and poor workload planning. Management Injustices is a dimension consisting of attributions to perceived injustices in decision making and making appointments. The dimension communication comprises of attributions to poor communication, and a breakdown in communication between team leaders and staff; while, outsourcing relates to inefficient outsourcing and attributions to the outsource company not performing.

The next secondary error attribution dimension of the theme Managerial Culture, is formed from attributions made by maintenance staff and is titled poor decisions. This dimension includes attributions to financial losses due to poor managerial decisions and the lack of consideration given to long term financial savings. Supervision is a dimension that encompasses attributions to inefficient supervision and management; supervisors not performing their duties, overlooking safety regulations, and allowing employees to fall short of fulfilling their tasks and responsibilities. Also included in this theme is the attribution to management placing unreasonable pressure of staff to complete outstanding work within a period of time.

The dimension inadequate training, highlights attributions made to a poor emphasis on basic training; the lack of proper induction and training of apprentices; as well as insufficient safety training and awareness of legislation for staff. Selection is a dimension that relates attributions made to the inconsistent and inappropriate selection process for either training, or safety positions; and finally, the dimension discipline and disciplinary process, is formed by grouping attributions made by maintenance staff during the interviews to inefficiencies in the disciplinary processes; as well as disciplinary issues such as employee truancy; late coming, death threats and the non-reporting of incidents.

The last secondary error attribution theme, headed ***Inadequacies Regarding Tooling and Equipment (N=45)*** consists of four dimensions incorporating attributions to tooling and equipment, which are: Equipment Unserviceable or

Unavailable (N=27); Tools Disorganised (N=4); Using Wrong Tools or Equipment (N=8); and Inefficiencies (N=6).

Firstly, equipment unserviceable or unavailable is a dimension comprised of attributions to equipment not being serviceable or available; the utilisation of this unserviceable equipment in order to perform or complete a job; equipment being poorly maintained; and their being insufficient stocks of certain equipment. Secondly, tools disorganised, includes attributions to tools not being replaced in its designated areas; tools being left scattered and disorganised causing a dangerous work environment and time wastage due to this disorganisation.

Thirdly, using the wrong tools and equipment, is a dimension that encompasses attributions to designated tools and equipment not being utilised to perform certain tasks; and lastly, the dimension inefficiencies, is made up of secondary error attributions made by maintenance staff to poor equipment design; long processes to get equipment that is required; insufficient controls to track equipment; and the wastage of spares.

Some attributions made by maintenance staff that were included in this theme are:

“…if you have tools lying all over the place, you trip and fall or you slip, that impacts on safety, that impacts on productivity, it impacts on your personal health…”; which was placed under the dimension of “Tools Disorganised”.

“…usually we are a lot of people with a lot of aircraft and sometimes there are ten other guys that are doing the same job that needs the same equipment and then I can't get it…”; which was placed under the dimension of “Equipment Unserviceable or Unavailable”.

“…we don’t usually use this thing unless there is an inspector running around, or someone that might see you. I've seen a guy who would take half an hour to an

hour to get the equipment ready…"; which was placed under the dimension of "Inefficiencies".

4.3.2. Maintenance Staff Focus Groups- Secondary Error Attribution Themes

Four secondary attribution themes emerged from the data analysis of transcripts for the Maintenance Staff Focus Groups Discussion. These are: Training and Attitudes (N=8); Planning and Strategic Interventions (N=12); Tools, Equipment and Job Task Support; and Management (N=9). Table 12 is a summary of the full table (including participant attributions and related coding) available as Appendix J.

The format of relating these secondary error attribution themes for maintenance staff focus groups is the following. First, the summary table tabulates the themes identified through thematic content analysis; and how they are constructed, i.e. all dimensions and the number of instances that each dimension appears within the raw data, to make up each theme. Next, each theme is described fully, listing each dimension and explaining the relationship between the dimensions and the main theme. Extracts from the raw data are provided to illustrate how phrases were coded under selected dimensions, and finally, each dimension making up the main theme is described in further detail, by relating the types of codes that were grouped together to form each dimension.

Table 12: Maintenance Staff Focus Groups- Secondary Error Attribution Themes (N=40)

Theme	Dimensions	Number of Instances (N)
Training and Attitudes (N=8)		
Planning and Strategic Interventions (N=12)		
Tools, Equipment and Job Task Support (N=11)	Support Tools	3 8
Management (N=9)		

The secondary error attribution theme ***Training and Attitudes (N=8)*** emerged from attributions made by maintenance staff during the focus group, to deficiencies in on the job training and inadequate training supervision. Also included in this theme are attributions to unacceptable attitudes towards training, and shortcutting which has it origins in the training that a staff member receives.

The phrase,
"…you work in a crew and you work with a gentleman and he teaches you shortcuts…the most dangerous problem in an industry, or in our trade is when the junior makes decisions on short cuts…" illustrates an error attribution to deficient on the job training, training supervision, as well as the impact of shortcutting.
The next secondary error attribution theme, ***Planning and Strategic Interventions (N=12)*** is formed by attributions made by maintenance staff to inefficient planning; short-sighted budget planning; uninformed decision making; mismanagement and poor workforce planning.

The phrase
"…come on man, if you haven't worked it how can you understand what it is, work it, go physically study it, just don't make a decision because you think that it's the right one, you know its small things…" illustrates one of the error attributions coded as uninformed decision making, while the phrase,

"…there is about 70% or 80 % of mechanical people that doesn't have one course on there name or certification…" has been coded as poor workforce planning and is also included under this theme.

The theme ***Tools, Equipment and Job Task Support (N=11)*** is formed with the two dimensions of Tools (N=8), and Support (N=3). The first dimension, tools, encompasses attributions to depleted stocks of tools and equipment; depleted tool stores; and the unavailability of tools and equipment. The second dimension, support, encompasses attributions to poor tooling and equipment support services; and inefficient tooling and equipment support structures. The following

phrases extracted from the interview transcripts of maintenance staff demonstrates this.

"…our planning, basically any department, our whole support structure, if you want a spare it takes sometimes like 20 minutes, half an hour, if you want to fault find…you must look at world class organisations with the support structures and facilities to back it up" "; which was placed under the dimension of "Support", and

"If you want this ladder from this store, it must be there, if you want this crimper, like we work with crimpers, it has to be there. You can't go for crimper and now you doing your job and the store man just says that some guys might have taken the only one... ....this is a multimillion dollar industry, one crimper for the whole airline, then you have to go look which guy got it there, it doesn't make sense...."; which was coded as depleted stocks of tools and equipment and placed under the dimension of "Tools".

Finally, the theme ***Management*** **(N=9),** is formed by grouping secondary error attributions made by participants in the maintenance staff focus group to reactive management; managerial loafing; inefficient management; and the lack of human and financial managerial skills on the part of managers.

