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STRATEGIC OCCUPATIONAL INJURY PREVENTION OCCUPATIONAL BLACK SPOTS - VICTORIA (ANALYSIS AND PRIORITIES)

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ABSTRACT

This report covers the identification of potential priority areas for the initiation of systematic activities by the Authority to reduce occupational trauma in Victoria, Australia; and the review of the WorkCover database in regard to revamping and improving the claims information system for use in injury-prevention activities.

The project included the analysis of the claims data for the 16 month period from 1.12.1992 to 31.3.1994. The main analysis was devoted to lost time injuries/diseases sustained during the period, which formed a subset of 21,449 cases, out of the total of 37,551 claims for injuries/diseases sustained during the period.

A severity criteria was developed as a preliminary measurement of injury severity, to be used as a criteria in assessing priorities for prevention activities. Three aspects of severity were used: days admitted as in-patient to hospital; all possible indication of maims in relation to the injury; and the duration of earnings related compensation payments (lost time).

The main analyses were carried out on the basis of occupational groups, with 11 groups selected on the basis of having above average severity ratings. Additional analyses were also carried out across occupational groups on the basis of "agency" of injury.

Major recommendations are made regarding the development of a systematic program for the prevention of occupational trauma; information system enhancement; initial projects focussing on the prevention of falls associated with working from heights, and pedestrian/ vehicle interaction at worksites; and a regional study combining the WorkCover claims data, VISS data, regional census data, and local data.

Table of Contents

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EXECUTIVE SUMMARY

Prevention strategy

This report covers the identification of potential priority areas for the initiation of systematic activities by the Authority to reduce occupational trauma; and the review of the WorkCover database in regard to revamping and improving the claims information system for use in injury-prevention activities.

A strategy for prevention is based on the understanding that occupational injuries are preventable; exposure, equipment, environment and operational procedures can be modified for preventive purposes. Solutions to these problems should, primarily, be sought in modifications of technology, organisation and exposure. Safe systems of work are the necessary foundations for safe behaviour in the workplace.

The application of scientifically based strategies to injury prevention and the benefits attainable is exemplified by road safety programs, and the significant reduction in the road toll achieved over the last 23 years (in particular the last five years). Examples of major programs include those of the TAC together with the Police Force and other agencies investing some $80M (booze buses, speed cameras, supporting publicity etc) resulting in estimated savings over the period of 881 fatalities, 8891 serious injuries and 22450 other. Other programs include the accident **'blackspot'** programs for which the TAC announced that it will contribute $75M over two years to help eradicate **500 blackspot locations** in Victoria. These programs provide valuable models which can be adapted to a workplace injury prevention program, and have been drawn on in this project.

Claims Data

The major steps in the project involved the analysis of the claims data bases with the objective of identifying priority target areas characterised by having above average severe injuries.

The claims period selected for study is **1 December 1992 through 31 March 1994,** thus minimising the complications of including data from before the major legislative changes to the scheme in December 1992. The main analysis was devoted to **lost time injuries/diseases sustained** during the period, which formed a subset of 21,449 cases. The total claims for injuries/diseases **sustained** during the period was 37,551; with a total of 49,554 claims **reported** during the period.

Severity Index

One important task for this study has been to establish a preliminary measurement of injury severity, to be used as a criteria in assessing priorities for p revention activities. In the present study, preliminary indicators of these three aspects of severity were used. As a variable indicative of medical severity, **days admitted as in-patient to hospital** was used. As a measure of permanent medical impairment, all possible indication of **maims** in relation to the injury were recorded. And lastly, as a measure of temporary incapacity due to injury, the **duration of earnings related compensation payments** was recorded. To add weight to this maim indicator it was further decided to use an age factor as multiplier- the number of years to reach 65 years of age (i.e. 65 - age at the time of injury) for the relevant cases.

The main analyses were carried out on the basis of occupational groups. The 400 categories of occupational code used in the WorkCover system, were condensed into **64** logical occupational groups, where exposure was similar.

Results - Occupations

The following occupational groups were identified as having the highest average severity in terms of lost time, days in hospital and indicated permanent impairment associated with injury. The selection is based on those groups scoring at least 25% above average on one or more of the individual severity indicators:

Group 1	Managers; agriculture/forestry/mining, etc	n=172
Group 2	Machinists	n=188
Group 3	Millers, Bakers	n=106
Group 4	Printers	n=112
Group 5	Other Metal Workers	n=346
Group 6	Construction Workers	n=582
Group 7	Fitters, Turners	n=594
Group 8	Riggers, etc	n=47
Group 9	Miners	n=95
Group 10	Forestry Workers	n=82
Group 11	Linesmen, etc.	n=53
		N=2377

In this selection, priority was given to high scores on individual severity indicators, rather than a compounded total high score. Groups like Painters, Woodworkers, Textile/Shoe Workers, Packers, Wrappers, Rubber/Plastics Workers, Sales Workers, Cleaners, Butchers, Vehicle builders and Electricians also represents above average injury severity, which would warrant further investigation and motivate applied prevention activities.

These 11 groups were then subjected to more detailed analyses on the basis of mechanism, affliction and bodily location in terms of severity rating. To more closely identify particular priority areas within each of the selected occupational groups, the determination of accident “mechanism” was determined manually from the free text in the claim form for each of the 2377 cases.

From the detailed analyses of the 11 occupational groups initial priority areas were identified for each group. Some examples from the larger groups of “Construction workers” and “Fitters and turners” include:

- Falls to lower level among Construction Workers.
- Traumatic contacts with vehicles among Construction Workers.
- Handling of glass, Construction Industry.
- Traumatic contact with machines among Fitters & Turners.

- Traumatic contact with forklift trucks

Occupational "blackspots"

It became apparent from the analyses that each occupation group has its own particular "blackspot" areas, which is characteristic and most likely peculiar to that occupation. For example **"millers and bakers"** have a high severity rating for **traumatic contact with materials (substances/burns) and machine power tools,** but related to the particular equipment used in that industry. Similarly **"printers"** injuries are conspicuous by their association with **traumatic contact with machines** (printing presses etc). Each occupation has associated with it, particular equipment, processes and practices and injury type and circumstances.

These observations suggest that a powerful and effective injury prevention program utilises the concept of "black spot analyses" as used in the road safety area, but applied systematically to each occupational groups (and particular types of industrial sites).

Similarly, this type of "blackspot" analysis could **focus on specific agencies of injury** identified in terms of high frequency and severity occurring across occupational groups. In this category, some examples based on the preliminary analyses carried out in this study, include, ladders/stairways; forklifts; and saws.

Coding system

The present information collected by the WorkCover Authority was designed for paying compensation. For this reason the information about harmful exposure, referred to as "pre-event" information in the road safety area, is insufficient in detail if it is to be used in applied prevention. We suggest that the WorkCover Authority complements this part of its system with the proposed new European standard of recording occupational injury and disease which is based on the New Zealand ACC coding system, adopted and further developed in Sweden, Norway and Denmark. This breaks down the narrative of the accident process into **activity, mechanism** and **contact.**

The adoption of this recording principle by the WorkCover Authority would simply mean that the present free-text descriptions ("claim description", "incident text", "accident text", "affliction text", and "bodily location text"), which have been heavily relied upon in the present analysis, be re-structured and linked to three questions posed on the claims form.

The "post-event" information of the system is, as expected in a workers' compensation system, of good quality, but certain areas, eg. types of medical procedures, could be investigated to contribute more detailed information on the tail-end of extremely severe occupational trauma. Days spent as in-patient in hospital should be compulsory information for all relevant cases, whether it be public or private hospital care.

The 1981 occupational code used by the WorkCover Authority should be substituted with the present 4-digit ASCO, so that exposure can be related to occupation according to census and labour force estimates.

SUGGESTED PROGRAM

It is recommended that:-

1. A three-year plan for the prevention of severe occupational trauma in Victoria is developed, involving in-depth investigation into priority areas, discussion and development of intervention programs into severe occupational trauma together with core industries, and the formulation of a framework for selected cost-effectiveness measurement in certain areas of intervention.

It is suggested that to commence the program, based on the identified priority areas, projects in the following two problem areas be initiated to reduce injury risk and severity associated with:

- **prevention of falls associated with working from heights, and**

- **pedestrian/ vehicle interaction at worksites**

The analysis of severe injuries among workers in the Construction Industry indicates the need to assess the possibilities of changing practices and upgrading equipment for work on height; equipment for working on roofs, ladders, trestles, scaffolding etc. This would be specifically needed in the area of low-rise, residential construction, where perceptions of risks and present equipment and practices should be addressed on an industry basis. However a number of different occupational groups and associated work practices outside the core house-building industries should also be included.

The logistics of transport and goods handling in manufacturing, distribution and storing, and particularly the problems of vehicles interacting with pedestrian workers at the worksite, are of general importance and constitute a top priority in a large number of industries. The analysis of traumatic contacts with vehicles among Construction Workers points specifically to the safety priorities at construction sites. However forklift trucks still constitute a major cause of severe and fatal occupational injury at a broad range of worksites in Victoria.

2. To support the injury prevention program data needs, a program of information system enhancement by the WorkCover Authority is necessary. Functional resources for this, and for the analytical and developmental requirements needed on the output side, should be allocated and budgeted.

3. On going research and intervention activities be undertaken by suitable institutions like Monash University Accident Research Centre, University of Ballarat, IPSO Australia and others, according to the priorities set forth by the WorkCover Authority, based on continuing analyses of the claims material.

4. A study of the Latrobe Valley, where regionalised WorkCover data, VISS data, regional census data, and data from local, participating companies could be combined to produce a regional occupational injury prevention plan to be implemented together with the big employers and groups of small employers. A more complete screening of injuries and of establishing criteria to rank the problems according to severity, would assist employers. This would be an approach to occupational injury prevention with significant public health potential.

The Victorian Injury Surveillance System (VISS), managed by MUARC, collects detailed patient presentation information from six major Victorian hospitals and is an additional and rich source of information on the circumstances of work related injuries.

1.0 BACKGROUND

As an outcome of discussions between the Victorian WorkCover Authority, MUARC together with IPSO, outlined a strategic framework to the WorkCover Authority aimed at initiating and developing an approach to long term, systematic and cost-efficient occupational injury prevention, built on the specific role and competence of the comprehensive worker's compensation system.

This report covers the Stage 1 project, which is essentially a pilot project aimed at identification of initial priority areas and the initiation of systematic activities in Victoria to reduce severe occupational trauma; and the review of the WorkCover database in regard to revamping and improving the claims information system for use in injury-prevention activities.

The proposed injury prevention strategy involves the following five basic stages, applied systematically:

Stage 1. Determine priorities for prevention.
stage 2. Problem identification.
Stage 3. Countermeasure development/ selection.
Stage 4. Implementation phase.
Stage 5. Evaluation Phase.

The injury information held in the **WorkCover database** forms the key source of injury data for use as a basis for prevention programs, and is absolutely essential to a serious program. The form in which such information is collected and held, however, must be adapted to the applied needs and goals of prevention (Larsson, 1991).

Injury information, to be effective, must identify harmful exposures, hazardous practices and dangerous agencies at a reasonably detailed level. It must reliably indicate which industries and occupational groups expose its workers to the highest risks of sustaining occupational trauma and disease. And it must make it possible to differentiate between occupational risks in terms of relative frequency/incidence and severity, and thus to indicate the priorities for applied prevention.

In regard to injury risk and severity, it is pertinent to emphasise that these are largely occupation dependent. On a national or industry-wide level, similar exposures, similar operations under similar conditions, tend to produce a stable volume of similar injuries to those that are exposed. A low level of physical risk, associated with low probabilities of death and severe medical trauma, tend to produce low grade physical injuries at times when the man-machine system becomes unstable, whereas a high level of physical risk, associated with higher probabilities of death and severe medical trauma, typically is associated with severe physical injuries to its operators. Human behaviour and error rates vary, but operators in hazardous jobs tend to be more competent than others in coping with risks (Hovden & Larsson, 1987).

We argue that systematic, criteria-based, selective and controlled occupational injury prevention will improve safety and reliability in important industrial sectors and reduce suffering and improve workers' health by targeting severe trauma in the high-risk occupational groups. Such prevention activities, properly conducted, will also be conducive to increased productivity, reduce the cost of workers' compensation and, as a result, reduce premiums/levies.

1.1. A Strategy for Prevention

A strategy for prevention must be based on the conviction that **occupational injuries indeed are preventable;** exposure, equipment, environment and operational procedures can effectively be modified for preventive purposes. This is the first - and possibly the most important - requirement of a strategy for prevention.

Allied with this view, a shift in general community attitude is required which moves away from regarding individual behaviour and "lack of care" as the main explanation for occupational injuries. The solution to these problems is to create safe systems of work, where technology and organisation reduce risk exposure and are conducive to safe behaviour in the workplace.

Secondly, a prevention strategy must state the **priorities for prevention.** Some injuries, some heavily exposed groups or some hazardous tasks or products must be singled out as more important targets for prevention than others. The strategy must also contain reasons for these choices based on real knowledge of severity, incidence and consequence costs.

Finally, the prevention strategy must state **how and by what means prevention will be pursued,** in terms of human, technical and financial resources for specific activities and set targets in terms of reduced severity, incidence or consequence costs for specific injury problems over periods of time.

A **selective** approach means defining an injury problem at a level where it can be addressed by prevention. It also means defining the problem of occupational trauma according to specific criteria like type of exposure, task, machine/product, hazard, rather than compensation-driven labels like "sprains and strains". It means establishing a constructive and uncontentious way of differentiating between severe and minor occupational trauma.

With a closer look at which occupations claim the highest average consequences in injury severity, the compensation data will potentially indicate which **activities** and **accident mechanisms** are typically associated with these **occupational exposures** (Larsson, 1990). This can focus preventative intervention in the form of technical redesign or development of details of machines, special attention to details of, or implements used in, certain tasks for training and retraining efforts, redesign or the introduction of new protective equipment, and selective information efforts targeted at the groups in question.

The importance of the injury problem depends on the relative severity of the trauma, the loss of life or degree of loss of quality-of-life, and the incidence and volume of the particular problem. An advantage to a compensation agency initiating and monitoring prevention activities, is the readily available **consequence and severity data,** which will make it possible to evaluate and assess the cost-benefit ratio of successful intervention.

1.2 Information for Applied Prevention

Traditional injury databases tend to focus on injury outcomes -that is the cause of death or hospital diagnosis for admitted patients and thus provide little information about the sequence of events leading to injury. Information which is particularly valuable for developing prevention programs relate to identification of the product, machines, tools or activities involved in the incident that lead to injury.

The **WorkCover database** is ideally placed to provide this information, with the need however to focus on upgrading the 'pre-event" variables, which would greatly improve the prevention potential of the system. Increased precision of variables describing pre-event exposure and post-event consequences would also improve present or future severity indicators, thereby making decisions on the cost-benefit of applied prevention more precise.

This type of data base, as distinct from most other injury related data bases, can also provide reliable information on injury severity and long term consequences. This is most useful in identifying priority areas, as well as enabling additional sophisticated analyses on the effectiveness of various treatment and rehabilitation procedures for various injury categories.

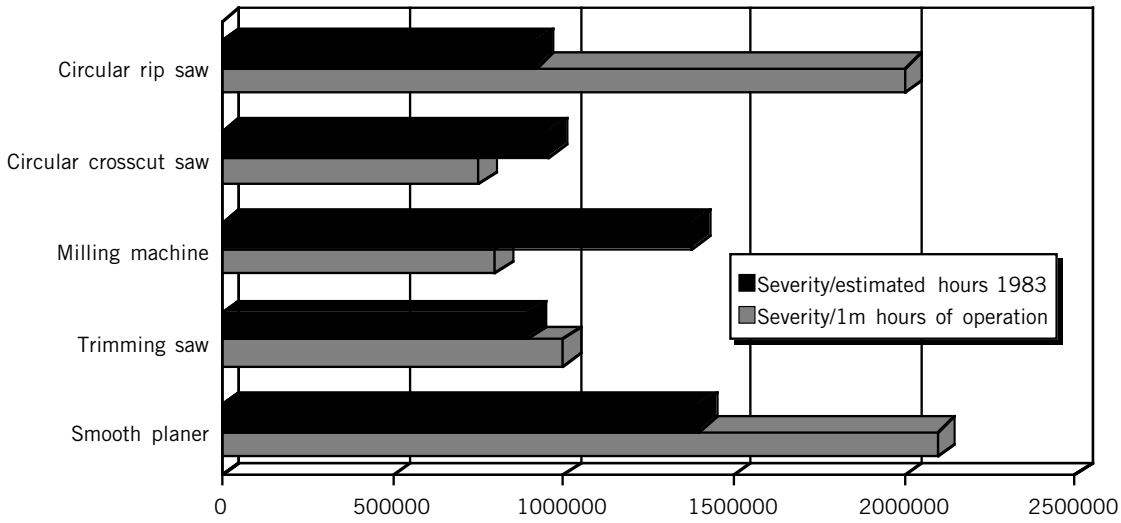
Precedents for the use and upgrading of workers' compensation databases can be found in other countries. In Sweden, for example, a decision was made to introduce a specific 'injury information system' into the claims-handling of the Swedish Occupational No-Fault Liability Insurance.

