

ACCIDENTS IN TRACTORS SINGAPORE LIMITED

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SYNOPSIS

A total of 214 cases of accidents from Tractors Singapore Limited were studied over the period 1981 and 1982.

INTRODUCTION

Every accident brings a measure of distress to the victim and this often affects all the other members of his family. Where there is permanent disability, the consequences may well be disastrous for the victim and his family for he loses his earning capacity and ability to enjoy a normal active life. The loss of productivity will affect the national economic well being too (1).

During the five year period from 1976 to 1980, the total number of accidents in Singapore rose from 18,192 to 22,023 and the amount of worker's compensation awarded rose from \$12.96 million to \$17.5 million (2).

This study attempts to examine the characteristics of work accidents in a Singapore factory, Tractors Singapore Limited during the period 1981 to 1982 with the purpose of recommending measures to decrease the work accident rate.

The characteristics studied were: nature of injury, type of injury, site of injury, day of week of injury, estimated time loss, and injuries occurring within or outside normal working hours.

A determined Safety Campaign was carried out in Tractors Singapore Limited from 1st August to 31st December 1981 after a factory inspectorate made several visits to the factory because of the high accident rates in 1979 and 1980. The study also examines whether there was a significant reduction in the number of accidents after this safety campaign.

Since 1st August 1981 pre-employment medical examinations are done with more detail and with the intention of correct pre-placement of new workers. Also several employees who were particularly accident prone were shifted to areas with fewer accident hazards.

All apprentices go through an intensive one week programme on safety practices. This includes films, slide shows, booklets and lecture notes.

On the job training on safety for apprentices and newly-qualified mechanics. Older foremen and supervisors who are resistant to new ideas on safety matters were gradually persuaded to accept new safety work practices.

Spot-checks are made to ensure proper housekeeping, and the use of personal protective methods.

Protective equipment are provided free by the Company and faulty ones replaced.

Defective and unsuitable tools are replaced by new ones.

All accidents are investigated and problems rectified. The results of the investigation is made known to the worker concerned so that he would be more safety conscious in future.

Counselling services started for those with 3 or more work injuries in a year. Areas looked into included family, social, mental, economic, inter-personal and morale.

MATERIALS AND METHODS

The study population constitute the workforce from the Parts, Field, Workshop and Marine and Oil Field Support Services. The actual work done in these services are similar, and it was not necessary to categorise the different workers. Besides workers are sometime shifted from one group to another whenever there are shortfalls in any group. Basic training in all departments ensures that they could work in any department.

Information was also collected regarding personal particulars such as date of birth; number of working hours which included overtime (when the workers are not working and therefore not exposed to risk, that time is not included as working (exposure) hours); number of workers involved in accidents; number of workers each month regardless of whether they suffered work injuries or not; number of accidents per month; accident characteristic such as nature of injury, part of body involved, type of injury and agency of injury; and consequence of accident such as man-days lost or day charged.

The study involves a retrospective examination of accident prevalence in Tractors Singapore Limited in 1981 and 1982. This period was further divided into

periods before and after the safety campaign which lasted from July to December 1981, inclusive.

The entire data processing for this study was done using the SPSS package on the National University of Singapore IBM 3033 Computer.

RESULTS

Altogether there were 214 accidents in Tractors Singapore Limited during the period 1981 to 1982. During this period, there were no deaths, permanent total or partial disabilities. All accidents were temporary disabilities or medical treatment injuries.

There was a monthly average of 242 workers in Tractors Singapore Limited during the period 1981 to 1982. 134 of these workers were involved in accidents in the same period, some more than once but none exceeding 4 accidents.

Below are the analysis made.

It will be seen from Table 1 that the workforce is a relatively young one with 62.4% younger than 35 years of age. In terms of duration of employment 78.7% had less than 12 years experience of work in this factory.

The number of accidents in November is very low adding up to 3.3% of the total.