The phrase
"…some guys don't know how to speak, they don't know the human element of the job and to make it worse, they don't know the financial element of the job…" illustrates an error attribution to a lack of human and financial management skills amongst managers, while the phrase

"…you got assholes like us who carry, do his job, so he can get paid, so that at the end of the day, if he can't make a plan, we will make a plan to get it done…" illustrates an error attribution to management loafing.

4.3.3. Team Leader Interviews- Secondary Error Attribution Themes

Thematic Content Analysis of transcripts for Team leader interviews highlighted five secondary error attribution themes, each consisting of various dimensions. The themes are: Tools and Equipment; Communication; Organisational Culture; Rules, Regulations and Procedures; and Poor Management. Table 13 is a summary of the full table (including participant attributions and related coding) available as Appendix K.

The format of relating these secondary error attribution themes for team leader interviews is the following. First, the summary table tabulates the themes identified through thematic content analysis; and how they are constructed, i.e. all dimensions and the number of instances that each dimension appears within the raw data, to make up each theme. Next, each theme is described fully, listing each dimension and explaining the relationship between the dimensions and the main theme. Extracts from the raw data are provided to illustrate how phrases were coded under selected dimensions, and finally, each dimension making up the main theme is described in further detail, by relating the types of codes that were grouped together to form each dimension.

Table 13: Team Leader Interviews- Secondary Error Attribution Themes (N=131)

Dimensions	Number of Instances (N)	Theme
Equipment Unserviceable	9	Tools and Equipment (N=26)
Availability of tools and equipment	7	
Using Incorrect Equipment	5	
Design	5	
Communication Regarding Environment	8	Communication (N=19)
General Communication	7	
Documentation	4	
…table continued on next page		
Employee Motivation	8	Organisational Culture (N=27)
Discrimination	4	
Safety Behaviours	15	
Rules, regulations and Procedures Contravened	18	Rules, Regulations, and Procedures (N=22)
Discipline	4	
Unreasonable Pressure	5	Poor Management (N=37)
Unnecessary Wastage	5	
Inadequate Knowledge and Training	12	
Planning	5	
Management Skills and Decision Making	10	

Tools and Equipment (N=26) is formed with four dimensions; Equipment Unserviceable (N=9); Availability of Tools and Equipment (N=7); Using Incorrect Equipment (N=5); And Design (N=5). This theme encompasses error attributions made by team leaders to tools and equipment, organised under the above four

dimensions. Attributions made by participants that have been associated with this theme include:

"…change the type of equipment we use so that I will look at each section and say listen, what is the type of equipment you use, is it serviceable, what is the calibration time with it, are they all calibrated, do we require new equipment…"; which was placed under the dimension of "Equipment Unserviceable".

"They'll buy the aeroplanes and they will not buy the tools, that's not normal and they will not buy the spares for it "; which was placed under the dimension of "Availability of Tools and Equipment".

"…the leatherman, you know this multitool, a hell of a lot of people use it, because it is not the right tool but it does the job"; which was placed under the dimension of "Using Incorrect Equipment", and

"…maybe its better to take the rags that we use to clean the aircraft and a selotape so that at the corner of those ladder…so even if a person can bump the aeroplane mystically they will not damage the aircraft…"; which was placed under the dimension of "Design".

Firstly, the dimension equipment unserviceable encompasses attributions made by team leaders to old equipment being unserviceable; the utilisation of unserviceable equipment; equipment being dangerous and not sufficiently maintained; as well as lack of sufficient controls. Next, the dimension of availability of tools and equipment encompasses attributions to poor equipment monitoring; the unavailability of equipment when it is required; as well as shortages of tools and spares.

Thirdly, using incorrect equipment as a dimension encompasses attributions to not using the correct equipment, using the wrong tool for the job, and utilising improper safety equipment. Lastly, the dimension of design includes attributions made by team leaders during interviews to flawed equipment design.

The second secondary attribution theme, ***Communication (N=19);*** is made up of the three dimensions; Communication Regarding Environment (N=8); General Communication (N=7); and Documentation (N=4). Documentation, being a written form of communication has been incorporated within this theme. Attributions made by participants that have been associated with this theme include:

“But when it comes to chemicals, I personally have not seen any notices to say that such chemicals are used or dangerous chemicals are in use, please adhere to the safety precautions ”; which was placed under the dimension of “Communication Regarding Environment”.

“…an old chemical, it has got its own quantities to be used and the new chemical has got different quantities to be used and the new chemical has got different quantities and different tests to be used and they were handling the new chemical on the old principle ”; which was placed under the dimension of “General Communication”, and

“Documentation that could come from the manufacturer of the aircraft…we'll from the manuals that they give you to do it in. You find some errors and there is a way of reporting them ”; which was placed under the dimension of “Documentation”.

The dimension, Communication regarding environment consists of attributions made by team leaders during interviews to the poor communication of dangerous situations to others present or entering the immediate work environment; while the dimension general communication comprises of attributions to the poor communication of policies; poor change management and related communications; as well as inadequate knowledge of communication processes in the company and insufficient communication to the grassroots members of staff. Lastly, the secondary attribution dimension documentation is formed by grouping secondary error attributions made by team leaders during interviews to

ambiguity within documentation, and errors within work manuals or documentation.

Organisational Culture (N=27) is the third secondary error attribution theme, and is made up of three dimensions. These are; Employee Motivation (N=8); Discrimination (N=4); and Safety Behaviours (N=15). These dimensions relate the nature of the environment within which employees must function and perform the duties and responsibilities encompassing their jobs, hence them being placed within the theme of "organisational environment". Some attributions made by participants, which have been included within this theme are:

"…disillusioned, much more disillusioned than anything else for various reasons…" which was placed under the dimension of "Employee Motivation".

"…but a black can do a mistake, I mean the spoken words of the talking are different…the other one has to be shouted at, the other one not..." which was placed under the dimension of "Discrimination", and

"…if someone has to walk in the hangar now, you find the APU is powered up and there are people without any ear protection…" which was placed under the dimension of "Safety Behaviours".

Attributions made by team leaders during interviews that have been grouped to form the dimension employee motivation, include those relating to employee unhappiness, clockwatching amongst employees, poor employee attitudes and an unsatisfactory work environment, as well as disillusionment. Next, the dimension discrimination, includes attributions made to the scapegoat and blaming of lesser qualified employees; being treated differently on the basis of race; as well as racial and class discrimination in the rules to operate equipment.

Safety behaviours is the last dimension forming the secondary error attribution theme of organisational culture. This dimension consists of attributions made by team leaders to dire safety behaviours such as driving with a cell phone; being

exposed to chemicals; not wearing safety equipment; not covering or cleaning up spills; not following protocol; and disposing of waste in an unsafe manner.

