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Reasoning and attributions in injury incidents in major maintenance operations

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2007-02-21T13:48:10Z
http://hdl.handle.net/10539/2067

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CHAPTER 3: RESULTS

There is a growing interest in research for causal factors of aviation accidents. However little emphasis had been placed on accidents experienced by maintenance personnel. The current research focused more on the safety of maintenance personnel, injuries and accidents experienced and contributory factors towards those accidents. Participants were asked about the injuries or incidents they had experienced and witnessed. They were asked to describe the experiences in detail and also explain the attributable factors or causes of those incidents. Data were gathered through interviews and analysed using thematic content analysis. The results of the analysis will be summarised around the research questions.

- Injury incidents
- Attributions
- Reasoned action and intentions
- Human error and violation types

Results were analysed by comparing team leaders and technicians responses towards the questions asked in the interviews, in order to get different perceptions regarding safety in their work environment.

3.1 Injury incidents

Table 2: Injury incidents experienced and witnessed by team leaders and technicians

	Team leaders		Technicians	
Injury Incidents	**N**	**%**	**N**	**%**
Falling	**4**	**40%**	**9**	**60%**
Head injuries	**3**	**30%**	**1**	**6.67%**
Chemical injuries	**1**	**10%**	**2**	**13.30%**
Eye injury			**1**	**6.67%**
Tow bar fell on foot			**1**	**6.67%**
Shoulder dislocated			**1**	**6.67%**
Back injuries	**1**	**10%**		
Hit by the landing gear	**1**	**10%**		

Any maintenance environment has a potential for injury incidents to occur. The most reported an injury incident cited by both team leaders and technicians was falling. Falling encompasses falling from stairs, stackers, scaffolding, and aircraft wings. Technicians most often experienced injury incidents as a result of falling as compared to team leaders in major maintenance. Technician **D** stated***" The most recent one, I was walking up the elevator stabiliser at the back of an aircraft and I stepped off the stabiliser onto the stand and I was repairing a panel. Unfortunately both my hands were occupied, the stand has got no rails and I lost my balance and fell off it".***

The second most reported injury incident was head injuries. Head injuries include bumping heads in the aircraft and this is because they work in confined spaces inside the aircraft. Team leader **A** illustrated by saying "***we work under low areas, the wings are low on the docks; you are very prone to bump your head for instance"***. Team leader B also stated ***"It's a big thing people bumping heads inside aircraft"***.

Chemical injury was cited as problematic and dangerous in any aircraft maintenance environment. Team leaders and technicians cited that they had witnessed a chemical injury where people were overcome by cleaning chemical fumes A technician reported, ***"They were working in a confined space, they were cleaners. They were using chemicals (cleaning chemicals) and there was no one observing them. They were affected by the chemicals or injured by chemicals. They had to clean inside an aircraft's tail. The place has a small opening and inside is a big area…they became unconscious and they fell down,".***

Technicians experienced the following injury incidents, an eye injury, as a result of being hit by an extension cord. Another technician dislocated his shoulder while trying to reach for a plug and also a technician was injured by a tow bar when it fell on his foot. A team leader experienced a different injury in that he was hit by the landing gear on his hip and this cracked his pelvis. Team leader **P** states that ***"back injuries is normally picking up things, heavy injuries… aircraft chairs extremely heavy and we got to get them in and out of the aircraft, a lot of times we have to take them down the stair case and when***

you walk down the stair case you strain your back". Back injuries are a problem in major maintenance and this is as a result of picking up heavy things.

