CHAPTER 4: DISCUSSION

The main aim of the present research was to find out the injury incidents experienced by maintenance personnel in the major maintenance environment. The second aim of the research was to investigate attributable causes, contributory factors and reasoned actions to those injury incidents and moreover find out if human error had some contribution to injury incidents. Moreover compare team leaders and technicians. The results will be discussed in relation to the literature provided in chapter one. The following discussion will analyse the results presented, with a view to outlining the theoretical and practical implications, and areas for further research will be suggested.

4.1 Injury incidents in major maintenance

It is argued that maintenance personnel work in highly complex and sophisticated aircraft systems. These aircraft systems represent a great potential for danger for maintenance personnel. A recent safety study on aircraft maintenance in Australia for the Australian Transport Safety Bureau (ATSB), which began in 1998, revealed that approximately 68% of the participants reported that they were involved in workplace injuries during the previous year (Hobbs & Williamson, 2003). Though over two thirds of participants reported that they had not been injured in the workplace during the previous year, there were approximately 22% who reported being injured once and approximately 10% were injured more than once the previous year. Campbell (2002) indicates that case files commonly implicate cuts, bruises, sprained backs and legs as common injuries to maintenance personnel with less frequent injuries including amputated body parts.

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(usually fingers). Injury incidents in major maintenance were described as injuries or incidents experienced or witnessed by participants in the previous twelve months. Injury incidents reported by maintenance technicians and team leaders ranged from participants being hit by the landing gear on the hip, falling and dislocating the shoulder in the process, slipping while working, person overcome by chemical fumes, hit by an extension cord on the eye, falling off stands, tow bar falling on the participants foot, bumping heads. The great majority of the injury incidents reported were as a result of design and instrumental factors; slips, falling, slippery or dirty floors and stands, chemical spills, head and eye injuries.

The most frequent injury incident reported in table 2 was falling; technicians reported 60% while team leaders reported were 40%. The second most frequent injury incident was head an injury, of which 30% was reported was reported by team leaders and technicians reported 6.67%. The third most frequent injury incident chemical injury where 10% was reported by team leaders and technicians experienced more chemical injuries which accounted for 13.30%. Other injury incidents reported were eye injury, tow bar fell on foot hit by a landing gear and shoulder dislocated was 6.67% for technicians and team leaders reported back injuries and being hit by a landing gear which was 10%. The next section will focus on the attributable causes and contributory factors towards the injury incidents.
4.2 Attributions

Attribution theory states that people attempt to understand their world by trying to explain and find meaning for others and their own experiences. It is argued that people interpret behaviour in terms of its causes and that these interpretations play an important role in determining reactions to behaviour (Kelly & Michela; 1980). Participants were asked to mention what they think are the attributable causes to injury incidents in major maintenance. The theory divides the way people attribute causes of events into two types. External attribution assigns causality to an outside factor, whereas internal attribution assigns causality to factors within a person. It is argued that people are more likely to make internal attributions when the event is positive and external ones when the event is negative (Heider, 1958).

Most external attributions (table 3) were made by team leaders and maintenance towards injury incidents that they have experienced or witnessed in their work environment. Participants in the study attribute injury incidents resulting from instrumental factors, poor ergonomic design, aircraft parts, and poor communication between members and also having too many people doing the same thing at the same time, dirty stands and slippery floors, equipment deficiencies, lack of training, negligence from both management and employees. Moreover pressure to get the job done quickly and also lack of attention or awareness which are largely internal attributions. The results below in this section refers to table 5.
4.2.1 Pressure

Perceived pressure or haste was the mostly commonly cited contributing factor towards injury incidents. Participants felt that they were being put under pressure to finish the job quickly and get the aircraft out on time. One could argue that maintenance personnel understandably strive to reduce the amount of time that aircraft spend out of service; pressure has become a fact of life for most maintainers. This brings with it the risk that maintenance personnel will be tempted to take shortcuts in order to meet the time deadlines. Pressure to get the job done was commonly cited by both technicians (in table 5), they reported 17.8% and team leaders reported 25% to have contributed towards the injury incidents. Pressure was ranked as the first most common causal attribution towards the injury incidents in major maintenance. It is argued by Hobbs and Reason (2003; p59) that “Personnel are often faced with the dilemma of being urged by their employers to follow the procedures, while at the same time being encouraged to follow the procedures”. The results also indicate that pressure to get the job done was associated with violations, by not following the proper procedures and taking shortcuts. Pressure was also associated with reasoned action theory in that participants felt motivated to finish the task quickly in order to please management in that the aircraft would be out of the hanger on time.