The fourth secondary error attribution theme ***Rules, Regulations and Procedures (N=22)*** consists of two dimensions, namely; Rules, Regulations, and Procedures Contravened (N=18), and Discipline (N=4). Rules, regulations, and procedures contravened, comprises of secondary error attributions made by team leaders to rules, regulations, procedures and instructions being infringed or contravened; while the dimension discipline includes attributions made to poor discipline and weak disciplinary procedures.

The phrase,
"…they are not doing what the company has said, they are not following the procedures or the rules…" illustrates an error attribution to the ignoring of rules and procedures, while the phrase

"…to prevent all those things people will have to be disciplined…it is always an ongoing process just to talk to the person, talk to the person talk to the person… …the best thing if ever you can just discipline a person right away…" illustrates an error attribution to weak disciplinary procedures.

Poor Management (N=37) is the last of the secondary error attribution themes from the team leader interviews. This theme is formed by the five dimensions; Unreasonable Pressure (N=5); Unnecessary Wastage (N=5); Inadequate Knowledge and Training (N=12); Planning (N=5); and Management Skills and Decision Making (N=10). The common thread between these dimensions is that they relate error attributions to shortcomings within management and managers. Attributions made by participants that have been associated with this theme include:

"…amongst those aircraft there is a time you see, and then we are not managing to do that…" which was placed under the dimension of "Unreasonable Pressure".

"…you find that there is a lot of screws, rivets, and lots of little things, components, lamps, that are taken from the store that's sometimes not utilised… …over a year it will accumulate to at least a couple of thousand or hundred thousand dollars I would say, because there is stuff there that we work in dollars and each little lamp there costs twenty cents or a dollar…" which was placed under the dimension of "Unnecessary Wastage".

"They don't train the juniors coming through and this I feel is a factor that actually causes errors to be carried out…: which was placed under the dimension of "Inadequate Knowledge and Training".

"…you will have the people rushing around because you can't cope with the planning problem on the down time of aeroplanes so that you can get all these things done in the proper manner" which was placed under the dimension of "Planning", and

"…some of these people can not handle pressure and they can not handle stress, they cannot delegate work and this is a big problem… which was placed under the dimension of "Management Skills and Decision Making".

First, the dimension unreasonable pressure relates attributions to time pressures, heavy workload, and work task pressures to get the work done. Second, the dimension unnecessary wastage relates attributions made to financial losses due to the wastage of components, leaving ground power units unattended, and time losses.

The third dimension, inadequate knowledge and training, relates attributions made by team leaders to poor on the job training; learning with a lack of guidance; unfair selection processes for training participants; a lack of knowledge and awareness amongst staff; and improper safety attitudes. Also included in this dimension are attributions to the company not rewarding the enhancement of qualifications, skills and abilities; as well as an employees repertoire of skills not being fully utilised.

Planning is the fourth dimension of the secondary error attribution theme poor management. Here team leader attributions to inefficient or poor planning and scheduling are grouped together. Lastly, the fifth dimension management skills and decision making comprises of attributions made by team leaders during interviews to a lack of managerial knowledge of employees; poor supervision and management; decisions not being given the due consideration and thought before they are taken; injustices in the promotional process of employees; as well as perceived budgeting weaknesses and a shortage of managerial skills.

4.3.4. Team Leader Focus Groups- Secondary Error Attribution Themes

Transcripts of focus groups with team leaders were organised into four secondary error attribution themes through the data analysis process. These themes are Breaking the Law (N=8); Tooling and Equipment (N=6); Skills (N=4); and Wastage (N=8). Table 14 is a summary of the full table (including participant attributions and related coding) available as Appendix L.

The format of relating these secondary error attribution themes for team leader focus groups is the following. First, the summary table tabulates the themes identified through thematic content analysis; and how they are constructed. Next, each theme is described fully. Finally, extracts from the raw data are provided to illustrate how phrases were coded under each theme.

Table 14: Team Leader Focus Groups- Secondary Error Attribution Themes (N=40)

Theme	Number of Instances (N)
Breaking the Law	**8**
Tooling and Equipment	**6**
Skills	4
Wastage	**8**

The first secondary error attribution theme that emerged from the focus group conducted with team leaders is headed ***Breaking the Law (N=8)***. This theme consists of attributions made by the team leader participants to using the wrong equipment; using the wrong tools; vandalism; theft; and the lack of compliance with procedures.

The phrase,
"…you get in our cases now, you change the component, you get tools to test afterwards and we haven't got that tools, so we take chance to send that thing up…" illustrates an error attribution to sending an aircraft into service without proper testing, included under the theme of "Breaking the Law".

The second theme, ***Tooling and Equipment (N=6)***, is made up of attributions to a depleted tool stock; an insufficient tooling to crew ratio; insufficient GPU's as well as supply of tools; and a shortage of equipment. The third theme ***Skills (N=4)***, is formed by attributions to miscommunication, inefficient planning, and bad management.

The phrase,
"…we had nine GPU's here, now we only got two and the others they can't fix…" illustrates the error attribution to a shortage of tools and equipment, while the phrase

"…we feel sometimes that it is definitely they can make a plan to keep the aircraft longer on the ground, especially if you have snags…" illustrates an error attribution to inefficient planning which has been included under the theme of "Skills".

Finally, the fourth secondary error attribution theme titled ***Wastage (N=8)***, is a grouping of attributions made by team leaders to time wastage due to the unavailability of equipment; and financial losses due to the damage of equipment.

The phrase
"the APU can use sometimes 500kg of fuel an hour and sometimes they are standing here between eight and twelve hours, the aircraft. Where you can have a GPU that runs on diesel…" illustrates an error attribution to financial losses due to wastage.

Table 15: Summary of Secondary Error Attribution Themes for Maintenance Staff and Team Leader Interviews and Focus Groups

Maintenance Staff Interviews	**Maintenance Staff Focus Group**	**Team Leader Interviews**	**Team Leader Focus Group**
Managerial Culture (N=54)	Management (N=9)	Poor Management (N=37)	
	Planning and Strategic Interventions (N=12)	Communication (N=19)	
Inadequacies Regarding Tools and Equipment (N=45)	Tools, Equipment and Job Task Support (N=9)	Tools and Equipment (N=26)	Wastage (N=8)
			Tooling and Equipment (N=6)
Employee Culture (N=44)		Rules, Regulations and Procedures (N=22)	Breaking the Law (N=8)
Safety Culture (N=24)		Organisational Culture (N=27)	
	Training and Attitudes (N=8)		Skills (N=4)

4.4. Summary

Thus far, the data collected through a thoroughly thought out and well operationalised methodology has been analysed through thematic content analyses, and presented to the reader in a methodical, understandable results chapter. The foundation laid by these initial steps in the research process, sets the tone for discussion chapter which follows, in many ways the epitome of an exploratory study such as this. In the chapter which follows, an equally thorough literature review presented in chapter two comes together with the results presented in this chapter to catalyse a discussion of significant findings.

