



Machinery Maintenance Injuries: Analysis of IRIS data

Summary

This report summarises injury reports related to harvesting machine maintenance supplied to the New Zealand forest industry Incident Recording Information System (IRIS) database from January 2015 to December 2019. There was a total of 185 harvesting maintenance work-related injury incidents recorded over this five-year period. The incidents comprised 16 lost time injuries, 55 medical treatment injuries and 144 minor injuries. The most common cause of lost time injury was being hit by unsecured door or guarding or falling from a machine. The hands, fingers and back were the most frequently injured parts of the body. Hand lacerations, particularly from chainsaw chain cutters and knives on harvester or processor heads dominated the medical treatment injuries. All categories of incident showed a reduction over the period 2015-2019, however there was high variation year-on-year. As the industry increases the level of mechanisation, machinery maintenance incidents will continue to be a focus area for improvement.

Richard Parker, Brionny Hooper and Christine Dodunski, Scion

Introduction

This report is the third in a series that focuses on lost time and medical treatment injuries in the forest harvesting sector. The purpose is to benchmark where the industry is currently regarding injury incidents prior to the development and introduction of new automated technologies into harvesting and logistics operations in New Zealand. This study is part of the "Forestry Work in the Modern Age" Primary Growth Partnership (FGR, 2018), one of the drivers of which is to make harvesting and log logistics operations safer.

This report focusses on injury incidents related to harvesting machine maintenance, and to identify trends in these incidents over the last five years. Analyses will provide a baseline of injury types, situations and causes from which any improvements in safety due to interventions such as new technology (or other innovations) on the log landing developed in the new FGR programme can be measured.

The New Zealand forest industry's Incident Recording Information System (IRIS) database includes records for both injury events (lost time, medical treatment and minor injury) and non-injury events (contact, and near hit incidents). Reporting of lost time injuries (LTIs) and medical treatment injuries (MTIs) is usually more reliable than reporting of minor injuries and near hits as there is less discretion possible in the reporting of such incidents.

Acknowledgements

Forest Growers Research acknowledges the support of the Forest Industry Safety Council in the publication of this report.



Methods

There are three injury types recorded in the IRIS database:

Lost Time Injury - An incident that results in injury to an employee to the extent that they do not return to work at the start of the next regularly scheduled workday or any other subsequent scheduled shift.

Medical Treatment Injury - An incident requiring medical treatment for the injured party by a medical practitioner (including prescribed medication) other than on-site First Aid Treatment. Employee returns to work at the start of the next regularly scheduled workday or scheduled shift.

Minor Injury - also referred to as First Aid Cases or Treatment Not Required. For example, contact with an energy source has occurred resulting in minor injury and treatment is applied on-site (first aid) or not sought.



HARVESTING TECHNICAL NOTE

HTN12-08
2020

IRIS data were selected for the period January 2015 to December 2019. The criteria for selection (Table 1) were:

- ACTIVITY = Harvesting
- OPERATION = All operations
- TASK = Maintenance

Table 1: Variables used in the analysis

Variable	Examples ¹
Task	Maintenance
Lost hours	9 hours considered 1 working day
Body part	Foot, Ankle, Head, Eye, Face, Shoulder, Knee, Hip/upper leg/thigh, Hand/wrist
Profile	Left, Right, Back, Front
Injury type	Fracture, Crush, Bruising, Chipped tooth, Puncture, Sprain/strain, Sting/bite
Injury cause	Chainsaw, Uneven surface
Injury severity	Lost time, Medical treatment, Minor, Near hit, Property damage, Contact-no injury
Incident cause	Body stressing, Hit by object, Loss of control, Slip/trip/fall

¹ Not an exhaustive list of examples used in the database

Results

There was a total of 482 maintenance-related incident reports to the IRIS database in the period January 2015 to December 2019. Most reports were for near-hit or minor injury events (Table 2).

The number of Lost Time Injury (LTI) and Minor Injury reports has declined since 2015 and remained stable since 2018. Medical Treatment Injuries (MTI) have remained relatively stable over the five-year period.

Mechanical clearfell operations and hauler operations contributed the greatest number of events reported to the IRIS database over the last five years (Table 3).

This is to be expected for two reasons: firstly, there has been a significant increase in mechanisation of harvesting operations over the last decade (Visser, 2019) and secondly, because mechanised operations have greater maintenance requirements than motor- manual operations.