Pressure was also cited as the most contributing factor in all the reported incidents, amounting to 23.5%. Lawton (1998; p87) found “time pressure, high workload and a quicker way of working (all of this relates to pressure of work) were strongly endorsed reasons for violations. It is argued further by Lawton (1998, p90) that “self imposed or
external pressure to do the job more efficiently and quickly is perceived by those carrying out the job to be the most important factor in motivating non-compliant behaviour…it appears that benefits to the worker in terms of saved time, energy or effort are the common motivational component underpinning intentional violating behaviours.

### 4.2.2 Lack of training

It is argued that training provided is insufficient and not everyone attends training. Lack of training was attributed mainly to chemical injuries in that maintenance personnel are not regularly trained about the effects of chemicals. Team leaders reported 25% while technicians reported higher and was 43%. It is argued by Benoff (2003) that training employees about chemical hazards in the hangar is imperative. He also argues that aviation maintenance facilities need a written hazardous chemical or material program where you can evaluate or assess the hazards to determine which hazardous materials are present in the workplace and also proper labeling to identify materials and to warn anyone shipping, storing or using them and most importantly employee training and information programs and systems.

### 4.2.3 Equipment deficiencies

The results indicate that the third most commonly cited attributed factor to maintenance incidents is deficiency in tools or equipment. When the available tools and equipment are inadequate to complete the job safely, workers are compelled to improvise with what they have, thereby exposing themselves to the risks of using the wrong tools on the wrong equipment, and potentially causing damage to both themselves and the equipment.

Equipment deficiencies here refer to stands which are not maintained regularly, stands
which are not safe to be used for example stands without safety rails on the side. Participants also referred to stands and scaffolding as being worn out and old to be used.

The findings of this research concur with a study done by the Bureau of Air Safety Investigation (BASI) (1997) on human factors in airline maintenance. An in-depth analysis of self-reported incident reports by BASI (1997), showed the most frequent local factors (unsafe acts or conditions) in OH & S events involved tools and equipment (i.e., broken stand, faulty electrical). A study done by Hobbs and Williamson (2003) on the links between errors and error-producing conditions in aircraft maintenance showed that the most commonly coded contributing factors were pressure 23.5%, equipment 14.4%, training 12.3%, fatigue 12.2 and coordination 12.2%.

Equipment deficiencies in the current research accounted for 40% of the attributions made by technicians and 25% by team leaders to injury. Feyer, Williamson & Cairns (1997) conducted a study to investigate the nature of work practices involved in fatalities and their relationship to subsequent behavioural events in the accident sequence. Parts of their results indicate that practices associated with “general equipment occurred in 26% of the cases (fatalities), with the majority of these involving the upkeep of equipment” (Feyer at al, 1997; p59). One could argue that equipment deficiencies have a great impact in maintenance injuries. One could argue that from attribution theory equipment deficiencies would be classified as external attributions because it is something that is external to an individual.
4.2.4 Management and employees

Management practices was also cited as a contributory factor because it is argued that management is not putting a lot of effort towards safety in maintenance environment, by not providing supervision, safety gear, proper equipment and training to everyone. Technicians reported 31% while technicians reported 25% as management not taking the responsibility to ensure a safe working environment in major maintenance.

It was also cited that management and employees are negligent in that they don’t take responsibility for safety. Technicians reported 28% and team leaders reported 25%.

4.2.5 Dirty floors and slippery stands

Dirty floors and slippery stands were attributed by 38% towards injury incidents experienced by team leaders and 13.30% as experienced by technicians. This is as a result of floors not being cleaned at regular times or immediately when the spillages happen. Burnette (1998) argues that accidents correlate to workplace cleanliness and order. A clean and well-ordered workplace demonstrates a professional attitude towards work being performed and it also reduces the number of workplace hazards.

Injury incidents attributed to dirty floors and slippery floors is also related to another attribution factor cited, which is safety gear. Technicians state that safety gear such as safety shoes are not provided on a regular basis and if provided the shoes slip on wet floors, chemicals, and the shoes do not grip on the floor, as they are required to be. Technicians reported 17.7% of injuries experienced through lack of proper safety gear such as shoes that do not slip on slippery floor.
The other factor that was cited was confined spaces as contributing towards injury incidents and technicians reported 40%. It argued by Burnette (1998) confined spaces are considered inherently dangerous even without being associated with other hazards. It is argued that maintenance personnel should receive appropriate training in entering such spaces and in using any safety equipment. One could also argue that maintenance personnel should also be encouraged to use safety equipment to prevent injuries.

### 4.2.6 Lack of attention

One could argue that technicians reported 25% and 20% for team leaders for lack of attention as a contributory factor. One could argue that participants did make some internal attributions towards injury incidents. Lack of attention and holding too many things at the same time was attributed to falling and was cited by technicians and accounted to 6.60%.