Chapter 5 – Discussion

Already, in examining the results, it has emerged that a wealth of information is available for discussion that cannot all be discussed. This study is a broad exploratory study, and while the results that have emerged provide sufficient information to examine each dimension in-depth, such an exercise, while giving good insight into why maintenance staff or team leaders made specific attributions, would be beyond the scope of this study. A strength of the qualitative methodology is the depth of information provided, however a weakness that accompanies this is the limitation of being unable to fully interpret and discuss all this information in one study.

For example, it is possible from these results to examine what specific error attributions maintenance staff made to form the dimension time pressure, and whether these were internal or external; based on beliefs, information or motivation; or whether they were deemed intentional or by chance and so on. This exercise could be carried out across all dimensions for maintenance staff and team leaders, as well as for the interviews and focus groups; but would be better suited to studies that apply attribution theory to a specific maintenance error theme at a time, ie. time pressure, documentation, or tools and equipment etc.

Thus, in staying with the broad, exploratory nature of this study, the structure of this discussion chapter is one whereby a predominant attribution theme that emerged under each research question in the results chapter is contrasted with reference to the attribution theory framework provided in the literature review. This is done with the aim of drawing out significant aspects that can be beneficial to knowledge in the realms of error investigation, error intervention and attribution theory.

5.1. Research Question A

A) What are the predominant primary error attributions during the minor maintenance of aircraft, comparing maintenance staff and team leaders?

Table 10: Summary of Primary Error Attribution Themes for Maintenance Staff and Team Leader Interviews and Focus Groups

Maintenance Staff Interviews	**Maintenance Staff Focus Group**	**Team Leader Interviews**	**Team Leader Focus Group**
Organisational Environment (N=79)	Shift Work (N=8)	Human Factors (N=55)	Tools and Equipment (N=8)
Managerial Issues (N=60)	Management (N=10)	Ineffective Management (N=29)	Selection Processes (N=6)
	Recognition and Reward (N=16)	Discrimination (N=27)	Communication (N=12)
Employee Motivation (N=22)	Employee Motivation (N=20)	Organisational Culture (N=85)	Employee Unhappiness (N=18)
Employee Culture (N=94)			

Referring to table 10, we find that the predominant themes that emerged from maintenance staff interviews were Organisational Environment; Managerial Issues; Employee Culture; and Employee Motivation. Maintenance Staff Focus groups raised similar themes, namely, Shift Work; Management; Recognition and Reward; and Employee Motivation. Team leader interviews raised four themes, Human Factors; Ineffective Management; Discrimination and Organisational Culture, while team leader focus groups raised the themes, Tools and Equipment; Selection Processes; Communication and Employee Unhappiness.

The theme “Organisational Environment” which emerged from maintenance staff interviews is similar to the theme of “Human Factors” that emerged from team leader interviews. Regarding this theme, Maintenance staff chose to focus on “Shift-work” during the focus groups, while team leaders emphasised “Tools and Equipment”. Both maintenance staff and team leaders highlighted management as a theme during interviews. With reference to the theme of “managerial Issues” maintenance staff focused on Recognition and Reward in focus groups, while team leaders placed emphasis on Selection Processes; Discrimination; and Communication.

Team leader interviews highlighted the theme “Organisational Culture”, which is very similar to the themes “Employee Culture” and “Employee Motivation” that emerged from maintenance staff interviews. Both maintenance staff and team leader focus groups highlighted employee motivation and unhappiness during focus groups.

On this basis, we see that the predominant primary error attribution that emerged from the previous chapter for this research question is encompassed by the descriptor of Organisational Culture. This descriptor includes themes identified in both interviews and focus groups with maintenance staff and team leaders, especially relating to employee motivation, and managerial culture. Dimensions which have been grouped together, forming these main themes are amongst others; recognition and reward, discrimination, time pressure, shift work, poor attitudes, unpleasant aesthetic work environment, selfishness and individualism for what is titled employee motivation. Managerial culture incorporates dimensions such as: management lacks skills and abilities, shortcomings regarding supervision, poor communication and consultation, inefficient planning, lack of consideration for staff and so on.

The reason that themes and dimensions related to organisational culture were categorised as primary error attributions, was due to the strong behavioural and biological element involved. While poor work motivation, shift work, managerial inefficiencies etc. all have a financial impact on the organisation; it is usually not

immediately visible to the organisation but deeply affects the employee's state of mind and self. The effect of this, if not dealt with properly, is quite possibly an increase in secondary errors.

Employee's who are not motivated are not as productive and efficient as those who are well motivated and have a high sense of morale. Herzberg's (1959) two factor theory of hygiene and motivator needs highlights the factors that should be present in a work environment to ensure motivated and satisfied employees. These include a pleasant work environment, the nature of job tasks, reward, organisational commitment, employee attitudes, recognition, achievement and numerous others that subsequent research has uncovered (Herzberg, 1959).

The primary error attribution to poor motivation, be it made by maintenance staff or team leaders, is primarily a person or internal attribution. It is referring to factors within the person as the reason for their behaviour which has resulted in other secondary errors. However, investigating a step deeper into the dimensions, shows that many of the dimensions relating to poor motivation are external attributions referring the cause of the secondary error conducive behaviour to be due to situational factors. These include: unpleasant aesthetic work environment, time pressures, recognition and reward, and training and selection opportunities amongst others.

At the same time, dimensions did emerge which can be categorised as internal attributions, such as racism and discrimination, work ethic, laziness, individualism, and negative attitudes. One could argue though, that some of these primary error attribution dimensions such as laziness and individualism, are not mutually exclusive and emerge because of the dominant environmental situation.

Similarly, Managerial culture as a primary error attribution is also largely inferring an internal or person attribution, since a culture of managers would be made up by the managers who engage in the behaviours that form that culture. This culture however could be enhanced or supported by the policies and processes

that govern managerial behaviour, but is still seen to be largely an internal (person) attribution. Like the descriptor employee motivation, both internal (person) and external (situational) attribution dimensions can be distinguished, such as: management style and abilities (internal), consideration for staff (internal), shortcomings regarding supervision (internal), and workload (external) as well as outsourcing (external).

Aviators have concluded that management errors are one of the most serious threats to safety (Weiner et al, 1993). These include the failure to delegate tasks and responsibilities adequately or efficiently; the failure to set priorities; inadequate monitoring and supervision; leadership styles; and the failure to detect or challenge non-compliance with standard operating procedures. Many of these attributions referred to by Weiner (1993) emerged in the study to form the themes and dimensions encompassed by the descriptor managerial culture.