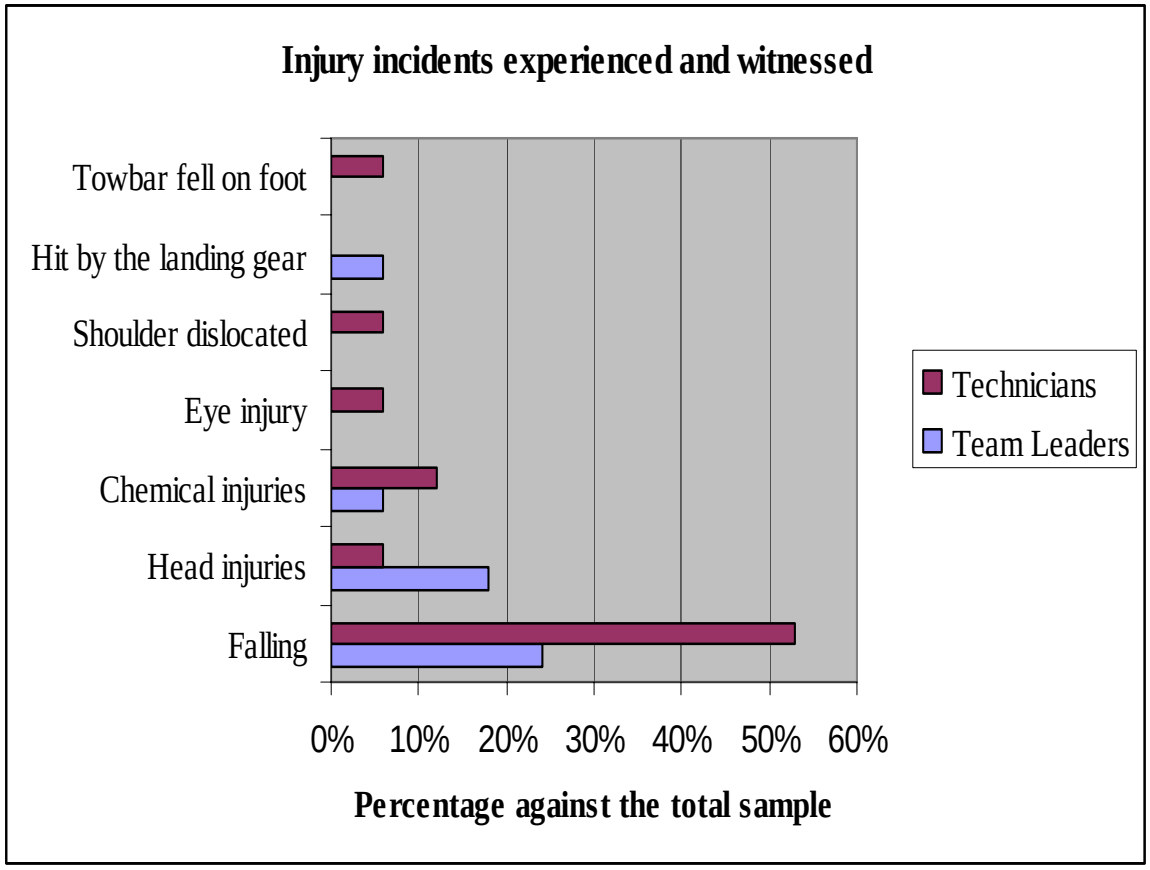

Figure 1: Percentage of injury incidents experienced and witnessed by technicians vs. team leaders.

Above is a figure indicating injury incidents experienced by team leaders and technicians. One could argue that in comparing technicians and team leaders, technicians experienced more injury incidents relating to falling and chemical injuries. Whereas team leaders experienced or witnessed more injury incidents such as head injuries.