### 4.3 Reasoned actions

The theory of reasoned action posits that individual behaviour is driven by behavioural intentions where behavioural intentions are a function of an individual's attitude toward the behaviour and subjective norms surrounding the performance of the behaviour. The findings support the theory of reasoned action in that intention represents the motivational conduct through which attitude; subjective norms and motivation converge to influence engaging in a particular behaviour or course of action. One could argue that what came out strongly was subjective norms. Participants felt that they had to please their referents, co-workers, team leaders and ultimately management by doing a good job and finishing the task quickly and getting the aircraft out on time. Management was the
most important referent to both technicians and team leaders. This was also the biggest motivational factor to get the job done on time.

One could argue that both technicians and team leaders did report that some of the injury incidents did occur even though they knew of the consequences or outcomes of the actions of performing a particular behaviour. Technicians did report that their social referents such as management and their team leaders and supervisors would not approve of some of the behaviours and actions they were involved in. But they argue that they get the job done quickly. This further encouraged violations of rules because they would take short cuts and endanger their lives in the process.

The results indicate that participants in the study argued that the reasons behind the injury incidents were related to pressure to get the job done. Ultimately by finishing the tasks on time, the aircraft will get out on time without any delays and ultimately pleasing management, of which most participants see management as their social referents. Results also indicate that most participants engage in finishing the job quickly because it produces positive outcomes. One could make the conclusion from the results, that the theory of reasoned action relates or is closely linked to violations, because participants when they are in hurry to finish the job, they violate the procedures and take shortcuts. One could argue that from the results it is apparent that the participants may not care about the consequences, they could misperceive the risk or consequences, or they might intentional sabotage the system.
However one could say that the strongest motivation was feedback that participants got when performing the behaviour (for example finishing the job on time) and also feedback from their social referents (management).

**4.4 Error and violation types**

Skilled based and rule based errors contributed to injury incidents in major maintenance. Participants would commit rule-based errors and this was more likely to occur in a combination of slips. Slips were also related to deficiencies in equipment such as stand, scaffolding and stackers. Knowledge based errors occurred to a lesser extent and was more related to insufficient or lack of training provided, especially in relation to chemicals used. Violations were the second most common error type committed by participants and these included routine and situational violations. Violations were linked to pressure to get the job done and to reasoned actions.

The prevalence of violations was also explained by reasoned action theory in that maintenance personnel would commit violations in order to get the job done quickly and pleasing management by not delaying the time that the plane has to get out. The results concur with the study done Hobbs and Williamson (2003) where 17% of the occurrences involved violations and most of these violations appeared to be well-intended attempts to complete a task in the face of time pressures or other challenges. Violations were also closely associated with pressure, which contributed 17.2% in a study done by Hobbs and Williamson (2003).
A study done by Zeitlin (1994) on why people fail to follow safety procedures, considered whether it was due to faulty communication or risky decisions. Zeitlin (1994; p179) concludes that “If a worker places high value on his or her time, convenience, self image, status among peers, and other factors, and if he or she estimates the probability of being injured by disregarding an instruction as sufficiently low, then it is likely that the instruction will be ignored despite its clarity of the presentation”. This relates to reasoned action theory, people will evaluate the outcomes of performing a particular behaviour and if the outcomes are positive, they will likely perform that particular behaviour (Ajzen, 1988).

Committing violations in the current study was also related to work experience that maintenance personnel had and how often they would commit a particular violation. The results indicate the more experience a maintenance technician has; the more likely he would be to commit a violation. Battman and Klumb (1993) in Lawton (1998; p89) “argue that violations occur when the working to the rule is not behaviourally optimal, humans optimise their behavioural efficiency in relation to their internal (e.g. skills, knowledge, mood) and external conditions (e.g. tools, colleagues, guidelines), where a perceived cost of behaving in a certain manner outweighs the perceived benefits, choosing to behave in such a way would be suboptimal for an individual”.

### 4.5 Comparing team leaders and technicians

Technicians and team leaders had similarities and differences with regards to the different research questions asked. One could argue that some of the results in terms of the similarities were not expected. Team leaders and technicians had experienced and
witnessed similar injury incidents relating to falling, head injuries and chemical injuries. However the degree to which they experienced or witnessed them was different. Team leaders 40% and technicians 60% of the incidents relating to falling.

Head injuries were more evident in team leaders with 30% and only 6.67% for team leaders. Technicians experienced and witnessed the following incidents relating to eye injury, tow bar fell on foot and dislocated shoulder. Whereas team leaders experienced back injuries and being hit by a landing gear. One could argue that falling was the most prominent injury incident between the two groups. Technicians and team leaders refer to the following factors as attributions towards injury incidents, pressure, lack of training, poor equipment, negligence by management and employees, slippery floors and dirty stands and lack of attention. Both groups make more external attributions while technicians make also internal attributions with regard to citing lack of attention and holding to many things at the same time.