For the purpose of this discussion, it is easiest to deal with just two descriptors that encompasses the two segments identified; shift work and time pressures for Organisation culture – external; and racism and discrimination for Organisational Culture – internal. The principles and tools implemented to analyse these two descriptors can then be implemented by the reader for the other descriptors that fall under each segment.

The primary error attribution to racism and discrimination, involves significant emotions in the South African context. This is primarily due to the majority black population in South Africa being oppressed under Apartheid, and eventually achieving freedom in 1994. Associated with the condemning of racism in all its forms, current South African legislation also demands that black's be given preference for jobs that they are adequately qualified for in preference to Whites, through an affirmative action process that attempts to redress the economic consequences of Apartheid.

Kelley's (1971) theory of attribution states that individuals attribute behaviour to internal and external causes, depending on three basic informational cues

(Ashkanasy, 1989). Generally, a person will attribute a behaviour to internal (personal) causes if that behaviour has low distinctiveness, high consistency, and low consensus. Alternatively, external (or situational) attributions will be made, if the behaviour has high distinctiveness, low consistency, and low consensus (Ivancevich and Matteson, 1999).

Racism and discrimination is clearly an internal or person attribution. Laws in South Africa strongly condemn these behaviours and equality courts within the justice system are dedicated to removing such practice from South African society. Thus, if a person discriminates, it is by choice. From Kelley's (1971) theory it can be assumed that this primary error attribution of racism and discrimination holds a low distinctiveness, high consistency, and low consensus.

Racism and discrimination is unacceptable, and thus is not expected from all citizens, including individuals in this organisational environment, meaning that racist behaviour should hold a low consensus; i.e. everyone has the right not to be discriminated against. While racist behaviour may hold a high consensus amongst certain groupings, from the perspective of the party discriminated against, this behaviour is unacceptable, i.e. is low consensus behaviour.

Further, racism from the data, is directed at black individuals in the case of this organisation. While it can be said that this makes the behaviour highly distinctive because of the clear distinction between blacks and whites, this analysis is incorrect. The analysis should take place within the group, rather than across the grouping. In this case, if a discriminatory behaviour is shown to one black individual within the grouping, and not to any others; then the behaviour can be said to be highly distinctive, and most probably would be due to other factors rather than racism. Thus, if racism is shown to all blacks within a grouping, then it can be held to be low in distinctiveness across that grouping.

If the present behaviour is characteristic of behaviours in the past, then it would be considered consistent. What is assumed to be racism, if not consistent cannot be racism due to racism being a deeply held belief upon which people form the

basis of their actions. The primary error attribution of Racism and discrimination is high in consistency.

Referring back to Kelley (1971), the attribution to racism is consistent with the requirements Kelley (1971) holds for an internal attribution, which are low distinctiveness, high consistency, and low consensus. A point to remember is that when seeking information to categorise distinctiveness, this is done within groupings rather than across.

The primary error attribution descriptor of racism and discrimination emerged from attributions to deficient on the job training and mentorship for black staff, a lack of opportunities for black staff, and black staff being set up for failure in various ways. Also, from the data, reference is made to discrimination between cleaners and mechanics; as well as favouritism in selecting within teams who should attend training courses.

Causal schemata available to the lay person range from simple to complex. There is evidence that lay people sometimes make attributions as if they were using schemata to meet the need for fast and economical analysis (Surber, 1981). Kelley (1971) acknowledges that there are occasions in which the perceiver lacks the information, time or motivation to examine multiple observations. In these cases, incomplete data attributions are made on the basis of a single observation, using causal schemata.

Due to South Africa's political history, their may be an argument for the presence of causal schemata that relate to racism and discrimination. Due to the sensitive emotions that surround this issue, black employees may have become accustomed to the belief that when they are mistreated, it is due to racism and discrimination, rather than fully taking the effort to fully analyse and seek information from the environment before making an attribution.

Beliefs not only affect the attributions made for events, but also affect the intake and use of causally relevant information. The interplay between prior beliefs and

new information involves sequential processes in which the prior structures both affect the information and are affected by it (Zadny and Gerard, 1974). According to this, a belief within a person, such as being racist or believing that someone is a racist, will bias the way that information from the environment is interpreted in favour of that belief. Thus, when actions are interpreted, they are automatically interpreted via the causal schemata, rather than on the merit of the action itself.

When people perceive that they are being treated unfairly, they are likely to look for justifications for the treatment. Failing to find any, they may behave in ways which harm the organisation. This is relevant to racism, discrimination as well as other issues of perceived fairness and unfairness, whether valid or not (Helriegel, Jackson and Slocum, 1999). Repeating what was discussed in the previous section, it is important to deal with both “valid” and “invalid” beliefs within employees, since what is invalid to the organisation, is a very valid belief to the employee, upon which he or she basis his or her actions.

The second descriptor is shift work and time pressures, which was identified to describe Organisation culture – external. Time pressure has become a fact of life for most maintainers, due to operators striving to reduce the amount of time that aircraft spend out of service. A particular risk is that maintenance staff faced with real or self-imposed time pressures will be tempted to take shortcuts to get an aircraft back into service more quickly (Hobbs and Williamson, 2000).

Another fact of life for maintainers is shift-work. It used to be thought that night workers adjusted and that their body rhythms became inverted, so that for them the early hours of the morning were the middle of the day. It is now known that even permanent night work only results in a general flattening of the 24-hour body cycles. Thus, maintenance workers may be sleep deprived at the start of a shift, and the circadian dip in arousal and performance will be even more serious than usual (Reason and Hobbs, 2003).

Then, Schachter’s (1964) theory of emotion, when cast in attributional terms, states that the emotion a person will experience upon his/her arousal depends on

the explanation he/she has for it (Kelley and Michela, 1980). Arousal by an unperceived cause can affect emotional behaviour through its attribution to some other cause, is well supported in research on aggression (Kelley and Michela, 1980). Rule and Nesdale (1976) surmise that the general paradigm is one in which the subject is badly treated by another person and also has a heightened arousal from an extraneous source such as physical exercise, aversive noise, high temperature, pressure etc. Under these conditions provoked subjects are more aggressive in verbal hostility than similarly provoked subjects lacking the extra arousal.

Finally, recent research has shown that moderate sleep depravation of the kind experienced by shift-workers, can have consequences that are very similar to those produced by alcohol (Dawson and Reid, 1997). Fatigued workers can become cranky and irritable, and have trouble controlling their attention (Reason and Hobbs, 2003).