Saturdays and Sundays were holidays except when there was overtime work, so that comparisons cannot be made. Fridays has the lowest accident frequency

TABLE 1
PERCENTAGE DISTRIBUTION OF ALL WORKERS BY AGE

Age (Year)	Number	Percentage
< 20	1	0.4
20-24	74	26.1
25-29	60	21.2
30-34	42	14.8
35-39	19	6.7
40-44	21	7.4
45-49	33	11.7
50-54	27	9.5
55-59	6	2.1
Total	283	99.9

TABLE 2
PERCENTAGE DISTRIBUTION OF ALL WORKERS BY DURATION OF EMPLOYMENT

Duration of Employment (Year)	Number	Percentage
3	59	20.8
3-5	55	19.4
6-8	37	13.1
9-11	72	25.4
12-14	31	11.0
15-17	4	1.4
18-20	9	3.2
21-23	10	3.5
24 +	6	2.1
Total	283	99.9

TABLE 3
FREQUENCY DISTRIBUTION OF ACCIDENTS BY MONTH IN 1981 AND 1982

Month	Number of Accidents		Total	Percentage
	1981	1982		
January	18	5	23	10.7
February	16	3	19	8.8
March	18	9	27	12.6
April	8	9	17	7.9
May	12	10	22	10.3
June	12	4	16	7.5
July	14	3	17	7.9
August	10	6	16	7.5
September	11	7	18	8.4
October	10	6	16	7.5
November	5	2	7	3.3
December	11	5	16	7.5
Total	145	69	214	100.0

TABLE 4
DISTRIBUTION OF ACCIDENT FREQUENCIES
BY DAY OF WEEK

Day of Week	Number of Accidents	Percentage of All Accidents
Monday	47	22
Tuesday	41	19
Wednesday	54	25
Thursday	33	15
Friday	23	11
Saturday	5	2
Sunday	14	6

TABLE 5
A) BREAKDOWN OF TOTAL WORKING HOURS BY NORMAL AND OVERTIME
WORKING HOURS IN 1981 AND 1982

	Normal	Working Hours	
		Overtime	Total
Hours Worked	609505	158415	767920
Percentage of Total Hours Worked	79.4	20.6	100

B) BREAKDOWN OF ACCIDENTS BY NORMAL AND OVERTIME WORKING HOURS

	Normal	Working Hours		Total
		Overtime	Unknown	
Number of Accidents	140	29	48	217
Percentage of All Accidents	64.5	13.4	22.1	100

figure, half that of Monday's and less than half of Wednesday's rates. Perhaps this is due to the coming week-end which normally boosts morale. Monday was the second highest at 22% as this day is probably an anti-climax to the week-end.

One would expect the rate of accidents to be higher during overtime work due to physical and psychological fatigue. However, when comparison is made between number of accidents to number of hours worked during normal working hours and during overtime, there appears to be no significant difference. Perhaps, the higher salary paid during overtime work had negated the effects of fatigue. Also overtime work is often done outside the factory workshop in the field where groups of 2 or 3 workers are sent to repair tractors. It is postulated that the 'Camarade' developed in a closer work relationship results in a healthier work attitude. For these reasons, overtime accident frequency figures may have been prevented from exceeding that of normal working hours.

During the 2 year period, no worker suffered more than 4 accidents. Only 11.9% experienced more than 2

accidents.

There was only one worker below 20 years of age and he suffered from an accident.

Accident incidence refers to the number of accidents divided by the average number of workers exposed multiplied by 1,000. As can be seen in Table 7, there is no appreciable difference in the incidences among the various age groups.

Next, an analysis was made to examine whether experience of the worker could affect the frequency of accident. Again 2 sets of values were computed.

Duration of employment had been calculated exactly from the day the worker joined the workforce up to the day of the accident. From Table 8, it can be seen that as the duration of employment, and therefore experience, increased, the rate of accident generally decreased. It is significant that all 59 employed for less than 3 years experienced work injuries. The management should perhaps attach more importance in placing new workers under the tutelage of the more experienced workers who have had at least 5 years of employment.