3.2 Attributions

Table 3: Attributions towards injury Incidents by Team Leaders

Injury incidents	Attributions	N	%
Falling	Slippery floors and dirty stands	**3**	**37.5**
	Poor equipment (not enough stands, unsafe stands)	**2**	**25%**
	Negligence by management to provide proper equipment	**2**	**25%**
	Lack of attention (concentrating on the job, lack of awareness)	**1**	**12.5%**
Head injuries	Working in confined spaces	**3**	**100%**
Chemical injuries	Lack of awareness about chemicals	**2**	**25%**
	Lack of supervision from management	**2**	**25%**
	Negligence from management and employee	**2**	**25%**
	Pressure to get the job done	**2**	**25%**
Shoulder dislocated	Ergonomic design of the plug (unreachable)	**1**	**100%**
Hit by the landing gear	Aircraft part	**1**	**100%**

The table above indicates injury incidents experienced by team leaders and the different attributions for each injury incident. Team leaders cited the following as injury incidents they have experienced and they are falling, head and chemical injuries, dislocated shoulder and also being hit by the landing gear. The attributions made for falling injury

incidents were mainly poor equipment. By poor equipment the team leaders mean unsafe stands, stands that do not have safety rails on the sides.

A team leader **A** recalls his accident ***"It happened two months ago, I was climbing the scaffolding and I grabbed one of the supports and it came lose in my hand. Nearly fell between the aircraft and the stand. I managed to trap myself between the aircraft and the stand. Injured my shoulder… Ahhh…broke my neck and my wrist". The attributional cause of the injury incidents was that the equipment (scaffolding) was worn out. "Ahhh…poor work equipment, the equipment was worn, the scaffolding. So it didn't maintain its structural integrity which it should have***". Another attribution made is towards management, in that management is responsible for providing proper stands to work with. However this is not the case and they are negligent by not providing proper equipment. Some of the attributions relate to not paying too much attention and they fall**.** Head injuries are attributed to confined spaces inside the aircraft and this prone to participants bumping heads inside the aircraft.

Chemical injuries are attributed to lack of awareness by employees with regard to the dangers and effects of chemicals. Management lack of supervision was also cited as an attributional cause towards chemical injuries. Pressure from management to get the job done was also cited as an attribution towards chemical injuries, because employees would use chemicals despite safety concerns. A team leader dislocated his shoulder while trying to reach a plug, the ergonomic design of the plug was cited as an attribution towards the cause of the injury incident. A team leader was also injured on the pelvis due to being hit

by the landing gear. The attributional cause on the injury incident was related to the aircraft part.

Table 4: Attributions towards injury Incidents by Technicians

Injury incidents	Attributions	N	%
Falling	Slippery floors and dirty stands	**4**	**13.3%**
	Poor equipment (not enough stands Unsafe stands, without rails)	**12**	**40%**
	Lack of attention (concentrating on the job, lack of awareness)	**3**	**10%**
	Pressure to get the job	**4**	**13.3%**
	Lack of proper safety shoes.	**4**	**13.3%**
	Lack of supervision from management.	**1**	**3.3%**
	Holding too many things at the same time	**2**	**6.6%**
Head injuries	Working in confined spaces	**2**	**40%**
	Pressure to get the job done	**1**	**20%**
	Lack of hard hats.	**2**	**40%**
Chemical injuries	Lack of awareness about chemicals.	**3**	**43%**
	No supervision from management.	**2**	**28%**
	Negligence from both management and employees.	**2**	**28%**
	Pressure to get the job done.	**3**	**42.8%**
Eye injury	Hasty, in a hurry to finish the job.	**1**	**33.3%**
	Lack of equipment.	**1**	**33.3%**

	Negligence from the employee	**1**	**33.3%**
Tow bar fell on foot	Poor communication between team members	**1**	**100%**

One of the major injuries that happen in major maintenance is employees falling. It can be falling and slipping from stands, stackers or scaffolding. This is caused by a combination of factors such as equipment deficiencies, inattention and pressure to get the job done quickly. It is argued by technicians that the main problem that they are facing is using equipment in terms of stands that do not fit the task or the job being done. It is argued that most of the stands in major maintenance don't have safety rails on the side; this is dangerous because if you fall you won't be able to hold on to anything. Technician D states "***The most recent one, I was walking up the elevator stabiliser at the back of an aircraft and I stepped off the stabiliser onto the stand and I was repairing a panel. Unfortunately both my hands were occupied, the stand has got no rails and I lost my balance and fell off it".*** One can note that the participants have fallen or slipped off the stand while they were busy concentrating on the job and also the contributing factor to the incident was that the stand was not safe to be used because it had no safety rails.