Thus, from this literature, it can be inferred that maintenance staff are in a heightened sense of arousal due to the time pressures that they are under, the shift-work environment that introduces its own complexities, as well as the nature of the environment which is noisy, with quite cold or hot temperatures at times. In this, state, according to Rule and Nesdale (1976) subjects are more aggressive. This inference agrees with the primary error attributions made by maintenance staff to shift work and time pressures

Zillmann et al (1974) found that subjects who were provoked while in a state of arousal, retaliated more after a brief delay than immediately. This also matches with primary error attributions made by maintenance staff and team leaders under the descriptor shift-work and time pressures, where the attribution of blame lies with this descriptor for such things as altercations with spouses, swearing, divorces, as well as arguments with fellow employees.

Kelley's (1971) theory of attribution states that external attributions will be made if the behaviour has high distinctiveness, low consistency and low consensus

(Martinko and Thompson, 1998). The operative word here is “behaviour”. Shift work and time pressures are not behaviours, the behaviour referred to is the error, while the attribution for the primary error is shift-work and time pressure. Thus, the error that lead to the primary error attribution of shift-work and time pressure according to Kelley’s theory (1971) is not consistent over time, is distinctive in this shift-work and pressurised context, and is only evident in few individuals in the same setting. For example, as discussed earlier, the behaviour of aggression; is not consistent over time (low consistency). A person is not usually perpetually aggressive, but is in certain contexts (high distinctiveness), such as in the shift-work or pressurised context and finally, this behaviour would not necessarily emerge in all individuals in the shift-work environment (low consensus).

Negative behaviour may have negative implications for self regard, unless causal responsibility is attributed externally; and motivation for self enhancement should result in self-attribution of positive behaviour (Zuckerman, 1979). According to Zuckerman (1979), some error attributions made to shift-work and time pressures could be for reasons of maintaining self-esteem; rather than the belief that they are genuinely the cause of a primary error. Based on these findings, in the maintenance environment, when internal or external error attributions are made during investigations, they should be examined closer for the underlying motives behind the attribution.

5.2. Research Question B

B) What are the predominant secondary error attributions during the minor maintenance of aircraft, comparing maintenance staff and team leaders?

Table 15: Summary of Secondary Error Attribution Themes for Maintenance Staff and Team Leader Interviews and Focus Groups

Maintenance Staff Interviews	Maintenance Staff Focus Group	Team Leader Interviews	Team Leader Focus Group
Managerial Culture (N=54)	Management (N=9)	Poor Management (N=37)	
	Planning and Strategic Interventions (N=12)	Communication (N=19)	
Inadequacies Regarding Tools and Equipment (N=45)	Tools, Equipment and Job Task Support (N=9)	Tools and Equipment (N=26)	Wastage (N=8)
			Tooling and Equipment (N=6)
Employee Culture (N=44)		Rules, Regulations and Procedures (N=22)	Breaking the Law (N=8)
Safety Culture (N=24)		Organisational Culture (N=27)	
	Training and Attitudes (N=8)		Skills (N=4)

Referring to Table 15, we find that the predominant themes that emerged from maintenance staff interviews were Managerial Culture; Inadequacies Regarding Tools and Equipment; Employee Culture; and Safety Culture. Maintenance Staff Focus groups raised similar themes, namely, Management; Planning and Strategic Interventions; Tools, Equipment and Job Task Support; and Training

and Attitudes. Team leader interviews raised five themes, Poor Management; Communication; Tools and Equipment; Rules, Regulations and Procedures; and Organisational Culture, while team leader focus groups raised the themes, Wastage; Tooling and Equipment; Breaking the Law; and Skills.

The theme “Managerial Culture” which emerged from maintenance staff interviews is similar to the themes of “Poor Management” and “Communication” that emerged from team leader interviews. Regarding this theme, Maintenance staff chose to focus on “Management” and “Planning and Strategic Interventions” during the focus groups, while team leaders made no emphasis. Both maintenance staff and team leaders highlighted “Tools and Equipment” as a theme during interviews. With reference to this theme maintenance staff focused on “Job task support” alongside general emphasis on inadequacies regarding ““Tooling and Equipment” in focus groups, while team leaders placed emphasis on “Wastage”.

The themes of “Employee Culture” and “Safety Culture” emerged from maintenance staff interviews, which are similar to the themes of “ Rules, Regulations and Procedures” and” Organisational Culture”, that emerged from team leader interviews. Regarding these themes, team leaders emphasised “Breaking the Law” during the focus group, while maintenance staff made no emphasis.

Data analysis of maintenance staff focus groups raised the theme of “Training and Attitudes” which is similar to the theme “Skills” that was emphasised during team leader focus groups.

Thus, a predominant secondary error attribution theme was Tools and Equipment. This theme emerged strongly through secondary error attributions made by both maintenance staff and team leaders during interviews and focus groups. Dimensions that form the main theme of Tools and Equipment include those relating to equipment not being serviceable or available; tools being

disorganised; staff members using the incorrect tools or equipment; as well as support systems relating to tooling and equipment being inadequate.

According to Hobbs (2001), one of the most influential conditions influencing work quality are the tools and equipment available to do the job. The second most commonly cited contributing factor was equipment deficiency because of a lack of ground equipment or tools (Hobbs, 2001). The finding that Tools and Equipment is cited as a predominant secondary error attribution theme in this study, is supported by Hobbs' (2001) study.

Associated with the secondary error attribution theme of Tools and Equipment, are attributions made by maintenance staff and team leaders to employees wasting time and effort finding tools that have been booked out by other employees; being selfish by keeping scarce tools with them so as to be able to finish their tasks in time; and other related behaviours.

This non availability of tools can be a powerful initiator of human error as workers struggle to perform their tasks in the face of obstacles and frustration, with the associated time deadlines. Further, the adaptability of maintenance staff in trying to make do with what is available to get the job done, compounds the possibility of error (Reason and Hobbs, 2003)

Clearly, the secondary error attribution to tools and equipment is an external attribution; since it attributes errors to situational factors outside of the control of the person. What this attribution theme says, is that a majority of secondary errors are caused by various inadequacies relating to Tooling and Equipment at the organisation.

Within Jones and Davis' (1965) theory of correspondent inferences is the first principle of non-common effects. This principle suggests that any characteristics shared between two choices do not help to explain why one alternative rather than the other was chosen. It is non-common effects; characteristics that differentiate between two alternatives that are important.

Based on this principle, maintenance staff that have experience performing the job with the correct tools; and performing the job with the incorrect tools should be able to differentiate that errors, frustration and difficulty is experienced when using the incorrect tools rather than the correct tools; thus leading to the secondary error attribution of tools and equipment.