The Swedish decision was made on the basis that the scheme, being the only available source of information in Sweden on long-term effects of occupational injuries and permanent medical disabilities, should use the claims data to identify groups, activities and agencies associated with high risks of occupational injury and to suggest preventive measures. This 'information system' carries low costs, since it is fully integrated into the normal routines of the insurance. The extra time to analyse and code the accident descriptors for 20,000 injury cases in one year is equivalent to one extra staff among 300, i.e. less than 0.5% increase in workload.

The level of detail potentially available for informed decision-making regarding prevention activities is shown by the following examples.

(i) Woodworking Machines - Sweden

The following graph shows the five most prominent machines causing medical impairment among Swedish wood-industry workers in 1983, according to relative severity as measured by lost time, constructive damages, hospital care and early retirement.



The severity measurement is based on some of the available Insurance variables and a complete National industry coverage. The additional information on exposure needed to produce the injury "price-tags" above was provided by wood products industry experts who estimated man-hours and machine park for different types of production (office furniture, general furniture, structural fittings & joinery, etc).

Measured this way, severe injuries in 1983 added SEK 2:- ($0.50)/hour to the cost of using a **circular rip saw** (Larsson, 1988). An improved protective hood for retro-fit onto circular saws and trimming saws, with improved exhaust properties and improved visibility, was developed by the Swedish Wood Technology Centre, in co-operation with the Joint Industrial Safety Council, as a result of this identification exercise.

(ii) Coal Miners - New South Wales

One of the best occupational injury information systems in Australia is kept by the Joint Coal Board of New South Wales. Claims data from this source was recently used in a priority-setting analysis for the Australian Coal Association and BHP Australia Coal (Mitchell & Larsson, 1994). The following three diagrams describe some of the pre-event information available in the JCB information system for lost time injuries among underground face workers for the period 1.1.91 - 30.6.93 in terms of average severity:

Figure 1.2 *Lost time injuries (n=4359), Coal miners-Underground face workers; severity distributed over tasks associated with injury (>80% of costs, 76% of cases)*

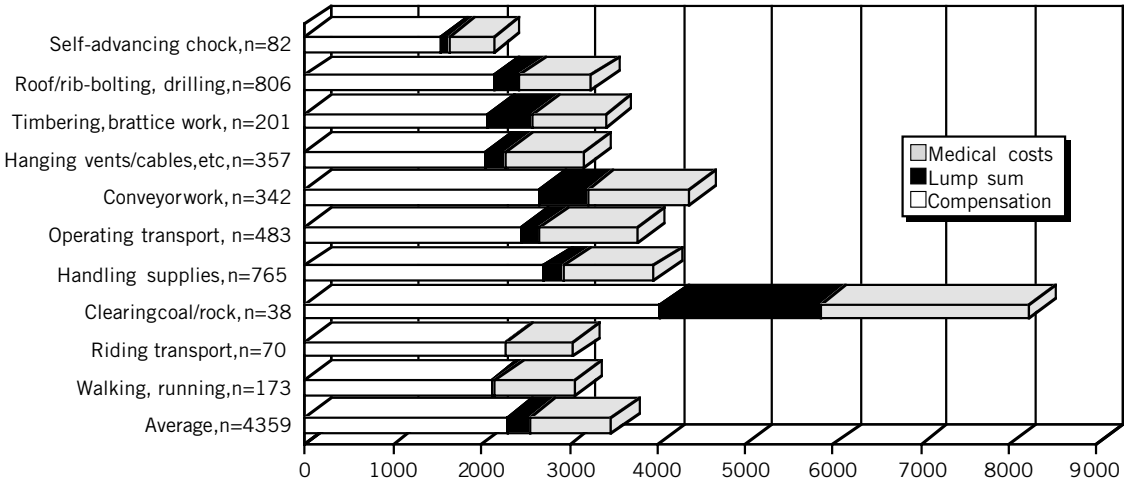


Figure 1.3 *Lost time injuries (n=4359), Coal miners-Underground face workers; severity distributed over mechanisms associated with injury (>80% of costs, 79% of cases)*

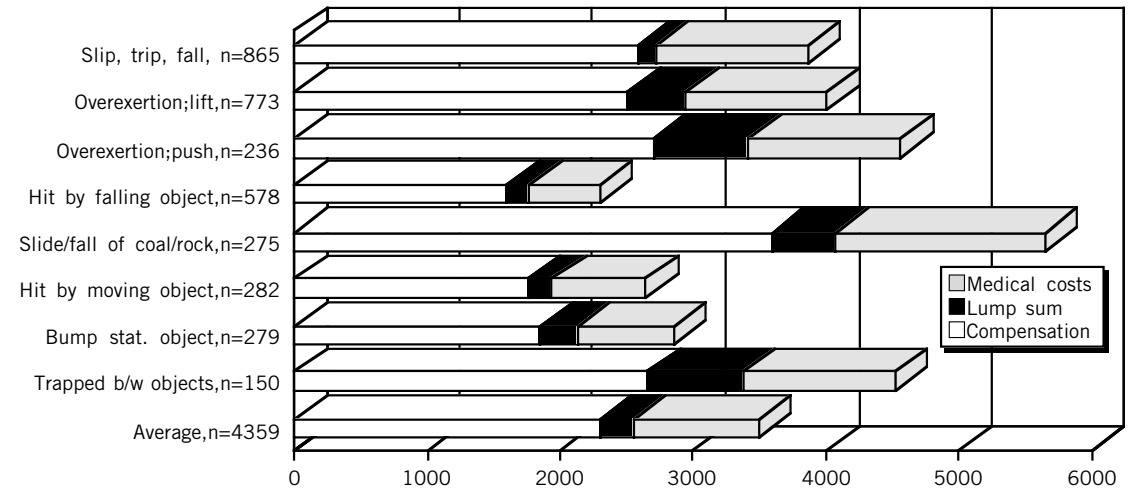
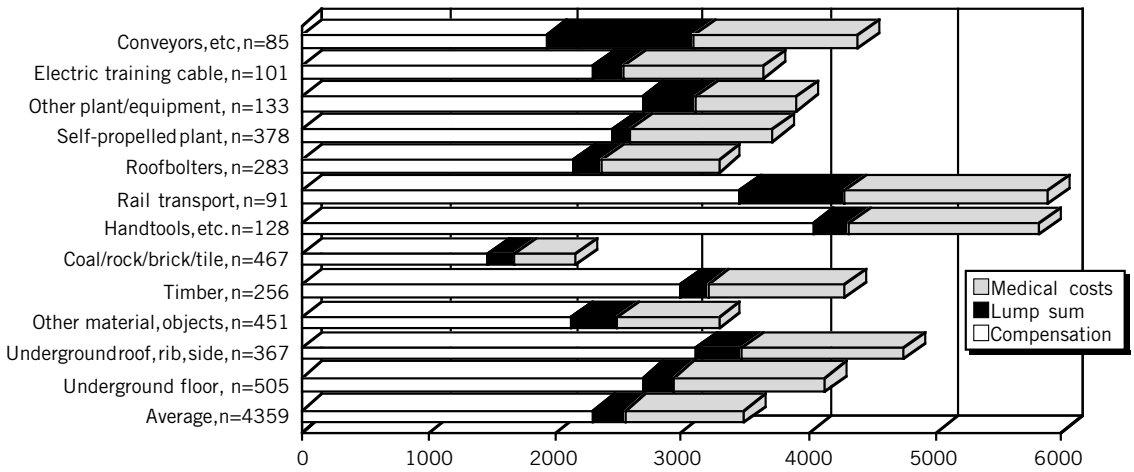


Figure 1.4 *Lost time injuries (n=4359), Coal miners-Underground face workers; severity distributed over agencies inflicting injury (>80% of costs, 74% of cases)*



The data identifies **tasks** such as clearing/breaking coal/rock, conveyor work, handling supplies/items and operating transport as associated with the highest relative injury severity. **Mechanisms** associated with the highest severity were slide/fall of coal/rock, overexertion from pulling/pushing, and becoming trapped between objects. Conveyors, rail transport, handtools and underground roof, rib, side were the **agencies** associated with the highest severity.

The logical focus for efforts to reduce severe occupational trauma among NSW Coal Workers is a) on the ergonomic details and safe procedures associated with manual tasks at the coal face and b) activities involving handling supplies and contact with conveyors and transport equipment. Even minor reductions in injury incidence within these areas would result in massive savings in compensation and improved occupational health among NSW Coal Workers.

(iii) Forklift Trucks - Victoria

Based on an analysis of severe occupational injuries and fatalities associated with forklift trucks in Victoria between 1987 and 1990, it was concluded that i) detailed information about accident mechanism and factors contributing to the injury was available from the **free-text descriptions** in the claims records of the workers' compensation system, and ii) 45% of the forklift associated injuries were forklifts hitting or driving over pedestrians; this proportion did not differ considerably between industries, and iii) a third of the fatalities were to the forklift driver, who upon leaving the vehicle to adjust cargo or equipment, was crushed or run over by his own vehicle (Larsson & Rechnitzer, 1994).

Specific recommendations, based on the claims data analysis in combination with critical incident analysis at a large number of companies in the greater Melbourne area, borrowed concepts from successful approaches in traffic management and suggested that the forklift truck be defined as a "heavy goods vehicle", and that

> in a **freight terminal,** no forklift and pedestrian movements should ever take place at the same level, in the same space;
>
> in a **warehouse,** all forklift truck movements should be separated from manual picking in space or in time;
>
> in a **manufacturing plant,** forklift trucks should be limited to specific areas and completely separated from pedestrian walkways and work stations.

Thus, detailed and conclusive information from the compensation system, can, when used together with principles of risk reduction and injury prevention from the area of road safety, point to necessary developments in materials handling, storage and plant safety.

1.3 APPLICATION OF ROAD SAFETY STRATEGIES TO OH&S

The significant reduction in the road toll achieved over the last 23 years (in particular the last five years) exemplifies the benefits attainable from the application of scientifically based strategies to injury prevention. Some of the lessons learnt in the road safety area have been drawn on for this project, and are briefly reviewed in the following.

Since 1989 the Victorian road toll has nearly halved, from 776 fatalities in 1989, to 396 in 1992. Victoria"s fatality rate of 1.6 deaths per 10,000 registered vehicles is amongst the lowest of any comparable community in the world. This drop in the toll is attributed partly to a downturn in the economy, but with over 70 % of this fall attributed to the various road safety programs implemented from September 1989.

The returns from the major investments in the road safety programs have been subject to extensive evaluation and typically show returns in the order of seven or more times their initial investment. For example, the Transport Accident Commission (TAC) together with the Police Force and other agencies have invested some $80M (booze buses, speed cameras, supporting publicity etc) resulting in estimated savings over the period of 881 fatalities, 8891 serious injuries and 22450 other injuries, or a saving of $1617M (7). If

only half of this saving is attributed to the speed and RBT programs, the return on the $80M investment is ten fold estimated at $800M, over the three year period 1990/92 (Vulcan, 1993).

These programs have relied initially on the extensive analysis of the major data bases of VICROADS and the TAC. MUARC has played a key role in this and in identifying priority areas for further research, countermeasure development and implementation. The techniques and experience gained in this type of analysis have been utilised by MUARC in this project.

Other programs which could be adapted to the workplace injury prevention program are based on the accident **'blackspot'** programs, which commenced in Australia in 1979, following overseas success. These have proved to be very effective use of resources, with the TAC announcing that it will contribute $75M over two years to help eradicate **500 blackspot locations** in Victoria. The objective (Tziotis, 1993) of the programs is to reduce the incidence and severity of crashes at road locations that experience high numbers of casualty crashes by implementing targeted, cost-effective remedial treatments.

The sites are identified by analysis of mass crash data. Detailed follow up investigations of each site is made to identify the casual factors contributing to this higher accident involvement. Countermeasures typically take the form of various low cost modifications to the road system (traffic light, roundabouts, line markings, sealing of road shoulders, etc) are used. The returns on this investment have been evaluated at various treated sites with an over 30% reductions in crashes being common. The benefit cost ratio has typically been over seven (7:1).

2.0 METHODOLOGY

2.1 SUMMARY

The full WorkCover database consist of many thousands of data items, most of which are related to claims handling and not directly relevant for analyses aimed at injury prevention. The first stage of this project entailed **selection of the claims period,** and the relevant subset of variables to enable extraction of the claims and formation of a much reduced and far more easily managed dataset. The final data set consisted of **49,554 claims by 61 variables** (refer Appendix 5 for a list of the selected variables).

The second stage involved the determination of the **severity criteria,** and hence variables, to be used for the analysis of the claims and the determination of **priority areas.** This preliminary index of severity has been built on the three main indicators of severity: **lost time, medical severity and permanent impairment.** The severity rating was calculated for each case, and the claims data then analysed/sorted to determine **priority** groupings based on **above average severity ratings.**

The main analyses carried out were on the basis of **occupation groupings,** with 11 groups selected as having above average ratings. These 11 groups were then subject to more detailed analyses on the basis of mechanism, affliction and bodily location in terms of severity rating. Separate analyses based on **"agency"** were carried out to determine major hazards independent of occupational groupings, and for which generic solutions may be feasible. Additional analyses were also carried out to **validate the severity index** and the variables forming the reduced dataset, (refer Appendix 1 & 2.).

2.2 Selection of claims period

The selected period for study is **1 December 1992 through 31 March 1994.** It was considered unwise to include data from before the major changes to the scheme, as the entry criteria for claims and claims assessment were significantly different pre and post November 1992. It is realised that a 12 months or preferably a 24 months period would have eliminated any seasonal variations, but it was considered important to include as much of the post November 1992 data as was available.

Two different samples were constructed, one including all claims **reported** during the period (N=49,554), and the subset formed by including all claims for injuries/diseases **sustained** during the period (N=37,551). The main analysis was devoted to **lost time injuries/diseases sustained** during the period (n=21,449). The selection of this latter group was predicated on the basis that the minimum threshold for "severe injury", which is the focus of this study, was to have at least 1 day of lost time.

There are a number of variables describing the consequences of traumatic injury and occupational disease available in the workers' compensation system. The task of selecting those that are the most valid and reliable for successful applied prevention is wrought with a number of problems associated with the structure of the scheme, the actual demand and utilisation of the benefits provided, the administrative routines applied in the system, the injury information system in use, and the general attitudes to the problem of occupational injury and disease in society.

2.3 Severity Criterion

The aim here has been to pick variables for a measurement of **severity** which can be seen to be as independent as possible of bias introduced by any of the aspects above. To create a completely objective measurement would be a formidable task; definitions of severity of injury/disease contain many different medical, psychological, sociological, philosophical, political and economical aspects.

In road safety research, for example, a number of standardised indicators are used for measurements and/or classification of injury severity. The most widely used is the Abbreviated Injury Scale (AIS) which was devised in 1969 through a meeting of physicians, researchers and engineers, with the aim of the development and acceptance of a uniform injury scale that would become an integral component of motor vehicle related crash investigations and statistical analyses (Petrucelli, States & Hames, 1981). From these meetings "an injury scale was drafted that was medically accurate and philosophically acceptable to the multi-disciplines involved". The AIS scale ranks injuries (on the basis of risk of dying) on a scale of 1-6, with AIS 6 rated as maximum injury severity and virtually unsurvivable. The AIS scale can be considered as a measure of the **medical** severity of injury, which was based, to a certain extent, on the subjective classification by the expert group.