Table 2: Maintenance work related event types reported to the IRIS database

Event type	2015	2016	2017	2018	2019	Total
Lost Time Injury (LTI)	7	2	3	2	2	16
Medical Treatment Injury (MTI)	13	10	13	9	10	55
Minor Injury	29	20	28	21	16	114
Contact - No Injury	30	18	27	3	13	91
Near Hit	51	28	37	10	18	144
Property Damage	13	12	17	8	12	62
Total	143	90	125	53	71	482

Table 3: Maintenance work events by operation

Operation	2015	2016	2017	2018	2019	Total
Clearfell Mechanical stems/Logs	50	42	70	27	37	226
Clearfell Motor Manual Stems/Logs	25	13	19	9	6	72
Hauler Stems/Logs	46	29	29	13	23	140
Log Transport	10	5	3	3	5	26
Production Thinning & Salvage	12	1	4	1	0	18
Total	143	90	125	53	71	482



HARVESTING TECHNICAL NOTE

HTN12-08
2020

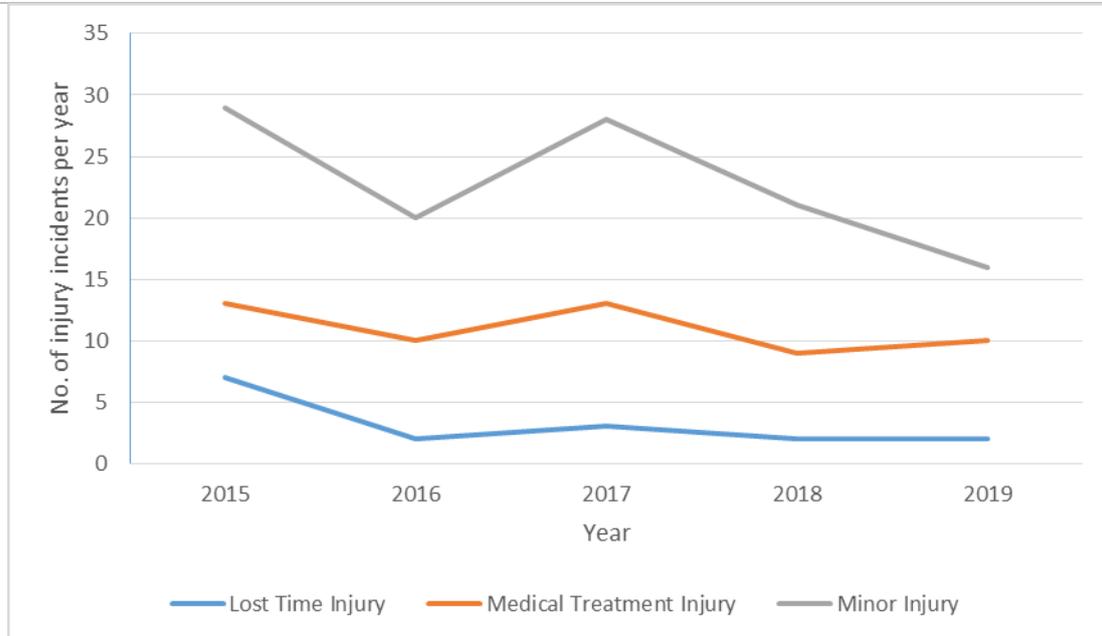


Figure 1: Trends in maintenance-related injury incidents

Lost time injuries

Focussing on Lost Time Injuries (LTIs) there was a total of 16 LTIs occurring during maintenance over the last five years. The trend was initially downward since 2015 but has remained relatively stable since 2018 (Figure 1).

The total amount of lost time from maintenance LTIs over the period was 1,929 hours, at an average of 121 hours lost per incident (Table 4).

Table 4: Maintenance work related LTIs by injury inflicting event

Event "Incident cause"	Number of injuries	Total number of hours lost	Average number of hours lost
Hit by Object	7	1020	146
Slip/Trip/Fall	7	711	102
Body Stressing	1	108	108
Hit object with body	1	90	90
Total	16	1929	121

Injury event

The equal highest frequency and most severe LTI event occurred from being 'hit by an object' (44% of maintenance LTIs). In 5 of the 7 'hit by object' injuries the worker was hit by a door, hinged guarding or a bolster which swung unexpectedly and hit them. These tended to be severe injuries with an average of 146 hours lost time (16 workdays). Two LTI events were related to other causes than guarding or doors. In one incident an engineer was heating a hydraulic pipe on an excavator boom and it burst spraying hydraulic fluid on his hand which ignited (198 lost hours). In the other incident a hauler tower was telescoped and laid down for inspection with some of the skyline coiled on the ground. The wind caught the slack skyline and it tightened striking a worker (135 lost hours).