Unsafe working conditions are working conditions that can precipitate active failures, and consists of the environment and equipment. One of the major causes of falling incidents, are slippery floors and dirty stands. However it is stated that they work in an environment where one needs to be aware of their surroundings in order to prevent injuries resulting from slipping on the floor. Technician **K** reports ***"Its just normal workplace, wetness on the floor, slipping on things, hitting heads working on the aircraft. Those are the***

things that happen all the time, it's not really a way you can prevent it from happening. It's more about awareness. Being aware of your surroundings…You know, sometimes something drops on the floor and it has not been cleaned yet, you slip on it… It is normally cleaned, the thing is it happens and an accident happens straight away before the cleaning is done… It's not like its left there, its something; we work with a lot of slippery fluids. Sometimes you working and something falls on the floor and somebody walks over it, there hasn't been time to do it". Attributable causes of injury incidents relating to slippery floors and stands are lack of proper safety shoes. It is argued by participants that the safety shoes slip and they don't grip on the floor. In addition to that it takes longer for them to get replacement shoes, which is supposed to occur every six months. Being hasty and pressure from management to get the job is another attributable cause because participants state that employees don't have time to clean the stand as this might take up too much time and will affect the time the aircraft has to go out. The main problem experienced in major maintenance is that stands and floors are not cleaned timeously and this results in slippery floors and dirty stands.

Attributable factors to chemical injuries are lack of awareness of chemicals by employees, and the lack of training about the impact and effects of chemicals. Moreover there is also lack of supervision, negligence by both management and employees. Head injuries are caused by a lack of observation, a lack of concentrating on the job and also a lack of hard hats. Eye injuries are attributable to lack of equipment, pressure to get the job done, being hasty and negligence by the employee. The attributional causes of injury incidents relating to a technician being hit by a tow bar was poor communication and

misunderstanding between members and too many people doing the same thing at the same time.

Table 5: Comparison between Team Leaders and Technicians based on attributions reported

Attributions	Team Leaders		Technicians	
	N	%	N	%
Slippery floors and dirty stands	**3**	**37.5%**	**4**	**13.3%**
Poor equipment (not enough stands Unsafe stands, without rails)	**2**	**25%%**	**12**	**40%**
Lack of attention (concentrating on the job, lack of awareness)	**1**	**12.5%**	**3**	**10%**
Pressure to get the job done.	**2**	**25%**	**8**	**17.8%**
Lack of awareness about chemicals.	**2**	**25%**	**3**	**43%**
No supervision from management.	**2**	**25%**	**3**	**31.3%**
Negligence from both management and employees.	**2**	**25%**	**2**	**28%**
Lack of proper safety shoes.			**4**	**13.3%**
Holding too many things at the same time			**2**	**6.6%**
Working in confined spaces			**2**	**40%**
Lack of hard hats.			**2**	**4.4%**

The percentages above indicate the attributions that were made across all injury incidents.