In these analyses, the aim is pragmatic: we have tried to isolate a small number of indicators representing different aspects of injury/disease severity and turn these into a **preliminary index of severity,** in order to put forth the priorities of applied prevention of occupational trauma. This preliminary index of severity has been built on the three main indicators of severity: **lost time, medical severity, permanent impairment.**

Lost time, ie. the time the claimant has been away from work, is the most basic indicator of injury/disease consequence available in the compensation system. It can be argued, of course, that this figure is related to structural variables and circumstances outside the area of occupational hazards, ie. unemployment, age, family and gender issues, and other labour market aspects and biases. If used as a single indicator it can be highly inappropriate as a measure of occupational hazard. If used in conjunction with other indicators it contributes important information about the consequence of certain exposures.

Medical severity cannot be measured by the payments for medical and rehabilitation services. It is clear that while a number of variables related to medical treatment can be used as indicators of severity of trauma, only a few in the present WorkCover system could be regarded as valid and included among the priority criteria for applied prevention. We have sought to isolate the **number of days spent as in-patient** in hospital as one possible criteria for medical severity which we have included in our index.

There is an independent tradition in the area of insurance to seek to determine severity of consequence associated with externally caused injury through tables of maims and constructive damages related to degree of impairment. **Permanent impairment** would be a strong component in any measurement of occupational injury severity. The compensation system is the only place where such long-term losses are systematically recorded (AMA, 1984; Larsson, 1994).

2.4 Severity index -Estimation, Standardisation and Control

The three indicators representing lost time, days in hospital and permanent impairment have been translated into a common denominator ($) for each injury case in the samples.

The **days lost** were multiplied by a standard $120 for each claim. In this indicator we have included all lost time associated with injury/disease. Days compensated by employers under excess agreements have been added to the count for these respective cases.

Days spent as in-patient in private hospital is not given in the present claims data. This figure had to be estimated using a sample of 650 claims from seven participating hospitals, where more detailed data was available. 80% of the cost for in-patients in this sample represented lodging, at an average per diem rate of $400. Thus, for each claim, indicated in-patient days in public hospitals were multiplied by $400; half day episodes in private hospitals were recorded at $200; and for the remaining relevant cases 80% of the in-patient cost in private hospitals was recorded as indicative of **days in hospital.**

Since a substantial number of permanent impairments have yet to be settled for the period ending 31 March 1994, it was decided to include as many indicators of permanent impairment as possible. Thus three separate maim indicators have been recorded; **maim benefit applied for, maim payment** and **maim pending.** To add weight to this indicator it was further decided to use an age factor as multiplier, ie. **permanent impairment** was set at an estimated average of 8%, representing $7,500 of maximum benefit ($93,080), and multiplied by the number of years to reach 65 years of age (i.e. 65 - age at the time of injury) for the relevant cases.

There is still a possible under-representation of maims in the selected populations. In the population of lost time injuries under study, the proportion of maims was **2.8%.** A comparison with claims for lost time injuries 1 December 1988 - 31 March 1990 showed the proportion of maims to be **4%.** However, since the total volume of claims for lost time injuries in this 1988-90 material was more than three times as big, it is hard to tell, without further analysis, if and how the drastic overall reduction in claims over the last four years has influenced the reporting of permanent impairments. The following tables (2.1, 2.3) show some of the differences in proportion of maims cases between the 1988/90 and 1992/94 data sets:

Table 2.1 *Proportion of maims (by afflictions) - 1988/90 vs 1992/1994 data sets.*

Affliction	% of LTI 88/90 N=67,509	% of LTI 92/94 N=21,449	Difference
Sprain/strain	3.9	2.3	- 1.6
Fracture	6.2	2.6	- 3.6
Amputation	3.5	3.0	- 0.5
Laceration	2.8	3.7	+0.9
Foreign body	1.5	1.9	+0.4
Contusion	2.7	3.3	+0.6
Burn	1.1	1.3	+0.2
Multiple injuries	10.0	7.1	- 2.9

Table 2.2 *Proportion of maims (by bodily location)- 1988/90 vs 1992/94 data sets.*

Bodily location	% of LTI 88/90 N=67,509	% of LTI 92/94 N=21,449	Difference %
Head, eye	3.3	2.2	- 1.1
Upper extremities	4.3	4.2	- 0.1
Neck, upper back	3.8	3.2	- 0.6
Back	4.9	2.7	- 2.2
Trunk	1.6	0.7	- 0.9
Lower extremities	2.9	1.7	- 1.2
All injuries	**4.0**	**2.8**	**- 1.2**

There is a conspicuous drop in maims related to **fractures,** while the proportion of this affliction has increased among the lost time injuries. At the same time, there is a slight increase in the maims associated with **contusions,** while the proportion of this affliction has dropped by 40% among the lost time injuries. Maims related to **back injuries** have also dropped, while the proportion of back injuries among lost time injuries has increased.

The turbulence created by changes to the scheme, and a variety of effects related to recession, tariff reduction and the restructuring of different parts of the Victorian industry over the last couple of years, may certainly have had an impact on the figures above. A stable scheme for some years and improved possibilities to identify changes in exposure (eg. distribution of gender, age, occupation/tasks for different industries) would be the necessary requirements for valid conclusions on this problem.

It seems that if we assume the same real proportion of maims in the population of lost time injuries in the populations under study, there could be around **250** cases of maims still to be reported and/or recorded.

For all analyses on group level (for occupations, afflictions, body parts and mechanisms), the indicators have been normalised, ie. group values on the indicator have been divided by the population average. This means that the average on each indicator for the population is 1, making the total average severity index 3.

In summary, the overall severity index is a sum of three components:

MAIM INDEX = (7500 x (65-age at claim) x maim indicator) / average
DAYS INDEX = (Days compensated x 120) / average
HOSPITAL INDEX = [(public hospital days x 400) +
(private day surgery x 200) +
(private hospital costs x 0.8)] / average
TOTAL INDEX = MAIM INDEX + DAYS INDEX + HOSPITAL INDEX)

Retrospectively reported injuries and diseases

Of the **49,554** claims received between 1.12.92 and 31.3.94, **11,993** referred to injuries/diseases sustained before 1 December 1992.

Affliction	n	%	% cost
Sprain/strain	4,800	40.0	9.6
Fracture	374	3.1	1.1
Contusion	455	3.8	0.6
Hearing loss	4,347	36.2	83.6
Hernia	268	2.2	0.2
Mental disorder	168	1.4	0.6
Laceration	498	4.2	0.7
Foreign body	134	1.1	0.1
Synovitis, etc	210	1.8	0.5
Other	1,113	6.2	3.0
All	**11,993**	**100**	**100**

The bulk of these claims were made up of hearing loss and soft-tissue injuries to back, shoulder, neck, knee. But there were also a rather large proportion of fractures, contusions and lacerations. These claims represent injuries suffered before the 1st December 1992 with possible remaining symptoms after this date, and reported to the WorkCover Authority in order to verify compensation claims or common law action after 1.12.92.

2.5 Analyses By Occupation Groupings

Out of the 400 categories of the 1981 occupational code recorded in the WorkCover system, we constructed **64** logical occupational groups, where exposure was roughly similar, ie. workers and labourers in the same industry were put together; bricklayers, plasterers, concrete workers, etc were put together.

This occupational code was used as the main identifying variable in the analysis.

The list of the reduced set of occupational groups and the original occupation codes is given in Appendix 1- Table 5 Severity Index by Old Occupational codings. This table enables a detailed review of the severity index by all occupational groupings and thus allows selection of subsets of occupations within the main occupational groups, which show high severity ratings. However care must be taken in interpreting this data, as small groups with low numbers of cases (say less than 25) can show an high average severity ratings, which may really only be due to the contribution of 1 or 2 cases with very high ratings. Overall, however the review of this data confirms that the basic selection of priority areas (as analysed in detail in Section 3 of this report) are indeed reasonable.

2.6 Validation of the severity index and database

The detailed presentation of the statistical validation analyses of the severity index is given in Appendix 1, with the main conclusions presented below.

Correlation analysis showed each component of the index to independently describe different measures of severity with the total severity index to be most strongly related to the maim index component ahead of the hospital and days index components in that order. The total severity index showed good relationship to the relative severities of coded claimant afflictions. The relationship of the total index with maim type was less clear due to the small number of maim claims in the database.

Claim total cost showed strong relationship with all three index components with the days component being strongest followed by the hospital and maim component in that order.

This suggested the index gave much more weight to the maims and hospital components in reflecting total claim severity than did total cost. Some inconsistency was found in the severity index of occupations collapsed to make the new, broader occupation groups for analysis. This was attributed mainly to the small number of cases in some of these groups.

Overall these analyses confirmed the 'validity' of the index to identify "high severity" injury groups, with a bias towards the 'maims' and 'hospitalisation' components.

Future analyses and construction of a "severity index", can readily be modified to focus on other attributes of the injury spectrum, as is considered necessary.

3.0 RESULTS

37,561 work-related injuries and diseases were reported to the Victorian WorkCover Authority as **sustained** during the period 1.12.92 to 31.3.94 and claimed by July 1994.

The main focus of analysis has been on the **57%** of these claims associated with compensation for **lost time; 21,449** cases.

The drop in the overall number of claims for compensation to Worker and WorkCover since the late 1980's is considerable. However, a number of factors, such as increased self insurance, high unemployment rate and a drop in the reporting of injuries, have probably had an impact on these figures (Larsson, 1994b). Without venturing further into this territory we will, for the benefit of this report, assume that the observed number of **21,449** cases of lost time occupational injuries for the 16 months, truly represents the occupational injury problem in Victoria 1993/94 for those employees covered by WorkCover.

3.1 Exposure; Industries

The identification and selection of priority areas for injury prevention, ideally takes into account exposure and hence enables calculation of incidence and identification of high risk categories of activities/ occupations etc. Data on the two important elements in this regard were not able to be identified: the coverage of employees in Victoria for different occupation groups by the WorkCover compensation system; and secondly the number of employees covered in each occupational group. However some estimates were attempted for the latter category.

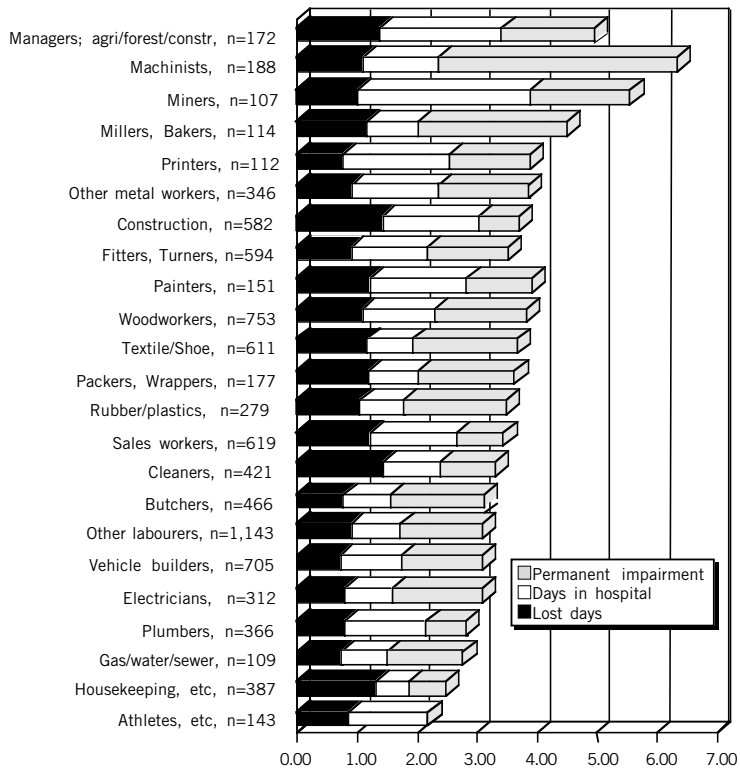
Since the occupational code used by the WorkCover Authority is the ABS occupational code of 1981, which is no longer in use in the census, comparisons on a reasonably detailed occupational level with contemporary census data is impossible. The following table represents the incidence of lost time injuries in the **industries** covered by the State workers' compensation system. We have based the estimate on total remuneration for establishments (WIC) in 1993, and tentatively let $32,000.- represent the average total remuneration per one full-time employed covered by the WorkCover Authority. Based on this, the average annual injury incidence in the covered area is **1.28%,** ie. around 13 workers in 1,000 sustain a lost time injury every year. There is considerable variation between industries, however:

Industry	n	LTI-Annual incidence; %
G52 Rail transport	285	4.78
G58 Storage	422	4.67
A03 Forestry & Logging	87	4.24
A04 Fishing & Hunting	34	3.71
G51 Road transport	1,251	3.50
C21 Food manufacturing	1.591	3.22
A01 Agriculture	587	3.17
G53 Water transport	20	3.15
C25 Wood manufacturing	582	2.92
A02 Service to agriculture	56	2.90
E41 General construction	1,188	2.89
E42 Trades; construction	1,122	2.74
C29 Metal manufacturing	193	2.31
C32 Vehicle manufacturing	868	2.30
K84 Other comm. services	1,270	2.25
C28 Non-metallic minerals	275	2.15
L91 Entertainment	633	2.00
B16 Services to mining	21	1.91
B12 Coal	42	1.90
K83 Welfare, religious	679	1.86
C31 Fabricated metals	546	1.85
B14 Construction materials	27	1.84
C23 Textiles manufacturing	267	1.61
D36 Electricity & Gas	280	1.49
C34 Misc. manufacturing	356	1.33
L92 Restaurants & Hotels	531	1.29
D37 Water, sewerage	55	1.24
G54 Air transport	75	1.22
C33 Other machine manufacturing	598	1.17
L93 Personal services	137	1.14
K81 Health	1,680	1.07
F48 Retail trade	1,586	1.04
F47 Wholesale trade	1,248	1.00
C27 Chemical manufacturing	214	0.97
G57 Services to transport	165	0.83
C24 Clothing & Footwear	141	0.74
J71 Public administration	296	0.71
C26 Paper, printing, publishing	271	0.68
K82 Education	822	0.53
I63 Business services	607	0.35
F46 Trade agencies	50	0.33
I61 Finance services	227	0.28
I62 Insurance services	33	0.10
Other industries	21	--
Unknown	10	--
Total sample	**21,449**	**1.28%**

3.2 Severity; Occupations

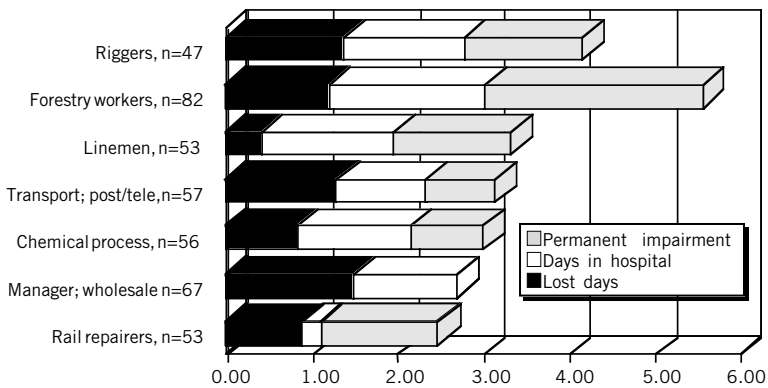
The occupational code was used to identify those groups of employees who suffered the highest average severity in terms of lost time, days in hospital and indicated permanent impairment associated with injury.

Among the lost time injuries sustained in the 16 months period under study, in the first priority run, those scoring at least 25% above average on one or more individual severity indicators were identified (the average severity for each indicator =1, with the total average =3):



Severity; occupations; lost time injuries 1.12.92 - 31.3.94
(>100 cases per Occupation group)

In the graph above, only occupational groups exhibiting more than 100 cases in the material were included. Occupational groups, similarly identified, but with between 35 and 100 cases are shown in the following graph:



Severity; occupations; lost time injuries 1.12.92 - 31.3.94
(small groups, 35-100 cases)

From the diagrams above, the 11 occupational groups (listed below) with two or more severity indicators above 25% of average, were picked out for further analysis

Group 1	**Managers; agriculture/forestry/mining, etc**	**n=172**
Group 2	**Machinists**	**n=188**
Group 3	**Millers, Bakers**	**n=106**
Group 4	**Printers**	**n=112**
Group 5	**Other Metal Workers**	**n=346**
Group 6	**Construction Workers**	**n=582**
Group 7	**Fitters, Turners**	**n=594**
Group 8	**Riggers, etc**	**n=47**
Group 9	**Miners**	**n=95**
Group 10	**Forestry Workers**	**n=82**
Group 11	**Linemen, etc.**	**n=53**
		N=2377

In this selection, priority was given to high scores on individual severity indicators, rather than a compounded total high score. Groups like **Painters, Woodworkers, Textile/Shoe Workers, Packers, Wrappers, Rubber/Plastics Workers, Sales Workers, Cleaners, Butchers, Vehicle builders and Electricians** also represents above average injury severity, which would warrant further investigation and motivate applied prevention activities. This report, however, has limited further analysis to the eleven occupational groups mentioned.