Further, Jones and Davis' (1965) principle of social desirability, concerns the perceivers' beliefs about what other actors would do in the same situation. Effects that are more desirable are diagnostic of their intentions. Thus, maintenance staff would recognise intentionality of errors through the desirability of wanting to produce that effect. Maintenance staff would also observe to see if other staff members commit the same errors in the situation with inadequate tools as compared to situations with adequate tools; seeking out the non-common effects. Newston (1974) studied the principle of non-common effects and found that fewer non-common effects resulted in more confident and extreme inferences about the cause.

Another principle that can be related to the secondary error attribution of Tools and Equipment is that of salience. Salience can be said to take place when an effect is attributed to the cause that is most salient in the perceptual field at the time an effect is observed (Kelley and Michela, 1980). This principle has been applied to the question of whether an actors behaviour (an error), will be attributed to him/her or to the situation within which it occurs. What is suggested by the literature, is that an effect is attributed to the first cause that comes to mind when the attribution question is raised, or at least the first one that provide sufficient explanation (Kelley and Michela, 1980).

In other words, when maintenance staff and team leaders were asked to attribute secondary error attributions for errors that take place in their environment during the interviews and focus groups, a salience effect could have been introduced which was due to the attribution of Tools and Equipment being the first attribution that provided sufficient explanation to the question raised.

Related to this, another explanation could be from the perspective of motivation. According to Berscheid et al (1976), dependence on another person may instigate the attribution process. The nature of the maintenance environment is one of interdependence, dependence on others to return their tools to the tool store; to inform each other about dangerous situations and circumstances; and to work together to complete certain tasks. This dependence on others could be the instigator in motivating maintenance staff to give thought to the cause of errors, drawing the conclusion of tools and equipment as the relevant attribution and relating this during the interview process to the researcher.

The issue of enhancement of self-esteem can also be raised. Kelley and Michela (1980) relate that negative behaviour may have negative implications for self regard, unless causal responsibility is attributed externally. Blaming the tools and equipment utilised to do the job could be a reasonable way for the employee to protect his/her ego; and in this way maintain the confidence in his/her own abilities.

Housekeeping, including the way that tools and equipment are tracked, is a fundamental factor that can increase or decrease the chances of errors. Ultimately, the housekeeping practices of an organisation reflect beliefs about people and how they do their jobs (Reason and Hobbs, 2003). Bringing in the issue of cognitive factors from attribution literature, the observer may know nothing more about the actor than his/her behaviour in a particular situation or in a limited range of situations; whereas the actor knows of his/her behaviour in many situations and is aware of its cross-situational variability (Storms, 1973).

Maintenance staff, being the actors within the maintenance environment, are able to compare their behaviour across a range of activities and draw out the cross- situational variability in the effects of those behaviours. This compared to observers who are not involved in maintenance work, but make attributions from the outside, looking in. Nisbett et al (1973) have found that actors perceive situational variability while observers make more trait ascriptions.

Returning to the secondary error attribution or tools and equipment, and also bringing in the issue of housekeeping; the maintenance staff and team leaders who are the actors during maintenance operations are in the best position to be able to make cross-situational comparisons of why certain errors take place, be it due to tools and equipment or housekeeping practices; while observers, who may know nothing more about the actor than his/her behaviour in a particular situation, seem to make more trait ascriptions.

5.3. Summary

In this chapter, predominant error attribution themes that emerged from the results were discussed in detail with reference to both attribution as well as maintenance error literature. This exercise drew out relevant comparisons and issues between the findings in the results chapter and what is found in the literature. It is acknowledged that some comparisons and analogies are quite broad. However this is out of necessity due to the lean amount of literature available with exploratory research such as this.

The discussion around Research Question A, focussed on the predominant primary error attribution theme and related attributions under the descriptor Organisational Culture which included both the themes of employee motivation and employee culture. Finally, results under Research Question B raised the discussion around the theme, Tools and Equipment.

5.4. Theoretical and Practical Implications of Research

5.4.1. Theoretical Implications

This research is one of the first exploratory studies that bring together the field of attribution theory and maintenance error. Its main strength is that it provides a theoretical framework, upon which is based a methodology that explores the primary and secondary error attributions made by employees for maintenance errors in their work environment. In other words, it is felt that this methodology can be implemented in a range of maintenance environments and unearth the error attributions of staff in that environment. Information such as this is very

beneficial to companies and organisations in their planning, strategising, problem solving and general development of the company or organisation.

Throughout the discussion, possible specific applications of attribution theory emerged in relation to the maintenance environment. While this has to be researched further, an implication of this research is the possibility of an Error Investigation model based on an attribution paradigm. In brief, this model would do the following:

1. Use Kelley's (1971) theory of co variation to make the distinction between internal (person) and external (environment) attributions. Based upon this, antecedents such as intention, knowledge, ability, and effort can be explored; as well as task, chance, luck and task difficulty. Exploring these antecedents for each attribution made verifies or refutes the internal or external distinction.
2. Beliefs are the basis of actions. Thus understanding what beliefs exist in an environment, whether valid or not, is important in recommending any intervention. Should the dominant beliefs not be addressed by an intervention, the intervention may not succeed, no matter how appropriate it is to addressing other errors in the environment.
3. As was discussed, the expectations of the attributor before witnessing behaviour can have an influence over what attribution is made. It is necessary for the model to explore the expectations of behaviour that surround an attribution. It is also necessary for the model to explore and mitigate the presence of an ego protective tendency within the attributor, as well as the effects of causal schemata.

5.4.2. Practical Implications

1. The study was a qualitative one, which unearthed issues within the organisation sampled, that may not have been consolidated and presented had this study not taken place. The implication of this is the opportunity for the organisation concerned to examine the study and make the appropriate interventions and remedial actions to address the

shortcomings identified, be it in terms of safety culture, the introduction of sanctioning processes, policies and procedures, training and so on. Further, the organisation can use this methodology at regular intervals to diagnose problem areas and make the required changes, thus serving, planning, strategising, problem solving and general development purposes.

2. This research and its methodology should prove useful to the design of training for maintenance staff, team leaders, managers, and error investigators; specifically related to the investigation and interpretation of error events and the differentiation between appropriate and inappropriate attributions for these events.
3. By bringing together and integrating the domains of attribution theory and maintenance error; this research can form the foundations upon which other studies are built, taking advantage of the knowledge in both areas to better understand and minimise maintenance error.

5.5. Limitations

All studies are carried out within certain limitations. These may include time, financial or other resources; as well as unforeseen circumstances or situations that arise during the research process.

The first limitation of this study is largely that it is an exploratory study in a field that has a very limited amount of integrated literature available. The difficulty in this is that in bringing the two domains together, much emphasis was placed on establishing a solid basis and understanding of attribution theory for the reader based on available literature which was then coupled with literature in the domain of maintenance error. The lack of empirical findings where attribution theory has already been applied to maintenance error substantially limited the comparisons which could be made between the findings of this study and other studies.