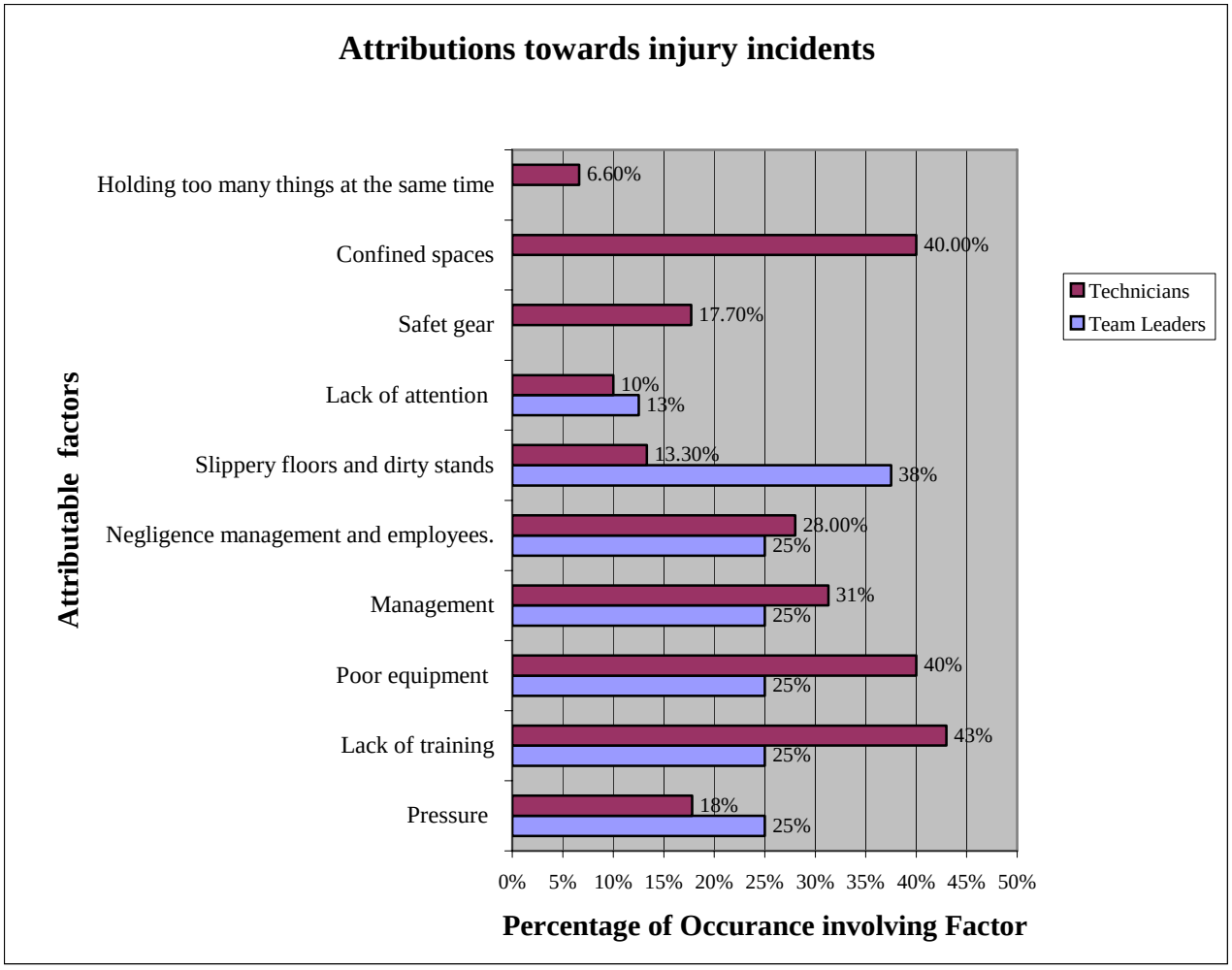

Figure 2: Attributions towards injury incidents in major maintenance reported by technicians and team leaders.

3.3 Reasoned actions

The theory of reasoned action is a model of the psychological processes to mediate observed relations between attitudes and behaviour. The theory of reasoned action is composed of attitudinal, social influence and intention variables to predict behaviour. The theory asserts that intention to perform behaviour is determined by the individual's attitude towards performing the behaviour and the subjective norm held by the individual.