3.3 Analysis of high severity occupational groups

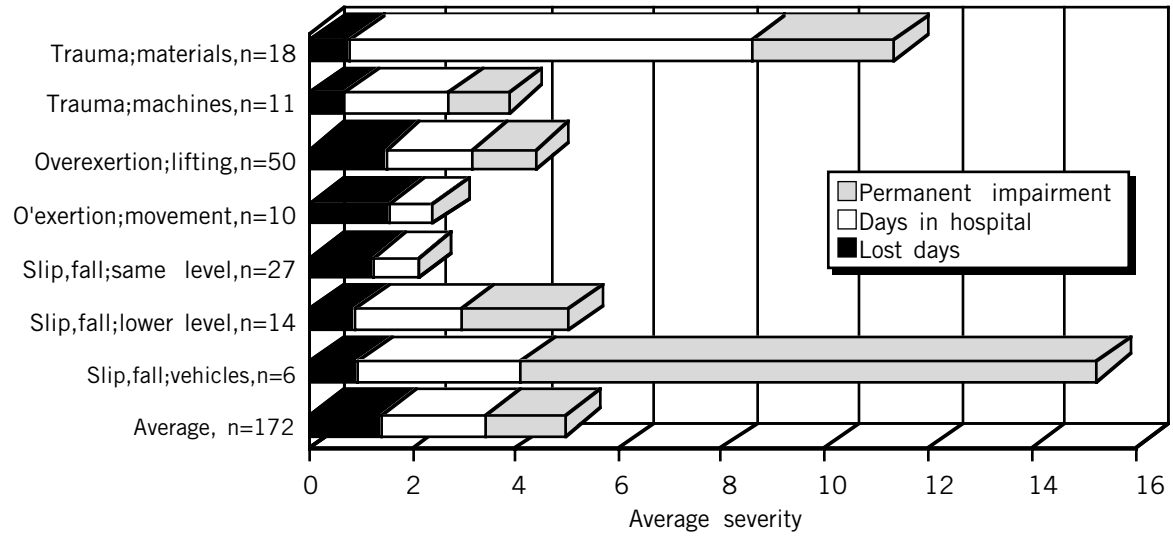
The above 11 occupational groups (n=2377), identified as having higher than average injury severity index ratings, were analysed in more detail as regards mechanism, affliction, and bodily location. For each of these occupational groups, a printout of each case was obtained with the following variables:

- Observation no; Industry; Claim description; Incident text;
- Accident text; Affliction text; Bodily location text;
- WIC code; Affliction & code; sex; bodily location code; agency of injury and the severity index by each component- days, maims, hospital, total.

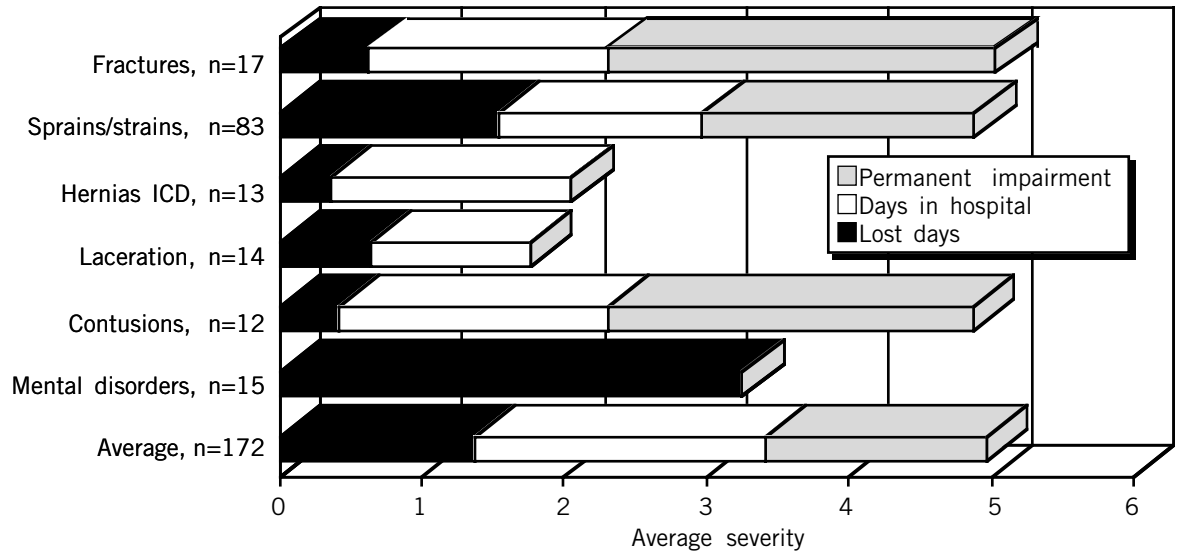
This information was reviewed manually and for each case a 'mechanism' type variable was allocated. This variable was then added to the data base for the cases in each of the selected occupational groups, and additional analyses carried out to highlight high severity index values within each occupational group, in terms of mechanism; types of afflictions and bodily location. The objective of these analyses is to more closely identify particular priority areas within each of the selected occupational groups.

The mechanism categories were general, except that in certain cases peculiar to that particular occupation (eg sport, or hit by animal). The proforma used for this screening of mechanism is given in Appendix 4.

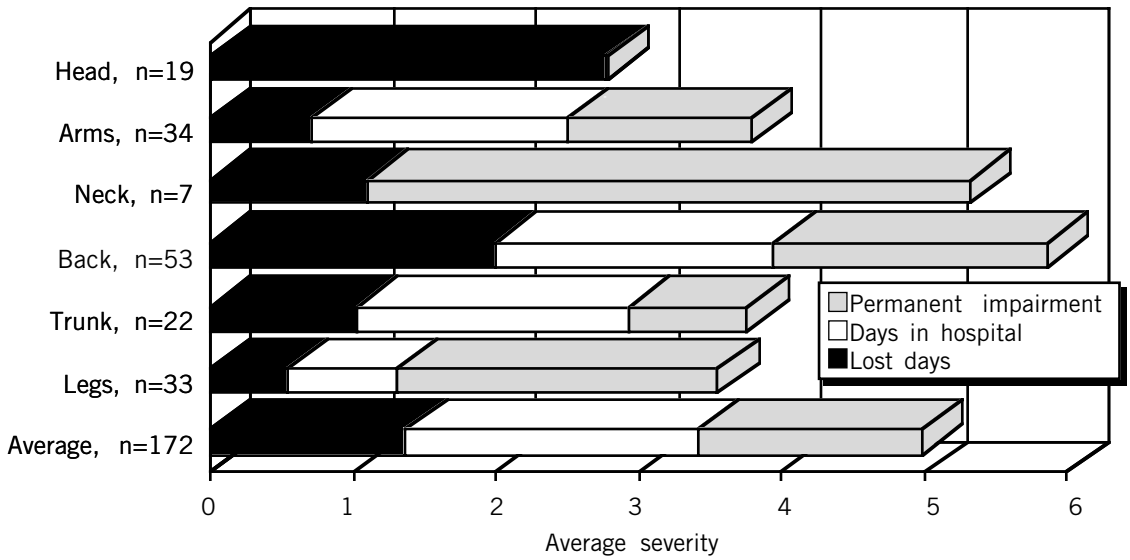
Executive managers (n=172); Types of accident mechanisms associated with lost time injuries 1.12.92 - 31.3.94 and average severity.
(79% of LTI for the occupational groups during the period)



Executive managers; Types of afflictions; (90% of LTI for the occupational groups during the period)



Executive managers; Body location; (98% of LTI for the occupational groups during the period)



(i) Group 1. 'Executive Managers' (n=172)

This group comprises Occupational Groups 110, defined as Executive Managers Agriculture, Forestry Mining, etc and seem to be characterised by personnel who also do the physical work- rather than being simply managers/ administrators at a desk.

The severity index (SI)[1] for this group had a "four star*" rating in terms of being above average for each index component:

Lost days index	Maims index	Hospital days index	Total index
1.38*	1.55*	2.04*	4.98*

The distribution of SI by mechanism; by affliction; and by body location are shown in Graphs a, b, c, opposite.

For "**mechanism**", a high severity rating (SI=11) was for '**traumatic contacts with materials, substances**' (n=18), with days in hospital being the major component. Of these cases 6 involved traumatic contact with materials and 7 involved dropping tools or materials on oneself. Some examples of incidents are:

- "lifting sign off back of ute turned too quickly jammed finger (severed tendons and nerves)"
- "crushed thumb between concrete pipe"
- "hit by falling yarn basket"
- "machine guard fell on head while using folding machine"

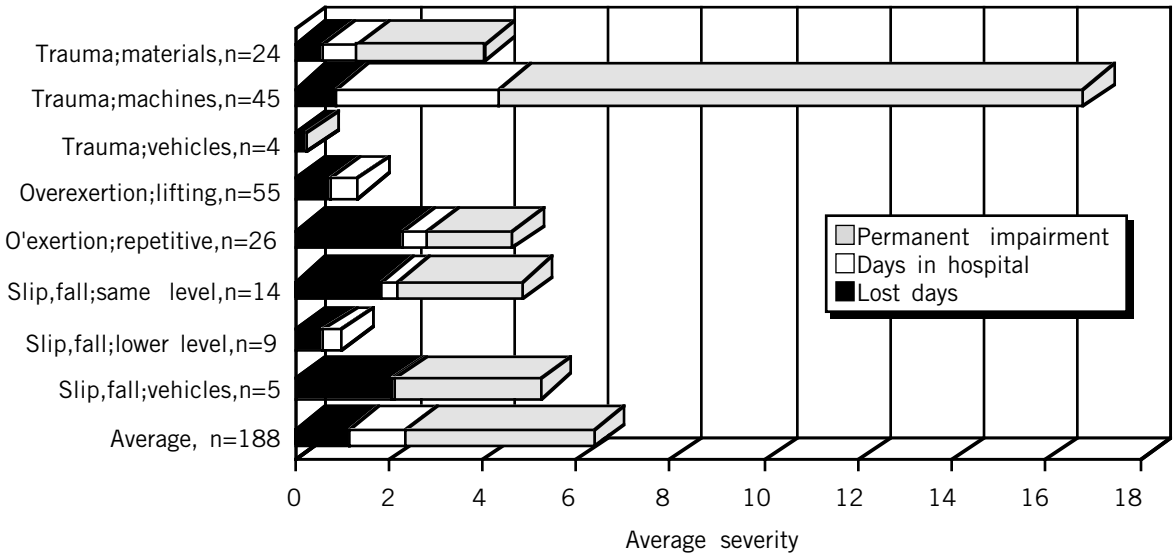
Slips and falls from vehicles (n=6) had a high SI, with permanent impairment being the main component. Some examples are:

- "fell entering Econ. hopper"
- "tractor and worker fell from transporting vehicle to ground; multiple fractures"
- "climbing off rail wagon, strained back"

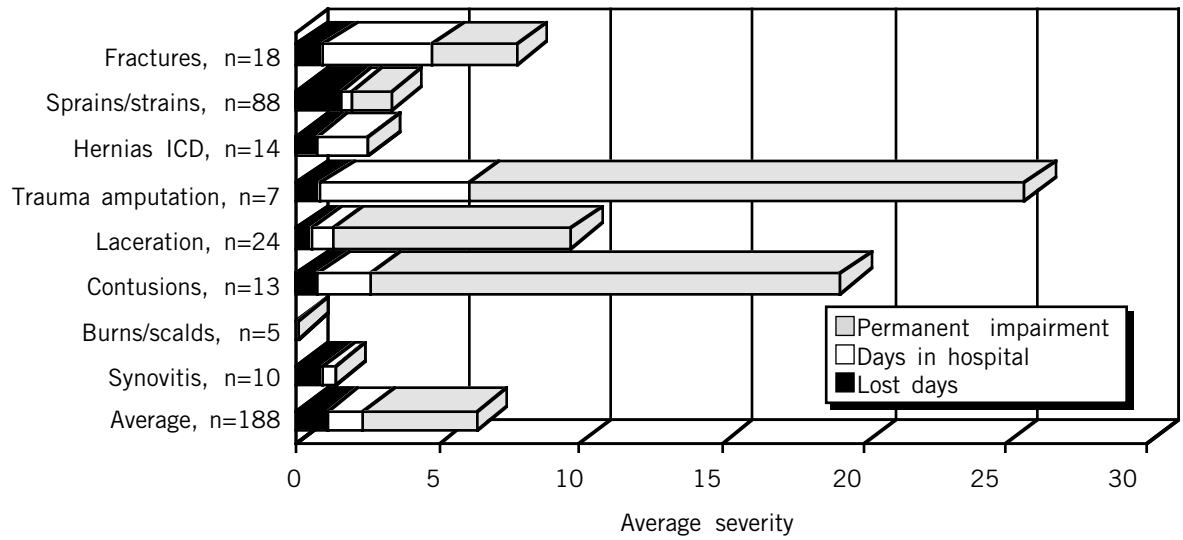
Overall '**Overexertion**' **(lifting, pulling, pushing etc)** comprised 50 cases and **slips, trips and falls** comprised 47 cases. Although about half the cases (83) are strains and sprains, the 61 consist of fractures, hernias, lacerations, contusions and notably 15 cases of "mental disorder".

[1]The average severity index, normalised =1 for each of the three components of lost days, maims, hospital days. The total average index, therefore, =3.

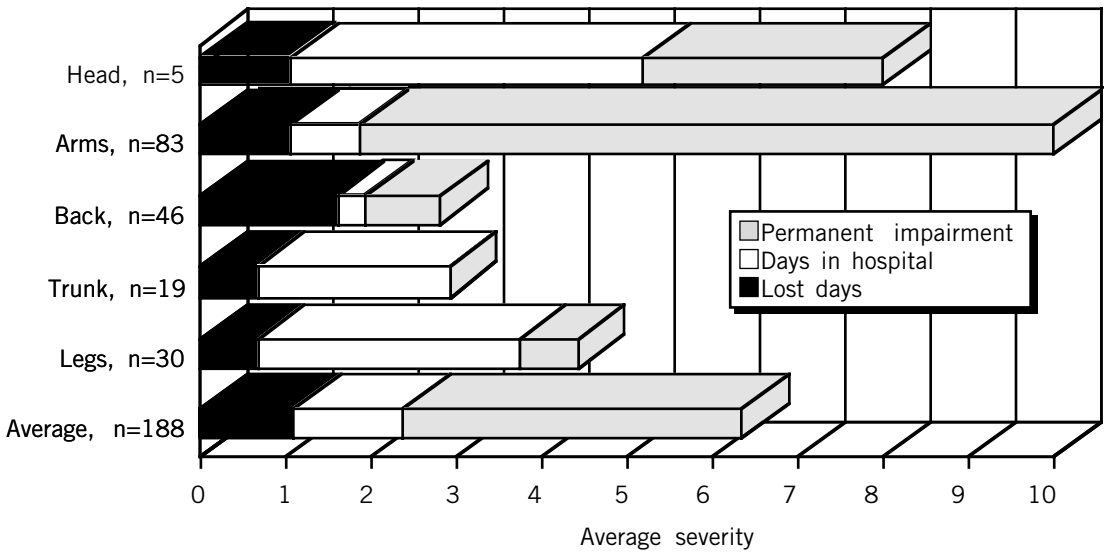
Machinists (n=188); Types of accident mechanisms associated with lost time injuries 1.12.92 - 31.3.94 and average severity.
(97% of LTI for the occupational groups during the period)



Machinists (n=188); Types of afflictions; (95% of LTI for the occupational groups during the period)



Machinists (n=188); Body location; (97% of LTI for the occupational groups during the period)



(ii) Group 2 'Machinists' (n=188)

This group comprises Occupational Groups 747, defined as "Machinists"; and has a "three star*" severity index rating, recording a high average maim index rating of 3.98.