The sample was provided quite willingly by a local organisation, on condition that it was within normal operations. Much effort was spent in trying to acquire as random a sample as possible, however due to interviews and focus groups

taking place during specific hours of the day and within and short window period in December, it is possible that some bias may have been introduced into the sampling process, through volunteering, staff members being on leave, or being occupied during the period of the study.

It was expressed earlier in the methodology chapter that the sample was felt to be sufficient enough to draw out credible results; due to the feeling that a larger sample would not have contributed significantly more information than was already collected. While this is true, larger samples always add greater credibility to research findings due to its effect on strengthening the reliability and validity of the study. Some could argue that this sample is not representative of the population, and that the data is only representative of the specific participants.

The qualitative analysis of results, in this case thematic content analysis, introduces a bias on the part of the individual who codes the data, working with the data to draw out themes and relationships. Strong attempts were made to ensure that transcripts were as accurate as possible, and that these transcripts were coded on the basis of the literature rather than the perceptions of the researcher. It is felt that this study is especially generalisable to other maintenance environments of this company within South Africa. While certain findings may be generalisable to other maintenance environments, it is difficult to make such wide-ranging claims, due to the limitations of the sample.

Finally, the volume of information collected through the interviews and focus groups, accompanied by the thorough coding and data analysis, meant that all the information collected could not possibly be discussed. For this reason, selected predominant themes that answered the research questions but also provided the tools and understanding for further comparisons and analysis were given the priority. It is logical that these themes were chosen over and above the remaining themes, since both maintenance staff and team leaders raised these attributions in both interviews and focus groups, i.e. making them “predominant”. It is acknowledged however, that the other themes that have not been fully discussed do also have valuable information that should be explored.

5.6. Recommendations for Future Research

During this research, it became apparent that research focused on a specific theory of attribution theory in the context of maintenance error, such as Heider's (1958), Jones and Davis' (1967) or Kelley's (1971), could produce very interesting and beneficial results when explored with specific maintenance errors in mind, such as tools and equipment, time pressures, employee motivation etc. This format could also be extended across theories, whereby selected antecedents of attributions are explored in relation to specific maintenance errors.

It will also be beneficial to conduct research studies such as this one, as well as those suggested above with samples that range across the transport industry, including rail, air, road and sea; as well as other maintenance environments, such as the nuclear power, and manufacturing industries.

This study has demonstrated that bringing together the domains of attribution theory and maintenance error produces interesting and informative results that give insight into the possible reasons why maintenance staff and team leaders explain errors in certain ways. Further specific and broad research that brings together both these domains could prove to be very beneficial especially with regard to error investigation, but also human resource management, and general organisational efficiency.

Future research should explore ways in which attribution theories can be consolidated into a model that can be implemented during error investigations; where this research contributes methods of questioning and inquiry to reduce attribution biases that respondents may consciously or unconsciously introduce into the process due to their own causal explanations. This model should investigate intentionality and un-intentionality, assisting in differentiating between violations and errors.; as well as search for the presence of aggressive behaviours initiated by arousal effects.

Chapter 6 - Conclusion

In humanity's quest to conquer gravity, we have engineered many inventions. Improvements and developments in the wheel, electricity transmission, telecommunications, and the jet engine come together with modern materials to constantly re-engineer the airplane, in the process bringing continents closer and making air travel more accessible to millions of people worldwide.

People demand that the forms of travel that they utilise are safe, dependable, efficient and convenient. At the same time, companies and their shareholders demand that their operations are profitable and maximise the use of their assets for this purpose.

As with anything created by humankind; like modern engineering with its fast moving components and nature defying actions; its bound to breakdown and be in need of repair. Which has evolved the need for maintenance that is both safe for passengers, while also being profitable for shareholders. Inherently this brings about a conflict, maintenance staff would ideally like a sizable amount of time to diagnose problems and rectify them, while shareholders would like their assets to be in service earning profits in the minimum amount of time.

This maintenance is carried out by human beings in a workplace that is specified for this purpose. Human beings are adaptable. We have emotions, can be injured and get ill. We have the ability to make choices, with a mind that allows us to sense and absorb information, processing it to make choices and decisions about our lives, our likes and dislikes, answering the questions of who, and what and when and where and why.

Understanding why the sun rises, why we exist?, why things happen the way they do?, why events take place?, why errors take place?, why people behave the way they behave?, are questions that humans ask ourselves constantly. This research has successfully sought to understand the psychology of maintenance staff better. Trying to discern what answers they find for their questions of why.

Before this study took place, the social psychology perspective of Attribution theory was yet to be fully utilised in South African research within the maintenance error landscape. By bringing together the domains of attribution theory; and maintenance error, this exploratory study has put forward a foundation for future research; and provided a framework of primary and secondary error attributions in the maintenance error context.

Through this, the study uncovered predominant primary and secondary error attributions, found within a maintenance environment, which has given an understanding of the South African landscape, that could have serious cost benefits to maintenance companies, benefits to staff in terms of reduced risk of injury, as well as better policies, procedures and equipment, if acted upon.

Twenty-five team leaders and 125 minor maintenance staff at a South African Aircraft Maintenance Company formed the population group from which the sample for this study was drawn. Within each group, 5 individuals were interviewed on a personal basis. Further, for each group, one focus group was carried out consisting of two and four individuals respectively. The individuals who participated in the focus groups were different to those who participated in the interviews. In total 28 percent of team leaders participated in the study and 7 percent of maintenance staff, which calculates to just over 10 percent of minor maintenance employees at the organisation involved.

The Qualitative data acquired through this in-depth interview and focus group discussion process, and subsequent transcription was coded and analysed using Thematic Content Analysis. While an average of five main themes emerged and were articulated as results under each research question. The discussion of primary error attributions comparing maintenance staff and team leaders, focussed on the predominant primary error attribution theme and related attributions under the descriptor Organisational Culture which included both the dimensions of employee motivation and managerial culture. Finally, results of secondary error attributions comparing maintenance staff and team leaders raised the discussion around the theme, Tools and Equipment.

This study's main strength is that it provides a theoretical framework, upon which is based a methodology that explores the primary and secondary error attributions made by employees for maintenance errors in their work environment. In other words, it is felt that this methodology can be implemented in a range of maintenance environments and unearth the error attributions of staff in that environment.

Information such as this is very beneficial to companies and organisations in their planning, strategising, problem solving and general development of the company or organisation. It is hoped that the sample organisation acts on the findings of this research, to address shortcomings within its own structures and people. It is also hoped that the sample organisation adopts this methodology, and carries out studies such as this one a regular basis to identify and address other shortcomings within their organisation that may arise in future.

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Appendixes