Table 6: Reasoned actions by Team Leaders

Injury incident	Attitude & beliefs	N	%	Subjective norm	N	%	Motivation	N	%
Falling	We assume it is safe to work, but it is not safe	4	100%	Work must be completed despite poor equipment	3	75%	To finish the job or task quickly	4	100 %
Head injuries	Will always occur, part of the job	3	100%	Employees need to wear hard hats	3	100%	To finish the job or task quickly	2	67%
Chemical injuries	Knowledge about effects of chemicals	1	100%	Take more precautions	1	100%	To finish the job or task quickly	1	100 %
Shoulder dislocated	Bad ergonomic design of the plug	1	100%	Should take more precautions	1	100%	Was to connect the plug and carry on working	1	100 %
Hit by the landing gear	Need to be cautious	1	100%	Should take more precautions	1	100%			

Team leaders gave similar responses regarding the reasons behind the injury incidents. Some of beliefs and attitudes behind the injury incidents for example falling related to the fact that they assumed that it was safe to work with the stands they were using and that they would not get injured. They believed that they are suppose to work despite the fact that the equipment (stands) is poor, does not fit the task being required to be done. Some of the beliefs and attitude regarding head injuries was they are bound to happen and one should anticipate that it will happen because they work mostly in confined spaces and bound to bump your head against something in the aircraft.

Team leader **A** states "***I said any incident is a concern. Ahhh smaller incident...t Ahhh… like bumping heads because you work in an area. Where we work under low areas the wings are low on the docks; you are very prone to bump your head for instance and it can happen to anyone anytime, you can't really avoid it altogether".*** Team leaders believe that chemical injuries are happening because employees are less aware about the effects of chemicals and this may be as a result of less training offered continuously about chemicals. Beliefs and attitude give for a technician who dislocated his shoulder is that it could happen to anyone and that it was just a bad ergonomic design of the plug. Team leader **O** believes that he was hit by the landing gear because ***"There was pressure in the landing gear that's all we need to think, pressure in the landing gear. It happened once before as well that a gear came out and nobody was interested….there was still the same pressure in the olium".*** One could say that every person have different attitudes and believes about the injury incidents that they have experienced or witnessed in their work environment.

Reasoned action theory states that subjective norm is the belief that one has about the referent and what he or she think about his or her behaviour and whether the referents would approve the behaviour. These subjective norms motivate the kind of behaviour an individual will display. Team leaders subjective norms were that they are suppose to get the job done despite any problems they are facing and they must always compromise. They deal with deadlines and aircraft maintenance must be done on time and be out of the hanger on the scheduled time. The main motivation behind the actions and behaviours is

to get the job done and finish as quickly as possible and ultimately management will be pleased.

Table7: Reasoned actions by Technicians

Injury incident	Attitude & beliefs	N	%	Subjective norm	N	%	Motivation	N	%
Falling	It is safe to work, but it is not safe.	20	66.6%	Work must be completed despite poor equipment	17	57%	To finish the job or task quickly	20	66.6%
Head injuries	Will always occur, part of the job	1	100%	Management need to provide hard hats	1	100%	To finish the job or task quickly	1	100%
Chemical injuries	Unsafe working conditions	2	100%	Insufficient training	2	100%	To finish the job or task quickly	2	100%
Eye injuries	Finish the task quickly and go home	1	100%	Unsafe maintenance practices. Negligence by the employee and management. More provision of equipment	1	100%	To finish the job or task quickly	1	100%
Tow bar fell on foot	Need to be cautious	1	100%	Must communicate with team members	1	100%	To finish the job or task quickly	1	100%

Technicians also gave similar responses made by team leaders regarding beliefs and attitudes relating to injury incidents such as falling. Technicians believe that work must be completed despite poor and inadequate equipment. Technician **D *"Using incorrect***

stands, either there are no other stands available or other stands are in for repairs. But the job has to be done. We have jobs that need us to meet deadlines. There is no way you can stop the job and go look all over for a stand. And the company I feel has not provided the right stand for the right job. The manager is supposed to be responsible for that. But if you do not have the backing of the managers and the CEO to follow up on health and safety then there won't be safety". One could argue that from the responses most of the technicians feel that the main reasons are that they are supposed to work to meet deadlines despite safety concerns in their work environment. Another technician **E** reiterates that ***"The equipment is scary, Ahhh…. The experience here, I have been here 3 and half years Ahhh… always trying to save money, trying to manufacture their own equipment's and things like that. Equipment that is meant to help you is not available".***