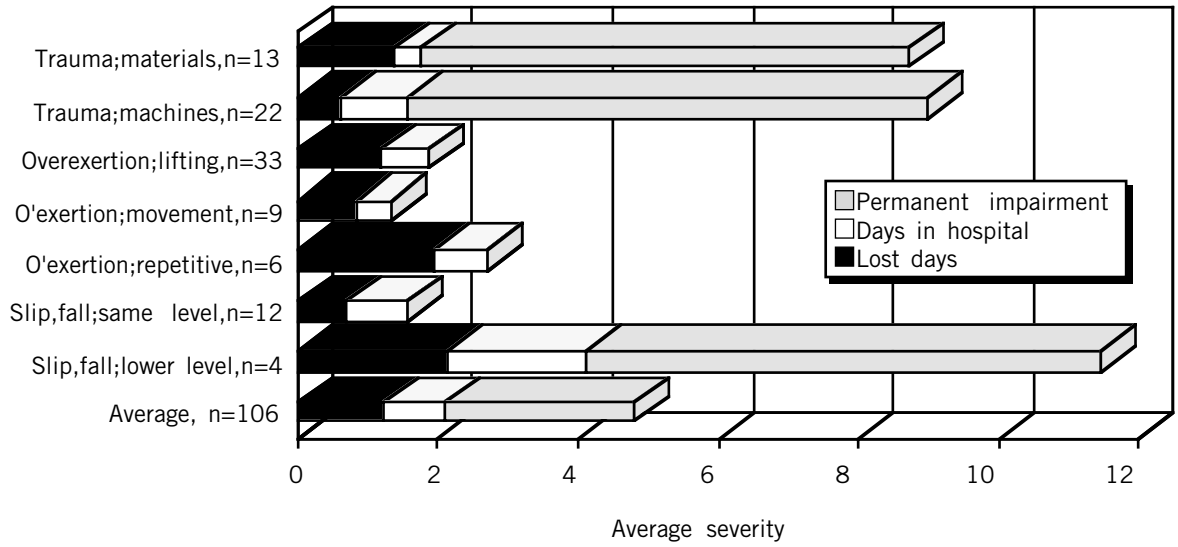
Lost days index	Maims index	Hospital days index	Total index
1.11	3.98*	1.26*	6.35*

The distribution of SI by mechanism; by types of affliction; and by body location are shown in Graphs a, b, c, opposite.

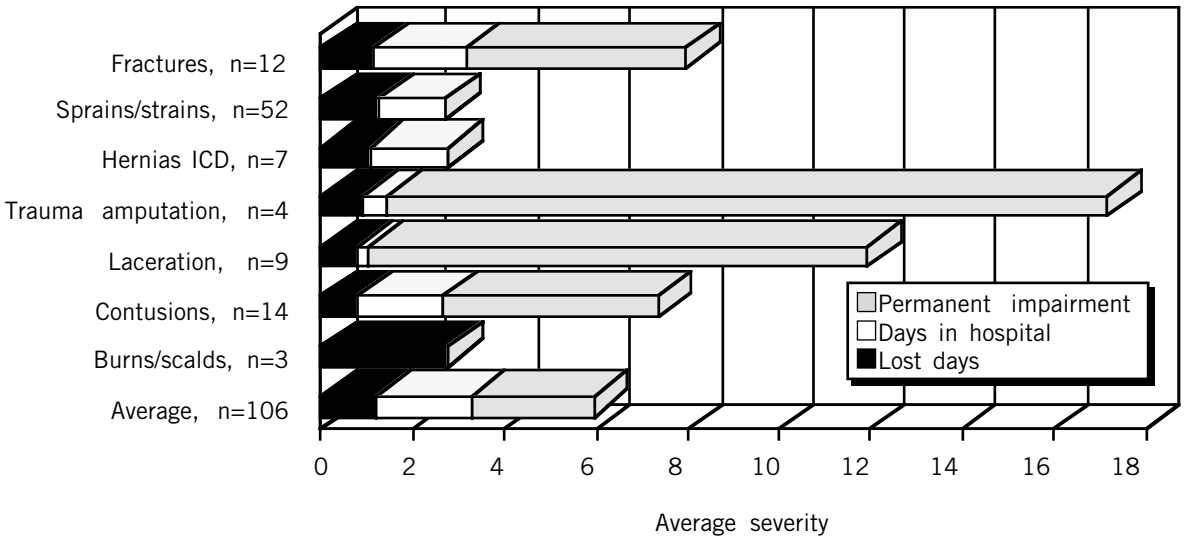
For "**mechanism**", the most significant factor is **traumatic injury related to machines and power tools,** with an SI = 16 over an average of 45 cases. This relates to a high SI for 7 cases of **traumatic amputation**; 24 cases of **lacerations** and 13 cases of **contusions;** with each category having high components of permanent impairment. Examination of the Accident description for these cases provides the following examples:

- 'cut fingers when put hand into machine to pull paper through'
- 'left foot caught in machine while clearing blockage-amputated 4 toes, broken foot and ankle'
- 'caught right hand in spinning machine'
- 'hand caught in machine'
- 'fingers caught in machine while changing card band'

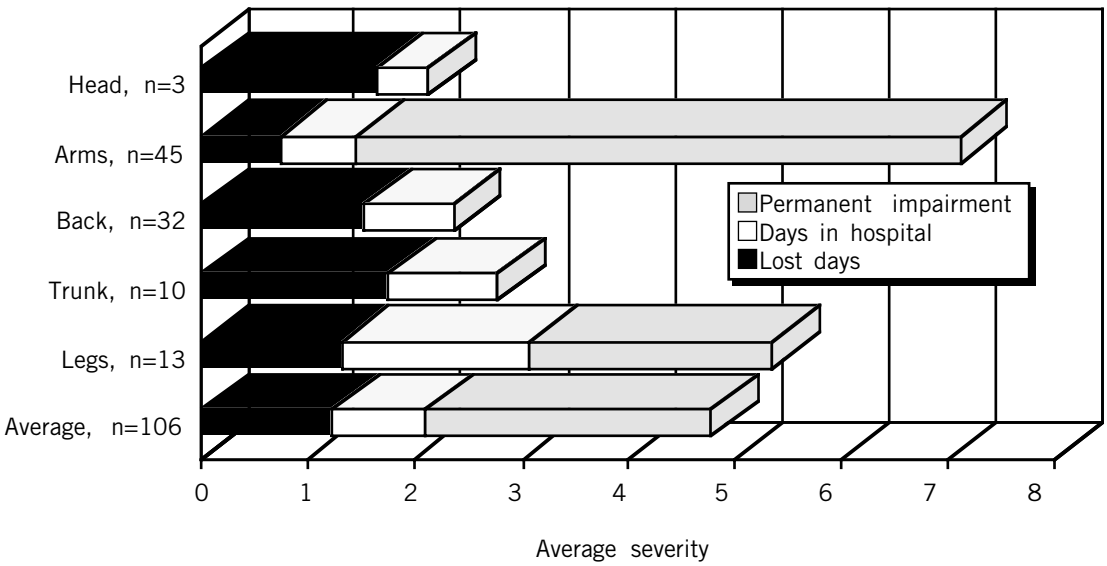
Millers, Bakers (n=106); Types of accident mechanisms associated with lost time injuries 1.12.92 - 31.3.94 and average severity.
(93% of LTI for the occupational groups during the period)



Millers, Bakers (n=106); Types of afflictions; (95% of LTI for the occupational groups during the period)



Millers, Bakers (n=106); Body location; (97% of LTI for the occupational groups during the period)



(iii) Group 3 'Millers, Bakers' (n=106)

This group comprises Occupational Groups 699, 700, 701, defined as "Millers- grain and related products; bakers, pastrycooks, confectionary makers"; and has a "two star*" severity index rating, recording a high average maim index rating and overall rating.

Lost days index	Maims index	Hospital days index	Total index
1.17	2.49*	0.85*	4.51*

The distribution of SI by mechanism; by types of affliction; and by body location are shown in graphs a, b, c, opposite.

The most severe rating is evident for **traumatic contacts with materials, substances/burns (n=13)** and **machines, power tools (n=22),** with associated fractures, amputations and lacerations and contusions showing high severity ratings.

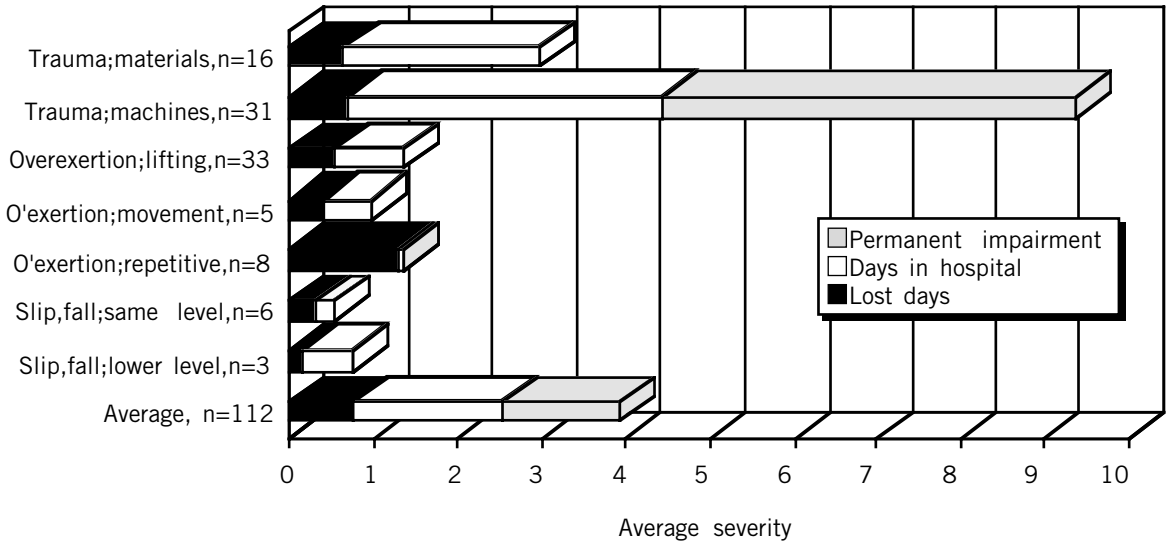
Some case examples are:

- 'caught finger in machine'
- 'crush injury when finger caught in bread machine'
- 'friction burn hand -caught in belt'

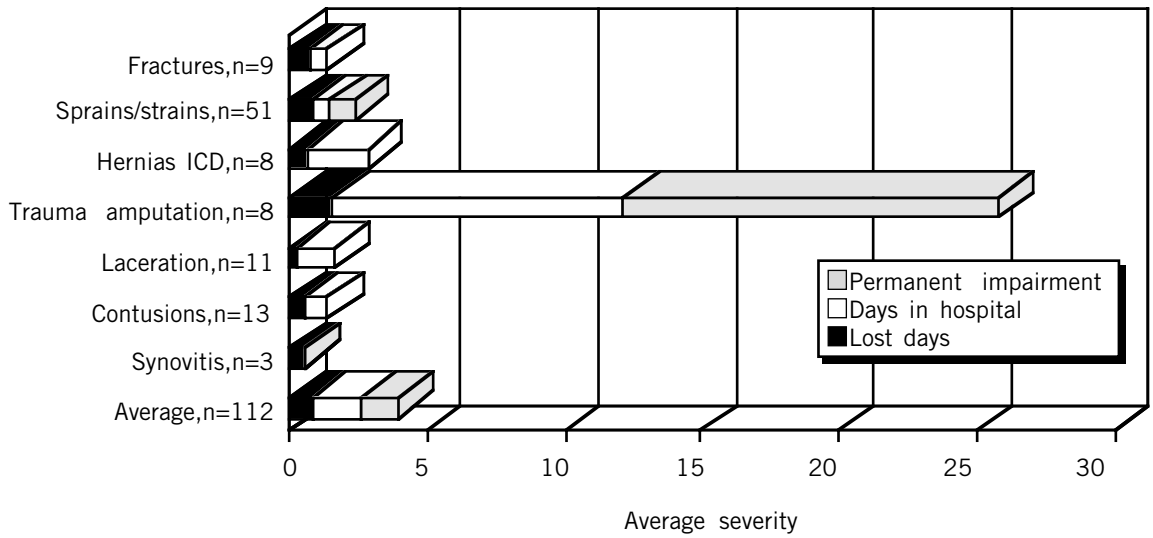
A small number of cases of **slip, trip, fall to lower level** (n=4) also showed a high SI, and these related to falling from ladders or stairs.

Approximately 50% of the cases (n=52) related to **sprains and strains** associated with **overexertion** (lifting, pushing, pulling) and movement, and hernias (n=7).

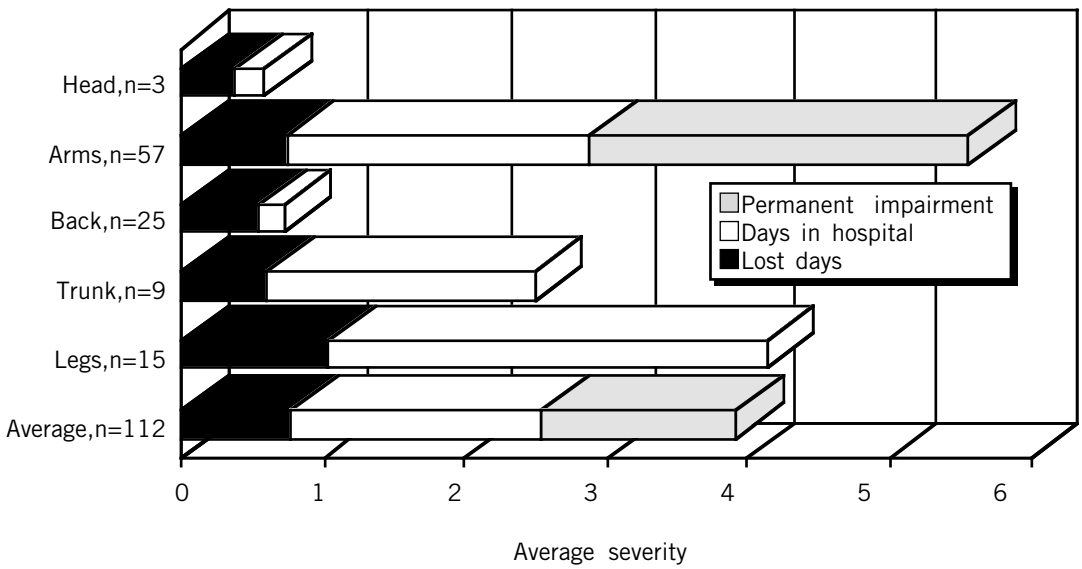
Printers (n=112); Types of accident mechanisms associated with lost time injuries 1.12.92 - 31.3.94 and average severity.
(91% of LTI for the occupational groups during the period)



Printers (n=112); Types of afflictions; (92% of LTI for the occupational groups during the period)



Printers (n=112); Body location; (97% of LTI for the occupational groups during the period)



(iv) Group 4. 'Printers' (n=112)

This group comprises Occupational Groups 687-692, 715, defined as "compositors, type setters, printers, photographic printers & developers etc"; and has a "two star*" severity index rating, recording high average maim and hospital index ratings.