The other equal highest frequency lost time injury type was 'slips, trips and falls' (44% of maintenance LTIs) resulting in an average of 102 hours off work per event. Five of the seven injuries were the result of falling from a machine during maintenance, and of these four injuries were while climbing down from the machine. The remaining two injuries were tripping and falling when walking on the ground around the machine.



HARVESTING TECHNICAL NOTE

HTN12-08
2020

Body part injured

The hands, fingers and the back/spine were the most frequently injured body parts during maintenance activities (Table 5).

Table 5: Maintenance work related LTIs by part of body injured

Body part	No. of injuries	Total no. of hours lost	Average no. of hours lost
Finger / Thumb	3	828	276
Hand / Wrist ²	3	450	150
Back / Spine	3	198	66
Head	2	30	15
Foot	2	180	90
Hip / Upper Leg / Thigh	1	135	135
Lower Leg	1	90	90
Neck	1	18	18
Total	16	1929	121

¹chest, back, shoulder

² hand, wrist, finger/thumb

Three of the seven 'hit by an object' injuries were to the hands and fingers caught by falling or closing guarding or doors and two injuries were to the head.

Most slip/trip/fall injuries (43% of events) were to hands and fingers, followed by back, neck and feet.

Injuries to the fingers were the most severe with an average of 276 hours lost per incident. During maintenance tasks the hands are especially likely to be injured because heavy objects need to be handled with dexterity and sharp metal edges on machine parts avoided. Fittings and tools often need to be precisely aligned in awkward and difficult-to-get-at positions. Maintenance work is often easier and safer when undertaken at ground level (Figure 2).



Figure 2: Maintenance work at ground level.
(Source: R. Prebble)

Injury type

Fractures, bruises, and sprains/strains accounted for the greatest number of lost time injuries followed by lacerations and concussions (Table 6).

Table 6: Maintenance work related LTIs by injury type

Injury type	Number of injuries	Total no. of hours lost	Average no. of hours lost
Fracture	3	576	192
Bruising	3	225	75
Sprain/Strain	3	135	45
Cut/Lacerated	2	117	59
Concussion	2	30	15
Crush	1	414	414
Amputation	1	234	234
Burn	1	198	198
Total	16	1929	121

The most severe single injury occurred when the bolster on a log truck trailer fell and crushed the driver's hand during maintenance. This injury resulted in 414 hours lost.



HARVESTING TECHNICAL NOTE

HTN12-08
2020

Medical treatment injuries

Focussing on medical treatment injuries (MTIs), these are incidents that are serious enough to require treatment by a medical practitioner (doctor, physiotherapist, chiropractor etc.) and not just treated with first aid on site. In this type of injury, the worker returns to work at the start of the next scheduled workday, so are not categorised as LTIs.

Injury event

There were 55 MTIs in the database during the period. As illustrated in Figure 3, and similar to LTIs, the most frequent MTI event was being hit by an object (35% of MTIs).

Workers engaged in maintenance activities on heavy machinery often must handle and move awkward fittings. On logging machinery mechanical parts are protected by heavy guarding and doors which can swing towards the worker and injure hands and head.

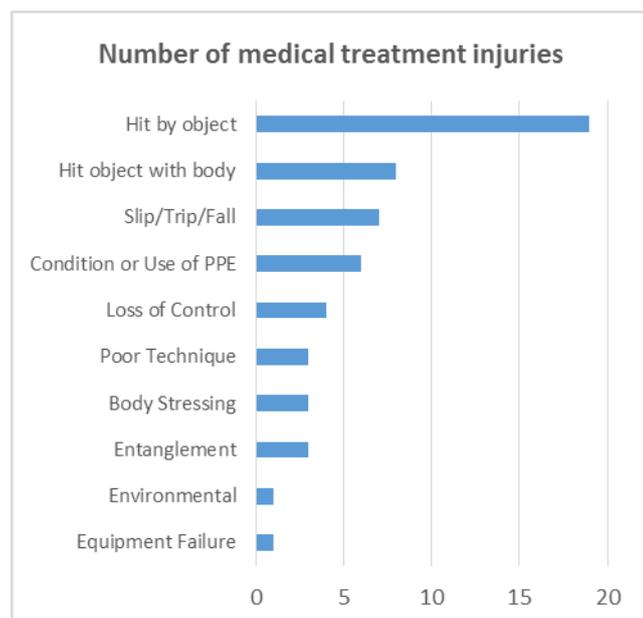


Figure 3: Number of maintenance related MTIs by injury event

Injury type

Cuts or lacerations (45%) were by far the most frequent type of medical treatment injury occurring during maintenance work (Figure 4).