Both groups made similar comments with regards to reasoned action theory. For example with regard to falling, the reasons that were given were that they assumed that it was safe to work with the equipment that they were using. However the biggest motivation across the different injury incidents in both groups was to get the done quickly and this will please their social referent, which is management. One could argue that the groups needs to form more social referents such as themselves, their co-workers and team members, it has to be hierarchy and needs to start with the people they work closely with, rather that just management. Another similarity was chemical injuries were due to insufficient
training provided regarding different hazards that chemicals may pose to the work environment and to the participants themselves. The major difference was that error and violation types were more prominent in technicians rather than team leaders.

4.6 Theoretical and practical implications

The discussion has highlighted a number of implications for injury incidents in major maintenance. The findings show that maintenance personnel experienced different injury incidents. However, injury incidents such as falling, chemical spillage and head injuries need to be given more attention on how they can be prevented and develop strategies to prevent them. The second practical implication of this research is attributions towards the causes of injury incidents was related to equipment deficiencies, pressure to get the job done and dirty stands and slippery floors.

One could argue that we need to focus more on these attributions and try to remove these factors from the environment by also instilling a safety culture among maintenance personnel and management. Everyone needs to take responsibility for safety in their work environment. Management de-emphasising the time pressure aspect and rather emphasise the safety aspect, it must be a joint responsibility. In terms of the theoretical implications, the study did confirm a lot of the existing literature with regard to attribution theory, that people will make external attributions if the conditions or the situation is unfavourable or has negative outcomes.
Maintenance personnel, team leaders and aircraft technicians made external attributions towards the causes of the injury incidents in major maintenance but they also made some internal attribution. However contrasted with the theory internal attributions were made by the participants. This is different to the theory because it argues that individuals will make internal attribution if and when the situation is favourable and or positive towards themselves. Reasoned actions towards injury incidents were more related to subjective norm and also being the biggest motivator to perform behaviour or actions. Management is seen as the most important social referent but one could argue that participants need to develop more social referents with their colleagues. One could note from the results that some of the reasoned actions given were more related to violations of procedures.

4.7 Limitations

As in any research endeavour, there are always constraining and compromising factors. The use of qualitative method entails various disadvantages. From a traditional quantitative viewpoint, qualitative research is too subjective and uncontrolled to be of value. Descriptive accounts do not necessarily yield more than what is already assumed by the researcher. However one could argue that the research employed a qualitative method to yield qualitative data to get more information and insight to aircraft maintenance safety of maintenance personnel, contrary to previous research which employed quantitative methods.

Given that the study was exploratory and qualitative in nature, the findings are clearly not generalisable to broader populations it is only generalisable to the research organisation’s populations. However one could say that some of the results are similar and comparable
to other aircraft maintenance environments. This of course highlights the desirability of conducting both qualitative and quantitative research into the area. Another limitation of the present study relates to the sample where we had an uneven number of technicians and team leaders, five team leaders and 12 technicians. One could argue that this was due to the research being conducted in December, which was around holiday time, and most employees were on leave and there was a staff shortage.

One could argue that another limitation is the sample size; one would have liked it to be more than 17 participants and also to be representative of the whole population. The most obvious limitation is that the study is a retrospective analysis and as such, it relies on individual’s memories to recall incidents. The study was looking at injury incidents of participants over the pervious year, so in effect; it took a longitudinal viewpoint but used memory to do this. The memory recall could have been affected by a number of extraneous variables over the year. This in turn could have affected the results of the study and because of the inability to completely control the extraneous influence; the internal validity of the study could be questioned. Employees want to make themselves look good, a self-referent bias on their side.

### 4.8 Directions for future research

A proactive approach is required, one, which will help, identify problem areas and device strategies to minimise maintenance errors. Since the aircraft maintenance industry needs direction in this area. It could be argued that further research needs to be undertaken to investigate accidents in the workplace involving maintenance personnel and this could be done by combining qualitative and quantitative methods. The exploration of reasoned
actions towards injury incidents needs to be investigated further to capture different components of reasoned action theory such as attitude and motivation factors. Further attention needs to be given in exploring the relation of human error and violation types towards injury incidents in aircraft maintenance environment.

The lack of generalisability or external validity of the present research is the most important implication for further research. The present findings need to be validated in other aircraft maintenance organisations. Another possibility is if this study could be done using both qualitative and qualitative methods to achieve results with a larger sample in an attempt to explore further the injury incidents, attributions and reasoned action.