Lost days index	Maims index	Hospital days index	Total index
0.78	1.36*	1.77*	3.91

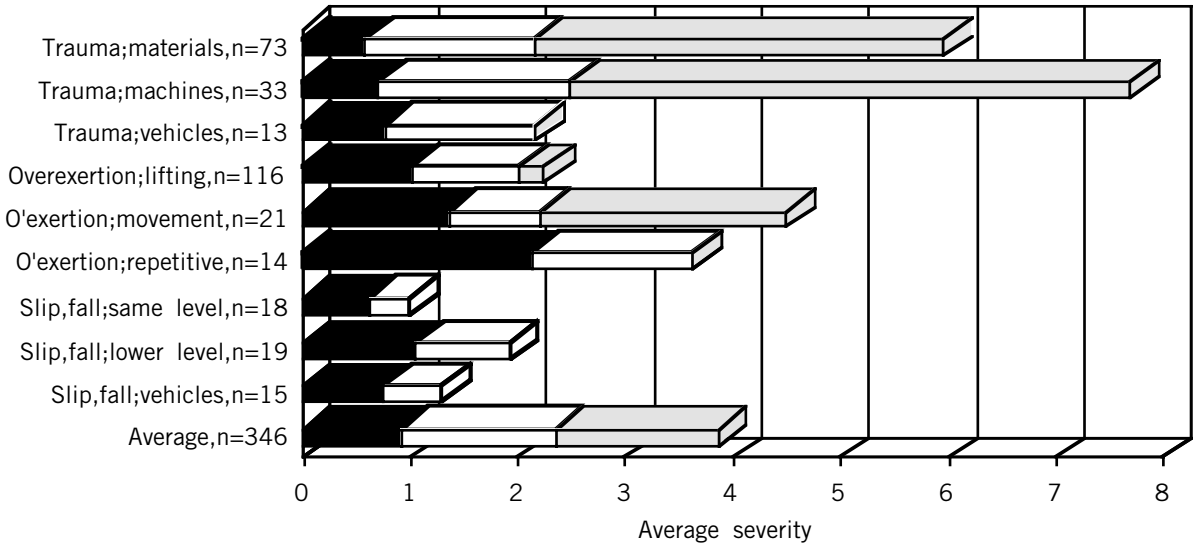
The distribution of SI by mechanism; by types of affliction; and by body location are shown in Graphs a, b, c, opposite.

The most conspicuous high severity mechanism relates to **traumatic contact with machines** (n=31), with high levels of **'hospital days'** and **'permanent impairment'.**

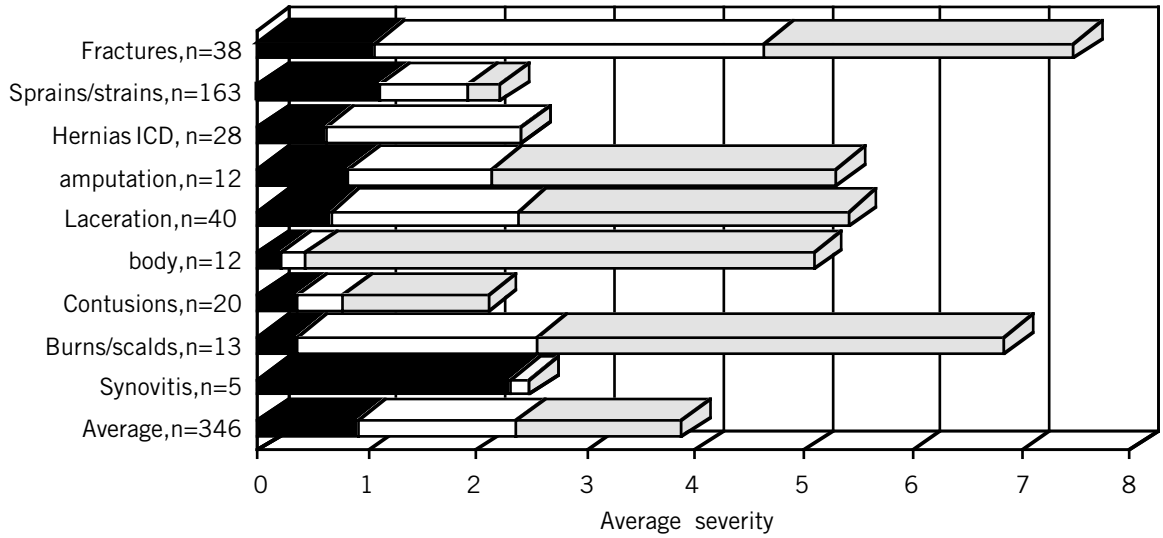
An examination of the cases for this group provides the following examples of injury mechanism:

- 'amputation of right arm-hand caught in printing machine'
- 'arm wrenched due to hand being caught in printing press'
- 'fingers caught in rollers of machine'
- 'cleaning printing machine-slipped hand went into printer, amputated finger'

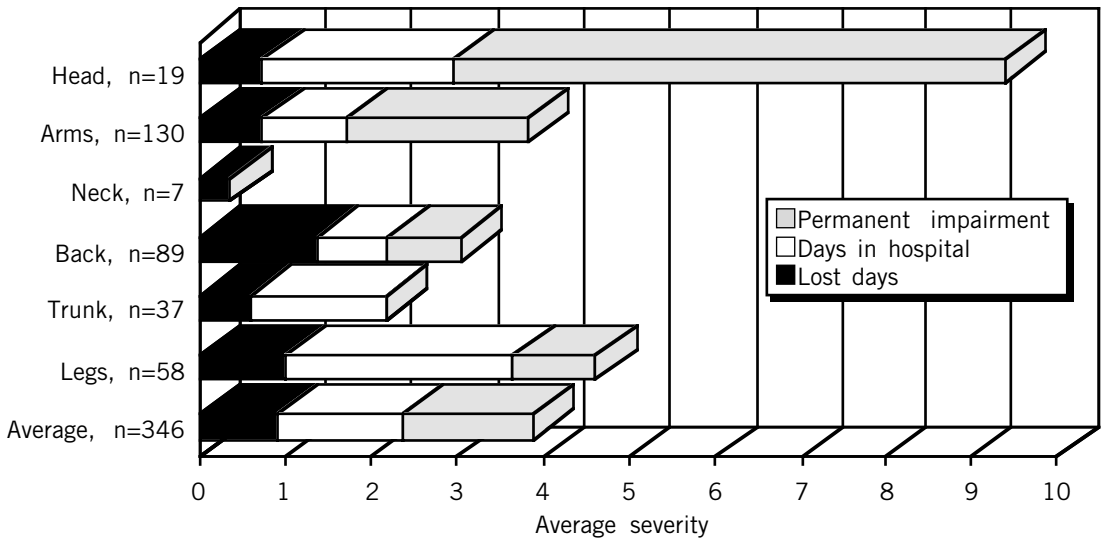
Other metal workers (n=346); Types of accident mechanisms associated with lost time injuries 1.12.92 - 31.3.94 and average severity.
(93% of LTI for the occupational groups during the period)



Other metal workers; Types of afflictions; (96% of LTI for the occupational groups during the period)



Other metal workers; Body location; (98% of LTI for the occupational groups during the period)



(v) Group 5 "Other Metal Workers" (n=346)

This group comprises Occupational Groups 645-649, defined as "electroplaters, engineers-not professional, mechanics, servicemen, metalworkers nec, etc "; and has a "two star*" severity index rating, recording high average maim and hospital index ratings.

Lost days index	Maims index	Hospital days index	Total index
0.91	1.52*	1.45*	3.88

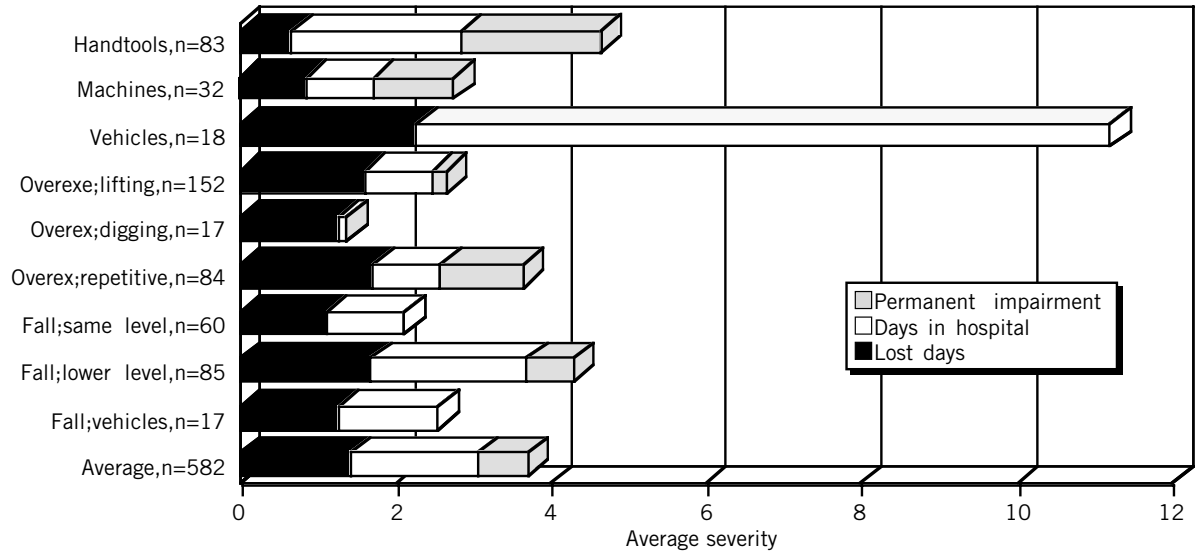
The distribution of SI by mechanism; by types of affliction; and by body location are shown in Graphs a, b, c, opposite

High severity ratings are indicated for **traumatic contact with materials etc (n=73)**-comprising of **contact with materials** (n=27), **handtools** (n=12), **substances /burns/ chemicals** (n=21) **and items dropped onto limbs etc** (n=13); and **traumatic contacts with machines, power tools (n=33)**. The corresponding injuries showing high severity ratings are: fractures (n=38), traumatic amputations (n=12), lacerations (n=40), foreign body (n=12) and burns and scalds (n=13).

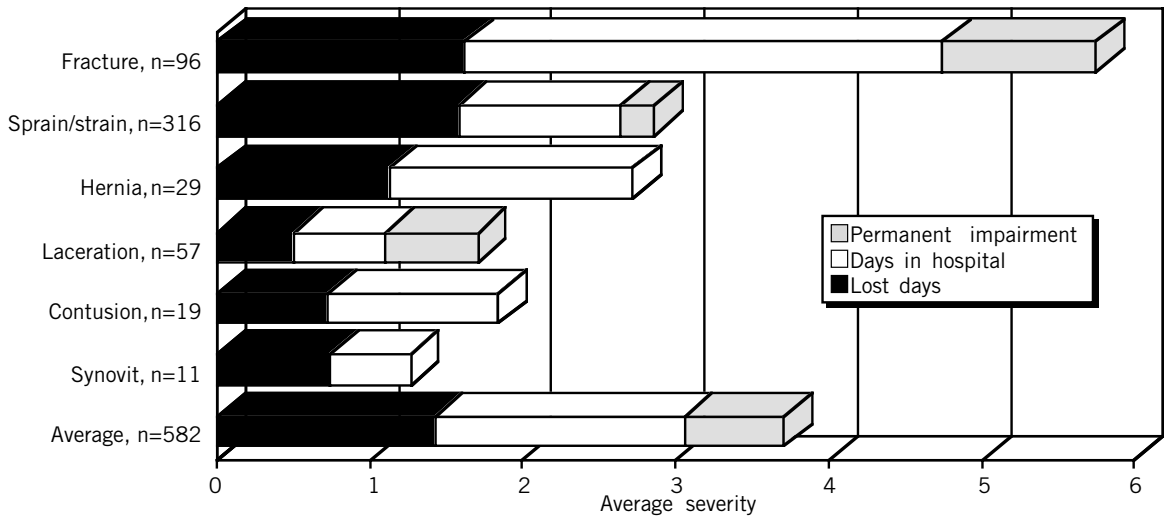
Examples from the accident reports regarding traumatic contact are:

- 'hand caught between gear box and chain of machine in operation-fractured fingers'
- 'clothing caught in saw and was pulled into saw -severe facial injuries'
- 'caught in electric hand drill -fractured right thumb'
- 'workshop explosion and fire whilst welding-burns to arms, legs, head, torso'
- 'burnt right ankle whilst operating casting machine in meltshop'
- 'struck by falling object-grinding machine, lacerations and fractures to shoulder'
- 'a set of rollers fell on ring finger'

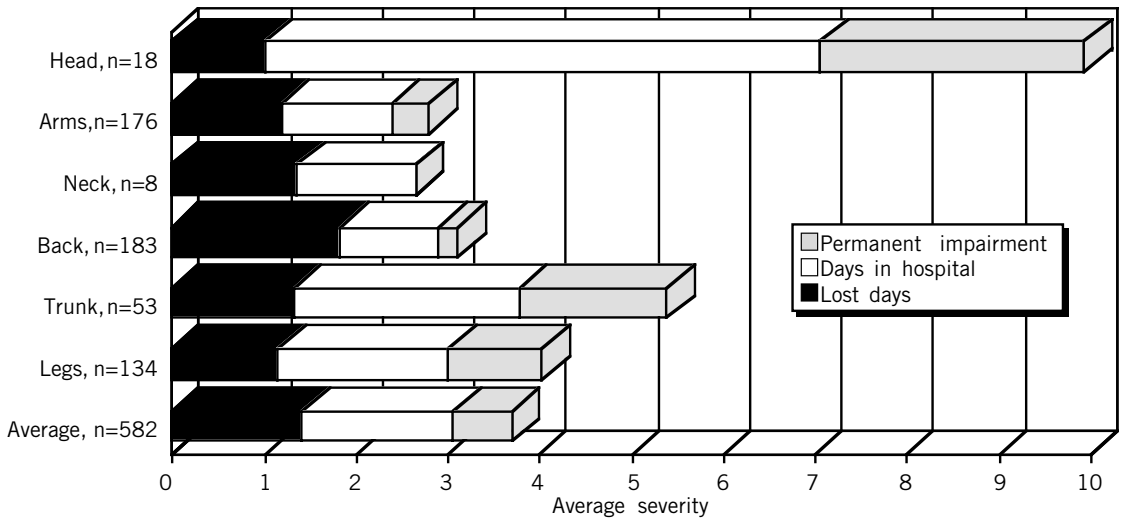
Construction workers (n=582); Types of accident mechanisms associated with lost time injuries 1.12.92 - 31.3.94 and average severity.
(94% of LTI for the occupational groups during the period)



Construction workers (n=582); Types of afflictions; (90% of LTI for the occupational groups during the period)



Construction workers (n=582); Body location; (98% of LTI for the occupational groups during the period)



(vi) Group 6: Construction Workers, n=582

A number of occupational titles were merged into the conglomerate of "Construction Workers", ie. Bricklayers, Plasterers, Concrete and Terrazzo Workers, Glaziers, Tilers, Foremen (building and construction), Building Tradesmen's Assistants, Building and Construction Workers, and Labourers (building and construction). This group has a "two star*" severity index rating, recording high average lost days and hospital index ratings.

Lost days index	Maims index	Hospital days index	Total index
1.42*	0.66*	1.63*	3.71

There were 582 lost time injuries for this occupational group in the material. Inspection of the information in the free text fields on these cases resulted in the following distribution over accident mechanism and severity, as shown Graphs a, b, c, opposite.

Three aspects of the exposure of Construction Workers stand out as particularly severe;

- **Falls to lower level**

- **Traumatic contacts with handtools, materials, substances, etc.,**

- **Traumatic contacts with vehicles, etc.**

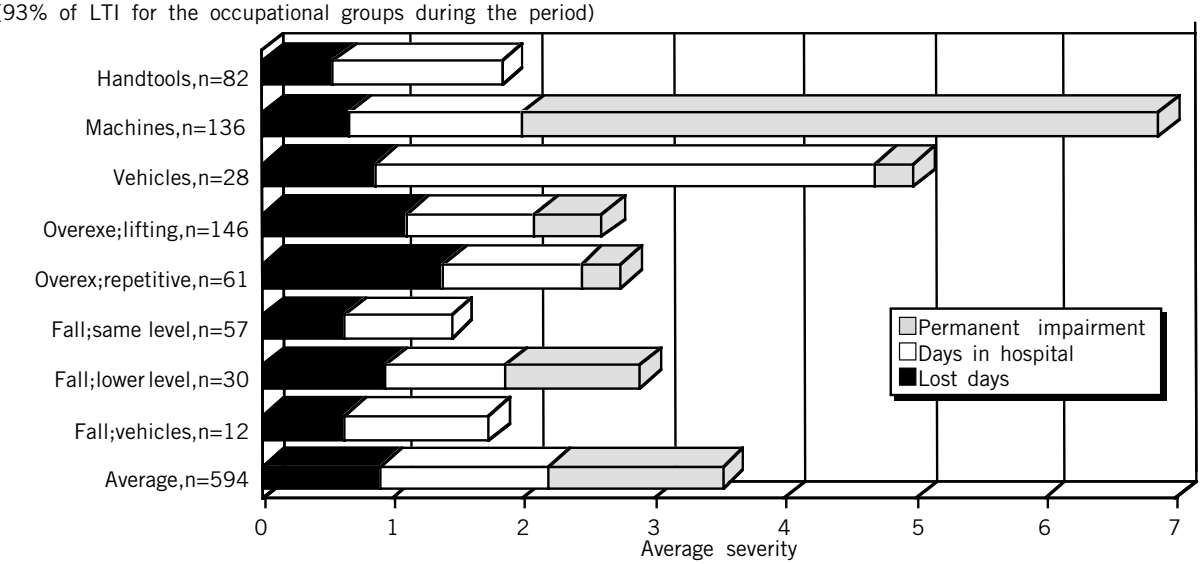
Looking more closely at the **falls to lower level** (n=85), these were to a large extent made up of falls from **roof or frame** (n=20), falls from **ladders** (n=23) and falls from, or collapse of, **scaffolding** (n=21). There were also some cases of falls into **trench, hole or pit** (n=8) and falls from **steps, stairways** (n=4). There were a further variety of falls, mostly from structures or implements used to stand or climb on when working ("edge of bath", "chair", "bin").