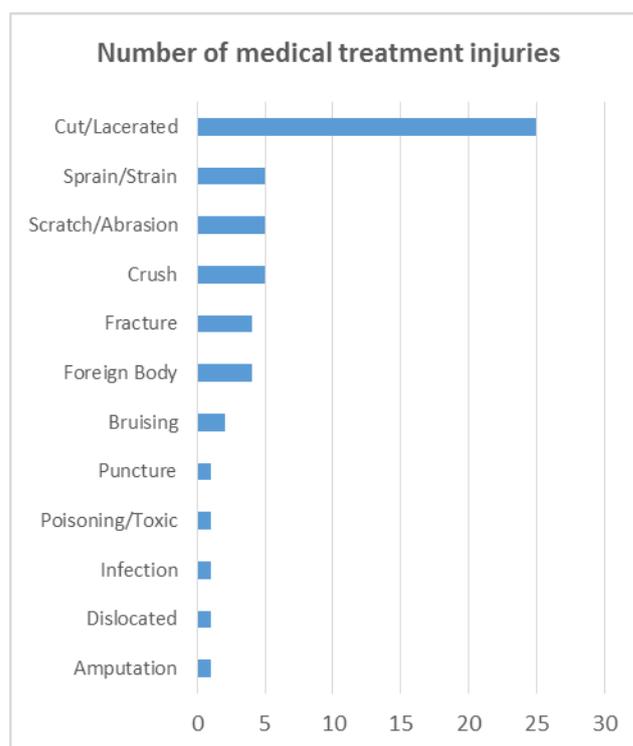


Figure 4: Number of maintenance related MTIs by type of injury

Most lacerations (12 injuries) were received during maintenance of the chain, knife blades or spikes on the rollers of a felling or processing head (Figure 5).

These types of injuries have been the subject of Safety Alerts circulated around the forest industry via the IRIS website (e.g. JNL, 2015; Rayonier Matariki Forests, 2019).



HARVESTING TECHNICAL NOTE

HTN12-08
2020



Figure 5: Chain maintenance (Source: R. Prebble)

Discussion and Conclusions

This analysis has highlighted the potential for maintenance workers to be injured by heavy or sharp and unsecured guarding or doors (5 of 7 LTIs) or from falling from the machine during maintenance (also 5 from 7 LTIs). Despite the severity of many maintenance related LTIs, the frequency is quite low (only 16 LTIs in a five-year period) compared to other harvesting related work. The number of lost time injuries in harvesting machinery maintenance has also decreased since 2015.

Medical treatment injury numbers have remained relatively stable over the period, and minor injuries have fluctuated but the overall trend is down. Declining injuries are a good outcome given the significant increase in mechanisation in New Zealand harvesting operations over the last five years.

During maintenance, workers suffered most lost time injuries to the hand/wrist/finger/thumb part of the body (37% of LTIs). These injuries most frequently resulted from being struck by a heavy or sharp object or from a slip, trip or fall.

These data provide a useful baseline of injury types, frequency and severity, situations, and causes, to compare against in the future. Changes in injury statistics related to maintenance work due to further increase in the levels of mechanisation of harvesting operations and changes in technologies developed as part of the Primary Growth Partnership “Forestry Work in the Modern Age” (and other innovations) will continue to be monitored.

References

Forest Growers Research Ltd 2018. Primary Growth Partnership Business Case “Te Mahi Ngahere i te Ao Hurihuri – Forestry Work in the Modern Age”. Business Case prepared for the Ministry for Primary Industries, 30 September 2018.

IRIS – New Zealand forest industry Incident Recording Information System supported by the Forest Owners Association and the Forest Industry Safety Council. <https://nzfoa-iris.com/PublicHome.aspx>

JNL 2015. Safety Alert #006 Cuts to fingers during maintenance work. Date: 18/11/2015
Reference: Incident Report 20151118-WF-FAI-001. <https://nzfoa-iris.com/SafetyAlerts/ShowSafetyPDF.aspx?id=164>

Rayonier Matariki Forests 2019. Red Alert. Arm Trapped in Felling Head during Repair. February 2019. <https://nzfoa-iris.com/SafetyAlerts/ShowSafetyPDF.aspx?id=213>

Visser, R. 2019. A Decade of Benchmarking Harvesting Cost and Productivity. Harvesting Technical Note HTN12-01, Forest Growers Research, Rotorua New Zealand. 2019.