TABLE 6
DISTRIBUTION OF ACCIDENT FREQUENCIES PER WORKER IN
1981 AND 1982 (THOSE WHO DID NOT EXPERIENCE WORK
INJURIES ARE EXCLUDED)

Number of Accidents	1	2	3	4
Number of Workers	93	25	14	2
Percentage of Workers	69.4	18.7	10.4	1.5

TABLE 7
DISTRIBUTION OF ACCIDENT SPELLS BY AGE AND THE
AGE-SPECIFIC ACCIDENT INCIDENCE

Age (Year)	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59
Number of Accidents	60	43	32	12	16	25	20	5
Percentage of all Accidents	28.0	20.1	15.0	5.6	7.5	11.7	11.7	3.0
Accident Incidence × 1000	72.3	64.3	68.0	57.0	66.7	67.6	67.6	71.4

TABLE 8
A) ACCIDENT FREQUENCY BY DURATION OF EMPLOYMENT
B) ACCIDENT INCIDENCE BY DURATION OF EMPLOYMENT

Duration of employment (year)	3	3-5	6-8	9-11	12-14	15 +
Number of Accidents	59	41	25	53	19	17
Percentage of all accidents	27.6	19.2	11.7	24.8	8.9	7.9
Accident Incidence × 1000	100.0	74.5	67.6	73.6	61.3	58.6

As seen in Figure 1, cuts occurred most often. This is not surprising as the workers used many sharp and pointed handtools for work. Contusions stand out too as the worker is often often knocked by or knocked against objects.

As seen in Figure 2, there is a much higher percentage of eye injuries affecting those workers with less than 10 years experience. This is probably due to the less experienced workers not understanding the importance of using machine guards and of using personal eye protective equipment such as safety goggles during welding, chipping and grinding.

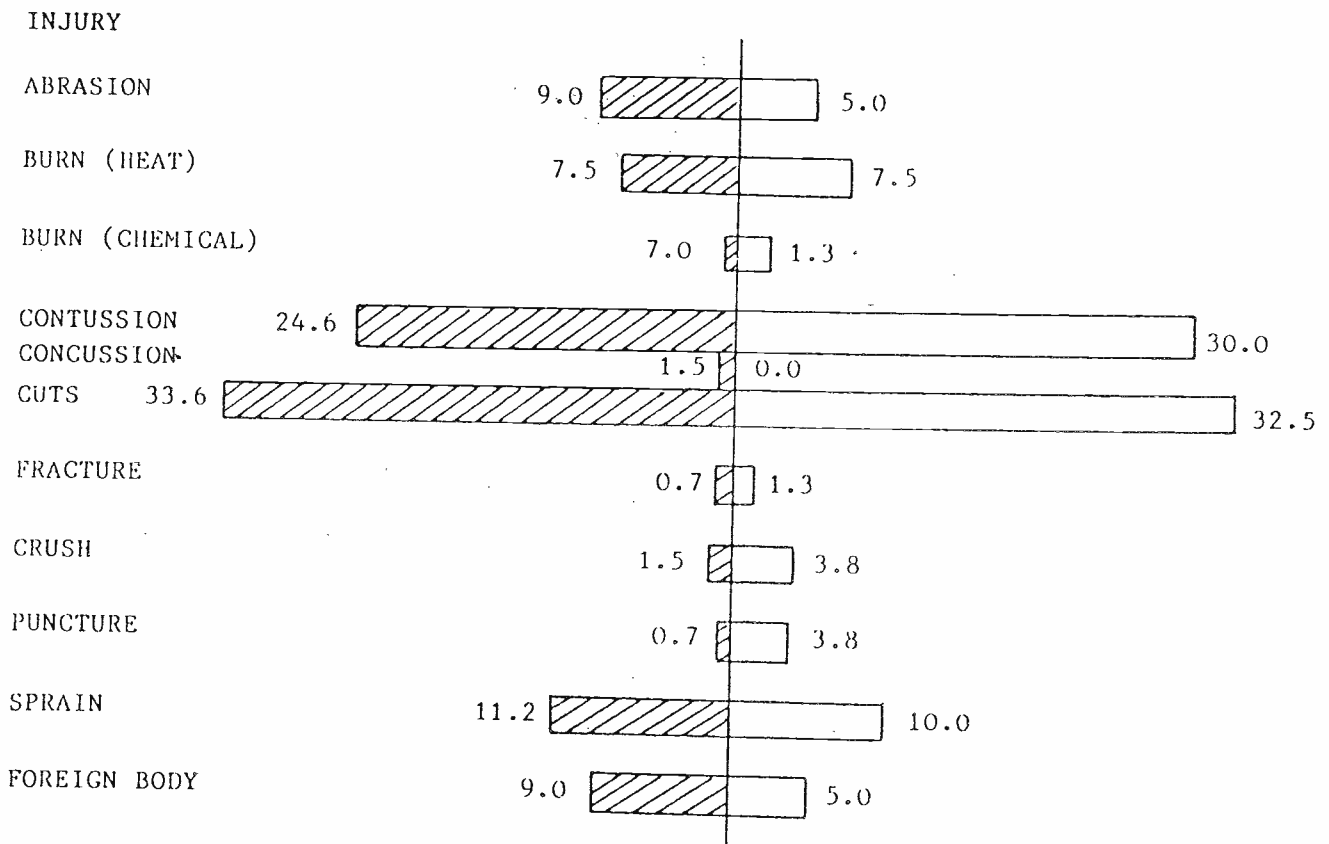
When the overall distribution was examined, hands, fingers and thumbs injuries constituted about half of all injuries. This is understandable as most work involved the use of hands and handtools. It follows then