Fifty percent of these injuries are **fractures,** which explains the high average severity.

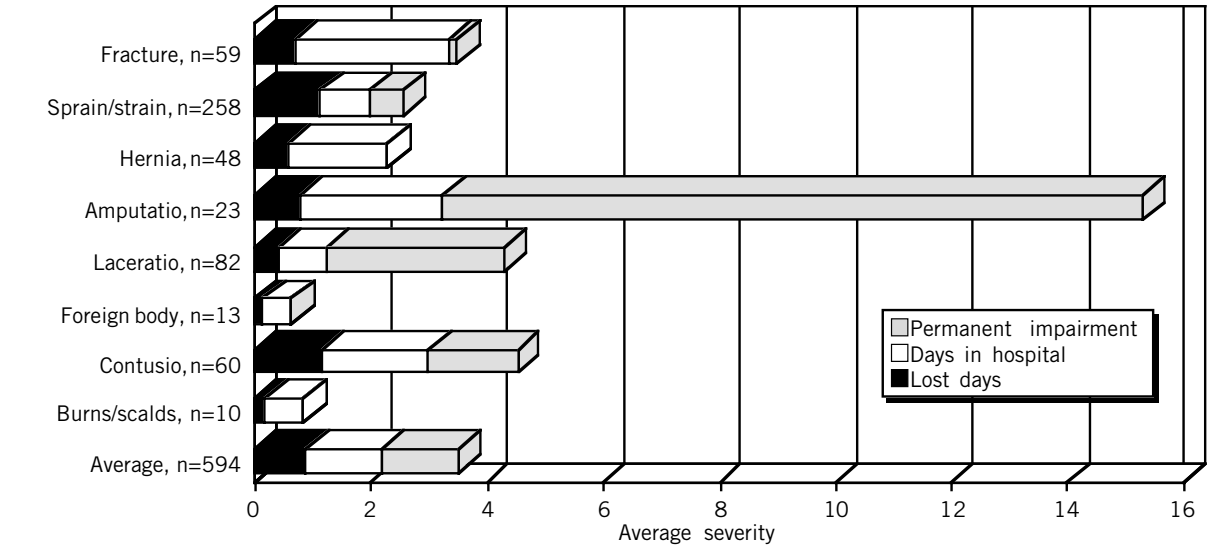
A closer look at the **traumatic contacts with handtools, materials, substances,** etc (n=83) reveals accidents like **dropping tool or material on oneself** (n=9), **striking against structure,** etc (n=11), **jammed, pinched, crushed by tool or material** (n=7), **fragment or substance in eye** (n=10), **cut by glass** (n=13), **cut by other sharp object** (n=9), **material or structure falling on worker** (n=19), **hit by tool, implement, material** (n=4), and **stepping on** (n=1). Thirty five percent of these injuries are lacerations, 29% are fractures.

Of the **traumatic contacts with vehicles,** etc (n=18), there were **car accidents** (n=3), **hit by truck** (n=3), **hit by forklift truck** (n=2), **run over by bitumen sprayer** (n=1), **crushed between vehicle and implement/structure** (n=4), and **caught in/crushed by crane, elevator** (n=2). The others were "injured finger on grader blade on rear of tractor", "strained shoulder working on the back of truck", and "glass trolley ran over foot".

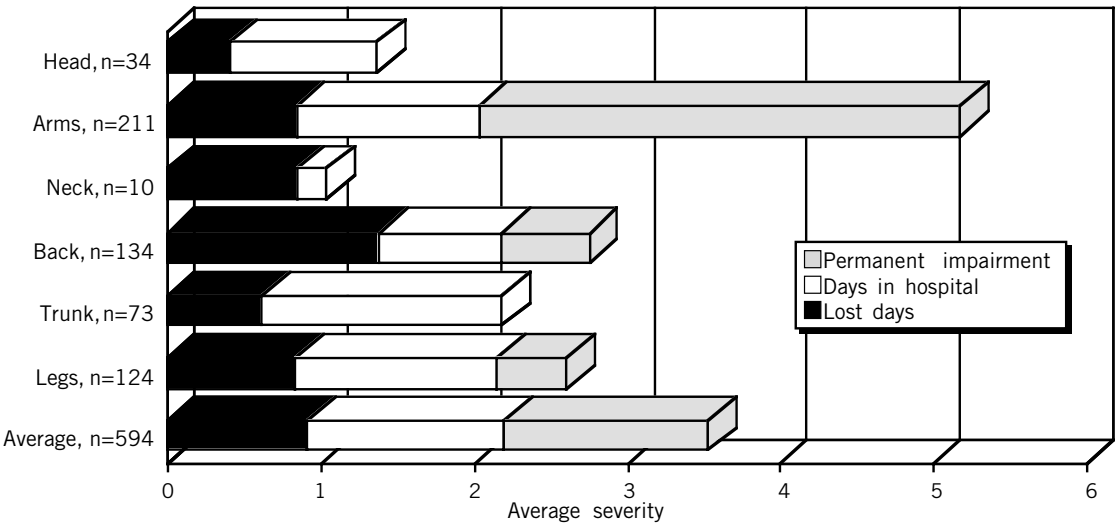
Fitters & Turners (n=594); Types of accident mechanisms associated with lost time injuries 1.12.92 - 31.3.94 and average severity.
(93% of LTI for the occupational groups during the period)



Fitters & Turners (n=594); Types of afflictions; (93% of LTI for the occupational groups during the period)



Fitters & Turners (n=594); Body location; (99% of LTI for the occupational groups during the period)



Some of these injuries were very severe, particularly in requiring extended periods of hospitalisation.

Head injuries indicated a high average severity in the diagram above. It is important to point out, however, that due to the small number, one extremely severe injury, where a worker was hit by a chain in the face resulting in multiple fractures, explains most of this. Half of the injuries under this heading were made up of "foreign body in eye", with an average total severity of 2.05, well under the total severity average of 3.

(vii) Group 7: Fitters & Turners, n=594

The occupational titles of Metal Fitter, Fitter and Turner, Machine Toolmaker, Metal Diemaker, Metal Machine Tool Setter and Operator, and Metal Machinist were merged into one occupational group, here called "Fitters & Turners". This group has a "two star*" severity index rating, recording high average maims and hospital index ratings.

Lost days index	Maims index	Hospital days index	Total index
0.91	1.34*	1.28*	3.52

There were 594 lost time injuries for this occupational group in the 16 months under study. The free text descriptions of these cases yielded the following information as shown on Graphs a, b, c, opposite.

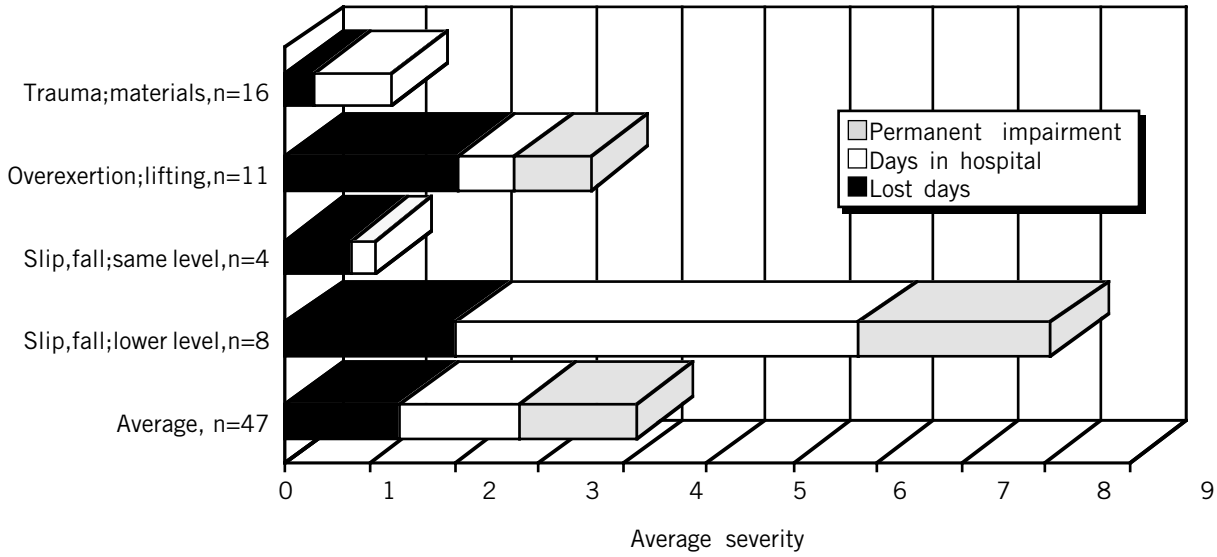
There is a dominance of injuries sustained as a result of **traumatic contact with machines or powered tools** (n=136). Smaller in numbers, but with high severity, particularly in requiring extended periods of hospitalisation, the **traumatic contacts with vehicles, cranes, conveyors, etc** (n=28) are also significant. Following logically from this, **amputations, fractures, lacerations** and **contusions** are the main afflictions with above average severity, and the **upper extremities** the body parts sustaining the main proportion of the severe and permanently impairing injuries.

A more detailed look at the **traumatic contacts with machines and powered tools** (n=136) reveal a great variety of machines involved; **lathe** (n=13), **power press** (n=12), **sawing machine** (n=11), **grinding machine** (n=6), **drilling machine** (n=6), **wrapping, heat-moulding machine** (n=5), **textile machine** (n=4), and more than 15 other specified machines.

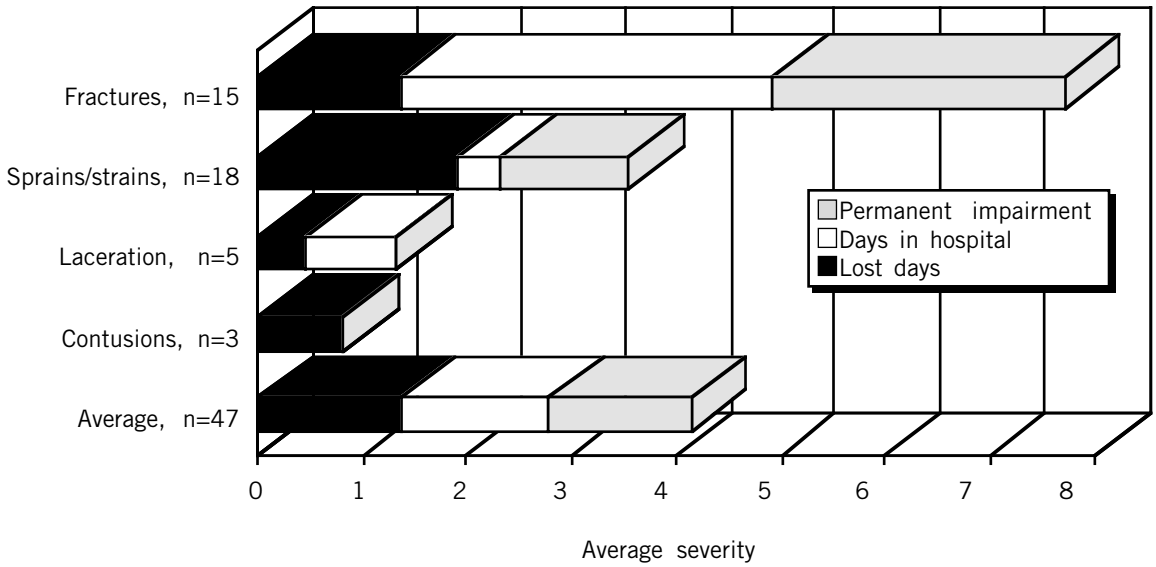
In addition to this there were **compressors/pumps/pressurised equipment** and **motors** (n=19), **welding equipment** (n=3), and, among the handheld equipment, **angle grinder** (n=8), **power drill** (n=3) and **chainsaw** (n=1). About 15% of these injury descriptions did not specify type of machine.

A closer look among the **traumatic contacts with vehicles, etc.** (n=28) show that **forklift** (n=7), **car** (n=5) and **conveyor, hoist, lift** (n=7) were the most prominent. There were also a number of **trolleys, etc.** (n=4), **railway carriages** (n=3) and **backhoes** (n=2) involved.

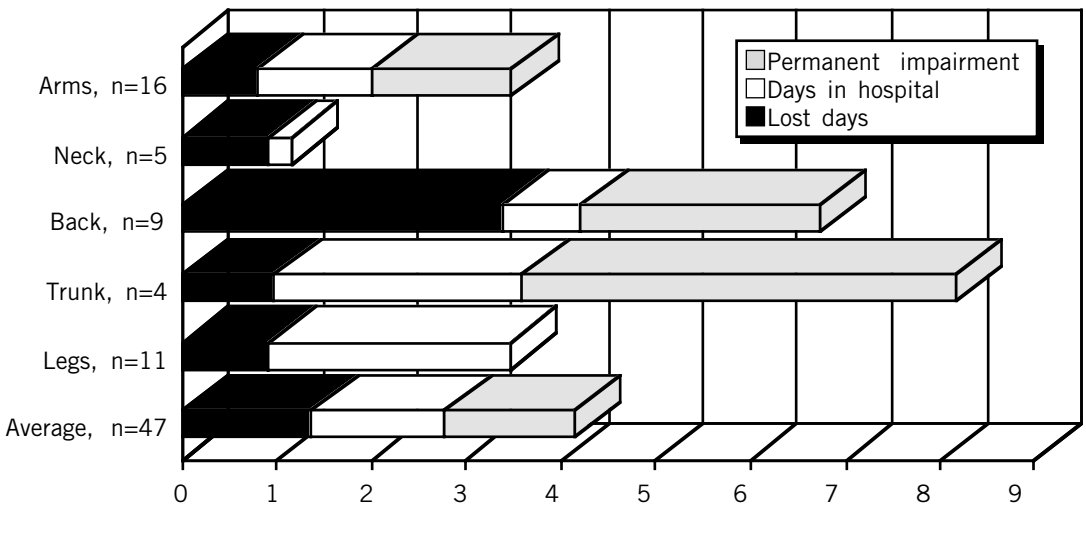
Riggers (n=47); Types of accident mechanisms associated with lost time injuries 1.12.92 - 31.3.94 and average severity.
(83% of LTI for the occupational groups during the period)



Riggers (n=47); Types of afflictions; (87% of LTI for the occupational groups during the period)



Riggers (n=47); Body location; (96% of LTI for the occupational groups during the period)



(viii) Group 8 "Riggers" (n=47)

This group comprises Occupational Groups 724, defined as "riggers & cable splicers"; and has a "four star*" severity index rating.