Technicians state that beliefs and attitudes behind injury incidents relating to chemical injuries relate to insufficient training provided to all technicians regarding the effects of chemicals. Technician **B** points out ***"Training- not everyone is exposed to training. Also they don't tell you about the dangers and risks of not using safety equipment when dealing with chemicals. There must be training for most things and must be available to everyone".***

The technician that experienced an eye injury stated that he experienced this injury because ***"Yes there was no equipment in our storeroom. I blame the company because there was not enough equipment in the store".***

The main reason and motivation behind some of the behaviour or actions that contributed to injury incidents is pressure to get the job done and being hasty despite the consequences that may arise from performing the behaviour. Technician **B *"We put our own safety at risk to get the job done. Ahhh… human being is a funny creature. We…. Ok … my opinion. We do something, do it right, and get the job done. You feel good for yourself, you have accomplished something. Get the aircraft out in time. The boss says yah… you got the aircraft out in time that's if you can do it. He doesn't stand there with a whip and force you to work and take a shortcut, that's why a human being is a funny creature, and he does it out of himself".*** Technician **M** pointed out, "***I wanted to finish the job quickly and go home…Advantages are that you finish the job quickly and you go home. Disadvantage is that you might get into trouble or get hurt. Anyone could have done what I did even the supervisors and safety reps they don't want to go to the store"***

Reasoned action theory states that people evaluate the behaviour they are planning to undertake whether it will yield positive or negative outcomes. As the technician above indicates, he wanted to finish the job quickly and go home and this was a positive outcome for him. However technician **M** states ***"The consequences were negative because I got hurt. But we always do this all the time and nothing happens, it was just bad luck".*** It could be argued that the motivation behind the actions and behaviours that lead or contribute to these injury incidents is pressure to get the job done in time. Another technician **L** reiterates "***Ultimately yes… however we are pressurised to do the jobs, time***

constraints, turn around on aircrafts. Things like that. I mean ultimately things ball down to making money and getting aircraft out on time". It could be argued that everyone has attitudes and beliefs about their injury incidents and these are influenced a lot by their referents, which is management in this case by pleasing them through finishing the task quickly and getting the aircraft out of the hangar on time.

3.4 Error and violation types

Table 8: Error and violation types by Technicians

Particular Injury incident	Knowledge-based error	Skill-based error	Violations
Falling		Slip	
Chemical injuries	Lack of training provided regarding chemicals.		
Eye injury			Used incorrect procedure

Violations are when the rules and regulations are not followed. Most respondents commit violations, going against the standard procedure of working in order to finish the job as soon as possible. Technician **K** pointed out ***"It's not that you want to get hurt. There are certain risks you take. Let's say you use chemicals, you wear a mask. Something that's really going to affect your health. But you see something up there; maybe I can just tighten the screws quickly and go. What are the chances that the guy is going to go off***

the panel? Then you say is like 1 in a 100. Tighten the screw quickly and you go. It worked once, it worked twice, and it worked three times".

Technician **L** ***states "Company is trying to have safety awareness but people don't use safety gear. Reasons because they don't know, some know but it is an inconvenience when they work with their gear on. E.g. the respirator that you have to put on and it must be connected to the air supply outside. So it is difficult to move from one place to another because sometimes it does not reach to other places and also you have to move around with that pipe to get to the place you want to. It is costly to get better equipment but if we don't then there will be accidents".***

Human error was mainly reported by technicians and what was prevalent from the responses were violations which were committed and these violations, as some lead to the injury incidents. However some of the reasons given for these violations were pressure from management to get the job done which resulted in taking shortcuts. The next section will discuss the results and linking the results to the literature provided earlier in the paper.