that efforts in injury prevention should be directed here.

Overall, 'struck against' and 'struck by' accidents constituted 72.0% of all injuries. This again is not to be unexpected as handtools are often used. Oily hands and handtools often slipped which result in cuts. Remedial efforts should be concentrated at this problem. All mechanics and workers should be taught how to use and maintain their tools properly. Supervisors and foremen should see to it that all defective equipment be replaced.

Next, accident rates were calculated. For each rate, 2 values are given, one for all accidents and the other for accidents where more than 3 days medical leave are given. The latter are accidents which are required by Singapore Law to be reported to the Ministry of Labour.

FIGURE 1
PERCENTAGE DISTRIBUTION OF ACCIDENTS BY INJURY AND DURATION OF EMPLOYMENT SHOWN BY A BAR CHART

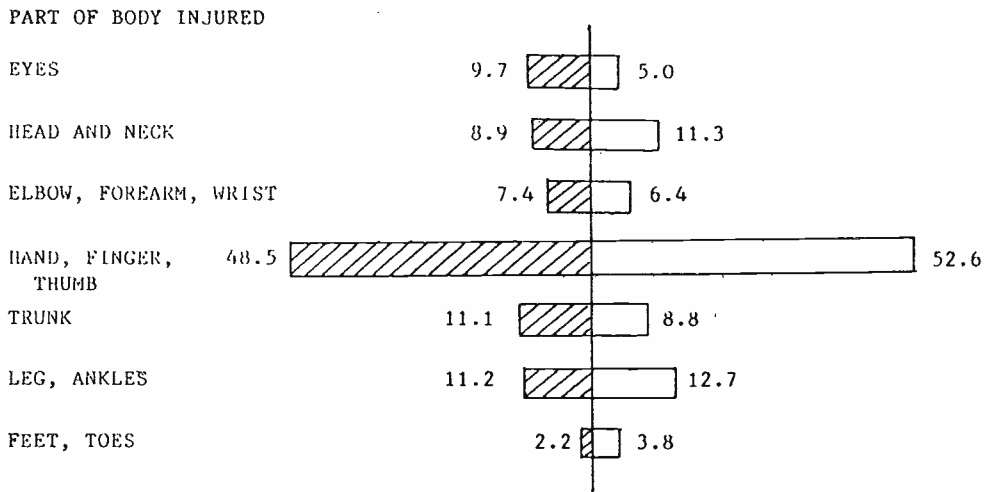


DURATION OF EMPLOYMENT

Less than 10 years Total 134 Accidents

More than 10 years Total 80 Accidents

FIGURE 2
PERCENTAGE DISTRIBUTION OF ACCIDENTS BY PART OF BODY INVOLVED AND
DURATION OF EMPLOYMENT AS SHOWN BY A BAR CHART

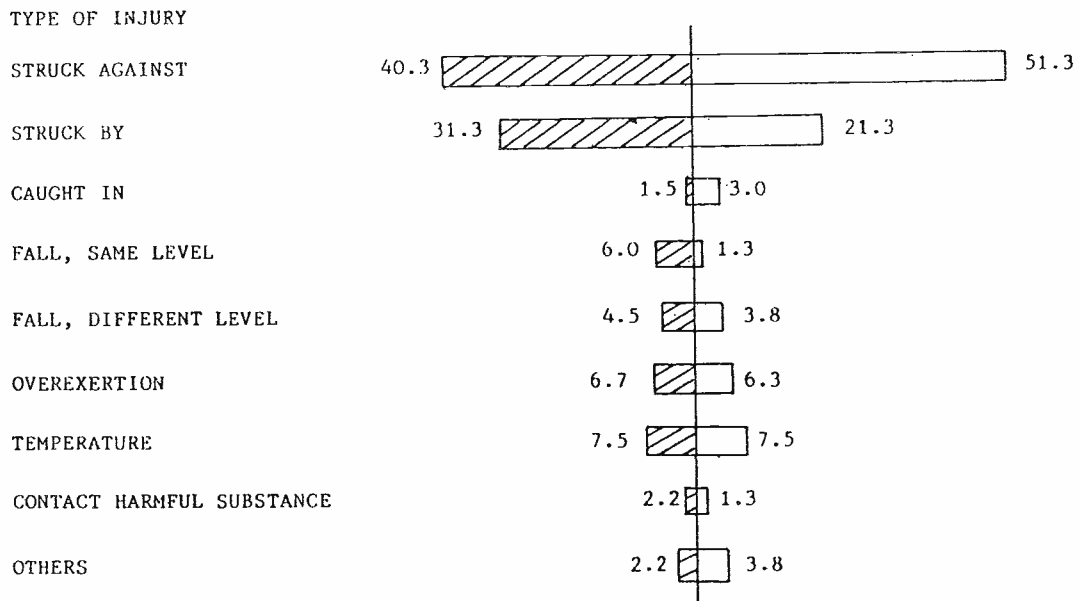


DURATION OF EMPLOYMENT

Less than 10 years Total 134 Accidents

More than 10 years Total 80 Accidents

FIGURE 3
PERCENTAGE DISTRIBUTION OF ACCIDENTS BY TYPE OF ACCIDENT AND DURATION
OF EMPLOYMENT AS SHOWN BY A BAR CHART



DURATION OF EMPLOYMENT

Less than 10 years Total 134 Accidents

More than 10 years Total 80 Accidents

Accident Frequency Rate

$$= \frac{\text{total number of accidents in a given period}}{\text{total number of man-hours worked in the same period}} \times 1000000$$

Accident Incidence Rate

$$= \frac{\text{total number of accidents in a given period}}{\text{average number of workers exposed in the same period}} \times 1000$$

Accident Severity Rate

$$= \frac{\text{total number of man-days lost from accidents in a given period}}{\text{total number of man-hours worked in the same period}} \times 1000000$$

Number of days charged per accident spell

$$= \frac{\text{total number of man-days lost due to accidents in a given period}}{\text{total number of accidents in the same period}}$$

It will be seen in Tables 9, 10 and 11 that all the accident rates were much higher in the period before the safety campaign (August to December 1981) than after it. In addition, the number of man-days lost per accident spell was also higher in the period before the safety campaign than after it. It could generally be inferred that the safety campaign was a success.

The accident frequency rates for reportable accidents seemed excessively high. However, it must be taken in the light that all accidents were included in this study, as long as it happened during working hours. Thus a worker who fell in the toilet is also classified as a work injury.

**TABLE 9
ACCIDENT FREQUENCY RATES**

	All Reportable Accidents Accidents (Medical Leave > 3 days)	
1981 and 1982	279	60
1981 January to July inclusive	410	54
1982	197	28

**TABLE 10
ACCIDENT INCIDENCE RATES**

	All Reportable Accidents Accidents (Medical Leave > 3 days)	
1981 and 1982	36.8	7.9
1981 January to July inclusive	55.1	7.3
1982	25.0	5.6

**TABLE 11
ACCIDENT SEVERITY RATES**

	All Reportable Accidents Accidents (Medical Leave 3 days)	
1981 and 1982	800	555
1981 January to July inclusive	1210	777
1982	420	210

**TABLE 12
MAN-DAYS CHARGED PER ACCIDENT SPELL**

	All Reportable Accidents Accidents (Medical Leave > 3 days)	
1981 and 1982	2.9	9.2
1981 January to July inclusive	2.9	10.2
1982	2.1	7.5

CONCLUSION

A total of 214 cases of accidents from Tractors Singapore Limited were studied over the period 1981 to 1982. The cases were obtained from the medical records of workers.

Lowest accident frequency was recorded for the month of November, constituting only 3.3% of all work injuries, although the number of man-hours worked was not less.

Fewer accidents occurred on Fridays.

Accident Frequency Rates during regular working hours and overtime were about the same.

During the period 1981 to 1982, of all accidents studied, only 11.9% of these workers suffered more than 2 accidents.

Age was shown to be not an important factor in determining accident rates.

Experience played a significant part in determining frequency of accidents. All 59 workers with less than 3 years experience suffered injuries while only 58.6% of those with more than 15 years experience met with accidents.

Of the accidents studied, about one-third suffered cuts while about one-quarter had contusions.

The anatomic site most affected were hands, finger and thumb and constituting 50% of all injuries.

The type of injuries most commonly experienced were 'struck against' and 'struck by' objects, constituting 72%.

The Accident Frequency Rate, Accident Incidence Rate and Accident Severity Rate were much lower after the safety campaign than before it.

Number of man-days lost per accident spell was also lower after the safety campaign than before it.

To completely eliminate accidents is to aim for the impossible. However, efforts can and should be directed in reducing them. Safe work methods go a long way in achieving this. In addition, as shown in safety campaigns, other methods could be just as successful. Pre-employment and periodic medical examinations help to fit the right man to the right job.

Safety education, good housekeeping, knowledge and application of safe work methods, use of protective equipment, application of ergonomics, a responsible and committed management, are the right ingredients in achieving results.

Investigation and analysis of accidents help to pin point areas of weakness and therefore areas where improvement can be most made.

It may be concluded from this study that concerted efforts to prevent accidents can be successful, not only in terms of accident frequency rates but also in accident severity rates and in number of man-days lost per accident spell.

More efforts should be directed at areas where accidents were more frequent such as hands and fingers being cut by handtools and knocked by

machines. Also the more experienced workers could spend more time in educating the inexperienced ones in safety.

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REFERENCES

1. Encyclopedia of Occupational Health and Safety. ILO, Geneva 1983; Vol I: 22.
2. Ministry of Labour, Annual Report 1980; 18.