Lost days index	Maims index	Hospital days index	Total index
1.37*	1.37*	1.41*	4.15

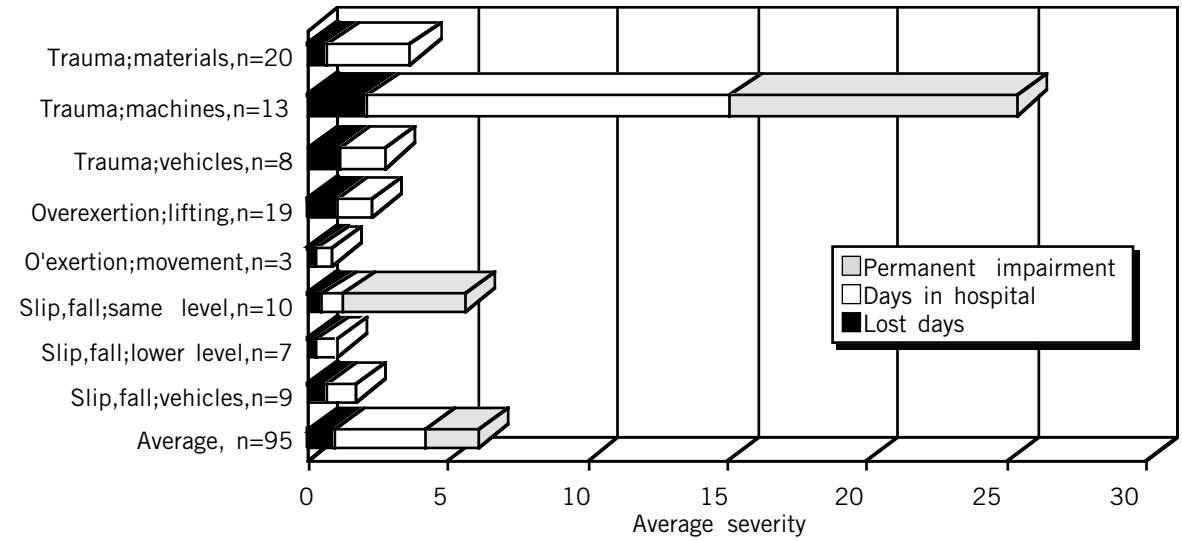
The distribution of SI by mechanism; by types of affliction; and by body location are shown in Graphs a, b, c, opposite.

High severity rating was for **overexertion** (n=11), and **slip, trips and falls to a lower level** (n=8).; with **fractures** (n=15) associated with the highest rating.

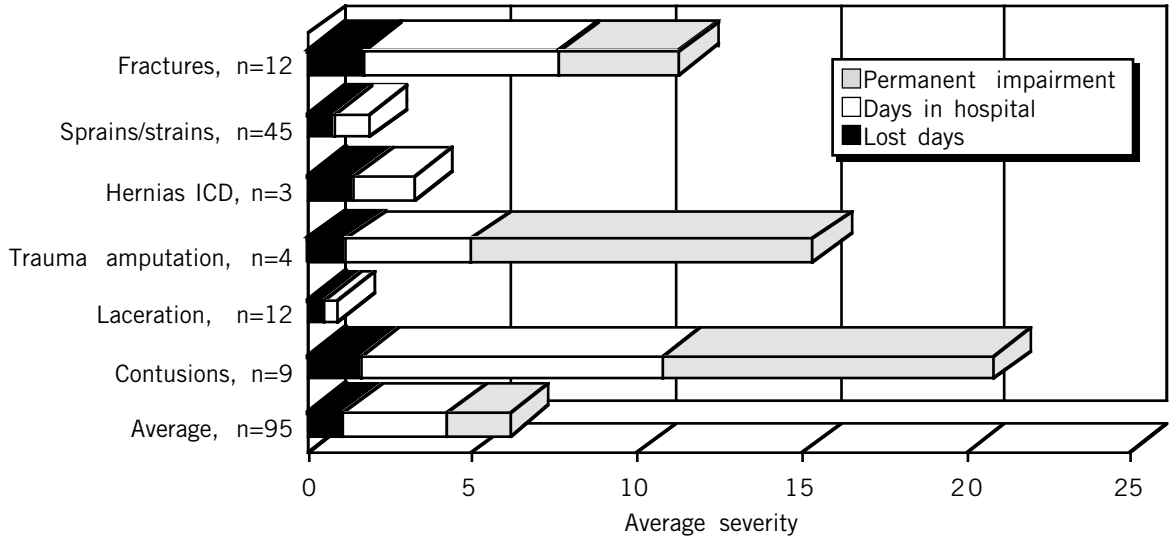
Examples from the accident text are:

- 'fell from temporary work platform whilst dismantling'
- 'standing on a cleat on a column, I slipped and fell'
- 'slipped on ladder, lost balance, fell and fractured both ankles'
- 'strained back whilst lifting electric motor'
- 'pipe crushed and fractured arm between chain blocks'

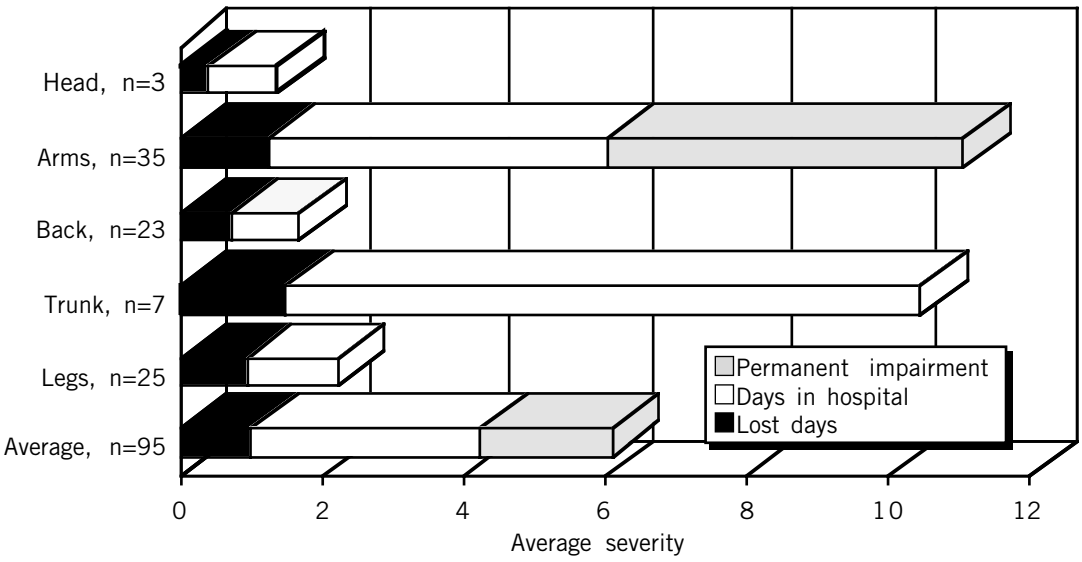
Miners (n=95); Types of accident mechanisms associated with lost time injuries 1.12.92 - 31.3.94 and average severity.
(94% of LTI for the occupational groups during the period)



Miners (n=95); Types of afflictions; (89% of LTI for the occupational groups during the period)



Miners (n=95); Body location; (98% of LTI for the occupational groups during the period)



(ix) Group 9 "Miners" (n=95)

This group comprises Occupational Groups 400, 404, 406-408, 410-414 , defined as " miners, ore and mineral treatment operators etc... "; and has a "three star*" severity index rating.

Lost days index	Maims index	Hospital days index	Total index
1.01	1.65*	2.90*	5.56

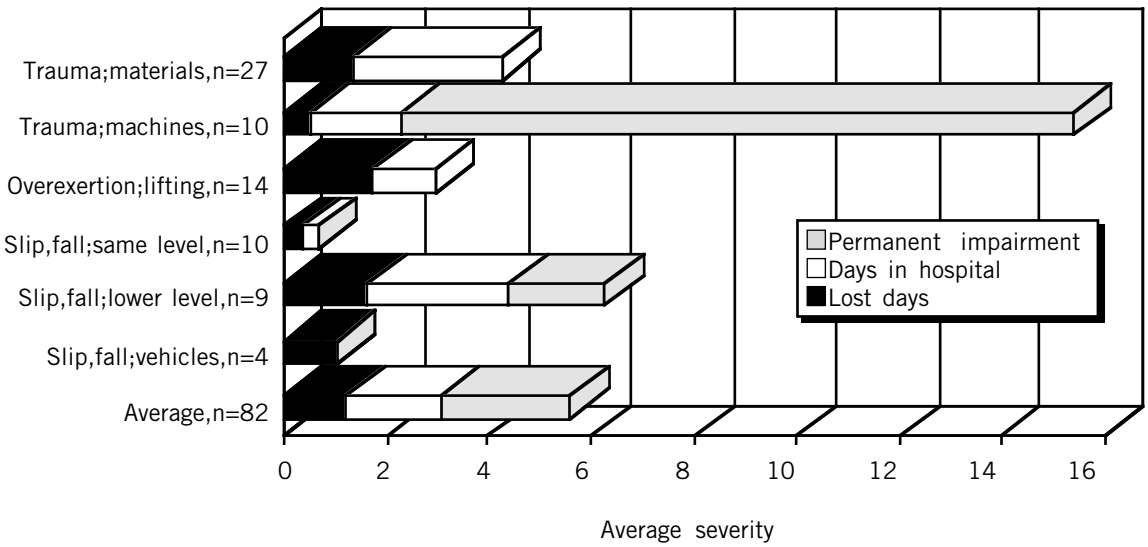
The distribution of SI by mechanism; by types of affliction; and by body location are shown in Graphs a, b, c, opposite

The highest severity rating is associated with **traumatic contact-machines and power tools** (n=13), and to a lesser extent **slips and falls-same level** (n=10). Associated high severity injuries are contusions (n=9), amputations (n=4), and fractures (n=12).

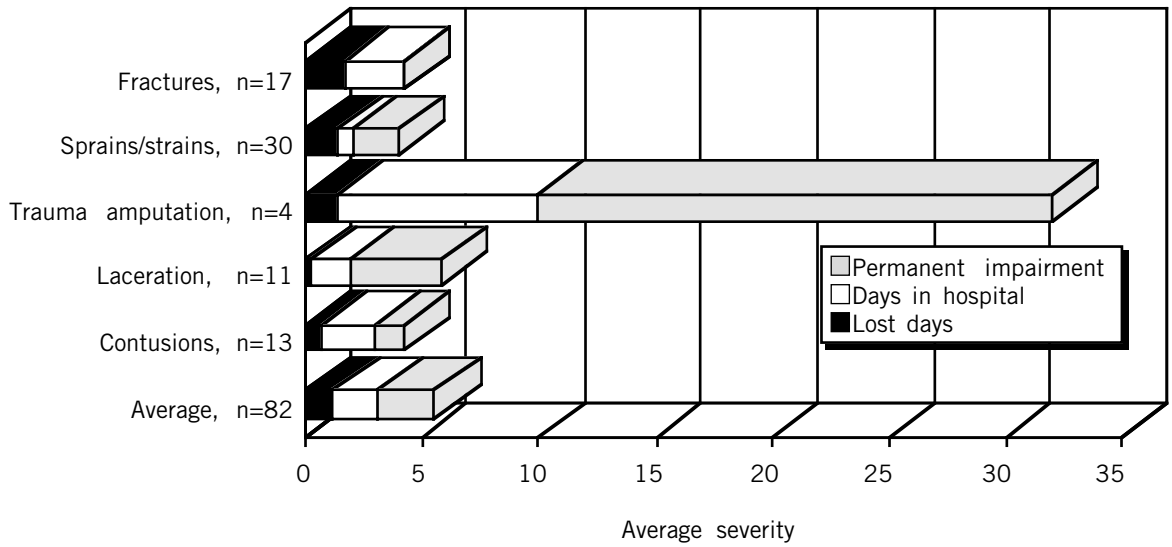
Examination of the accident text for these cases, provides the following examples:

- 'cleaning conveyor drive drum on sand plant -belt was slipping-hand crushed'
- 'feeding wood into saw-timber flew back into stomach'
- 'operating screening plant, brushed soil off conveyor belt, hand caught, fractures'
- 'lifting timber for stacking-disc prolapse'
- 'hand came into contact with circular saw'
- 'caught under rock fall-internal injuries'

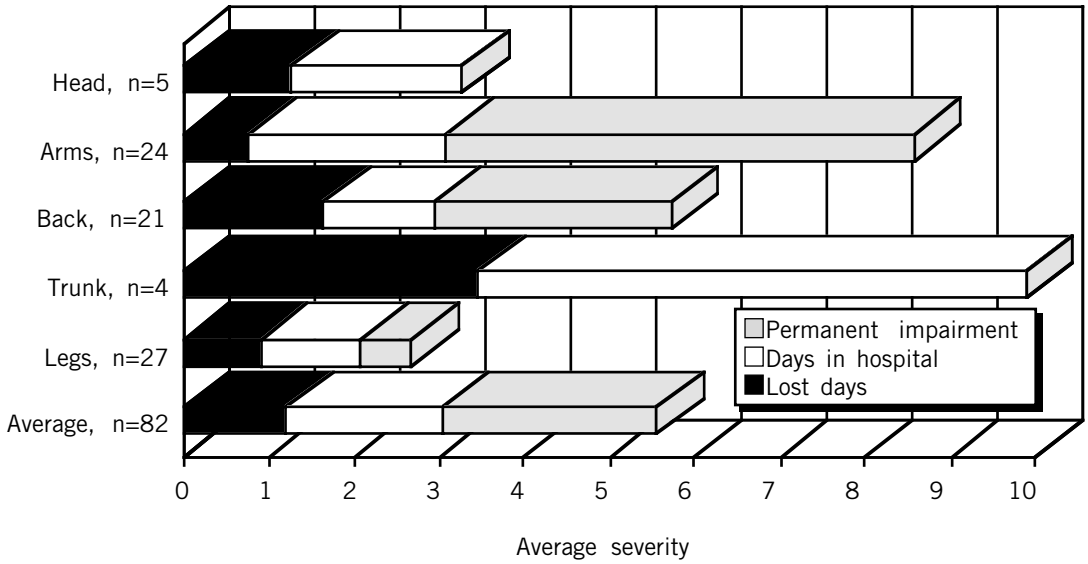
Forestry workers (n=82); Types of accident mechanisms associated with lost time injuries 1.12.92 - 31.3.94 and average severity.
(90% of LTI for the occupational groups during the period)



Forest workers (n=82); Types of afflictions; (91% of LTI for the occupational groups during the period)



Forest workers (n=82); Body location; (99% of LTI for the occupational groups during the period)



(x) Group 10 "Forestry Workers" (n=82)

This group comprises Occupational Groups 336, 337 , defined as "axemen & related timber getters, forestry workers"; and has a "three star*" severity index rating.

Lost days index	Maims index	Hospital days index	Total index
1.2	2.53*	1.83*	5.55

The distribution of SI by mechanism; by types of affliction; and by body location are shown Graphs a, b, c, opposite.

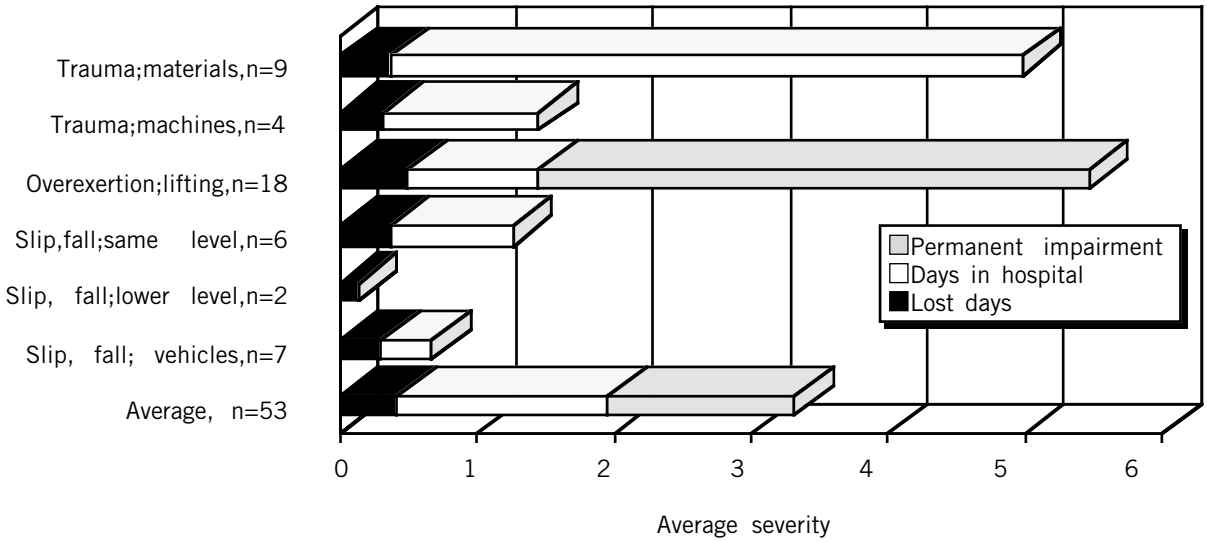
The highest severity rating was for "**traumatic contact with machines, power tools**" (n=10), followed by **slips and falls to lower levels** (n=9) and **traumatic contact with materials** (n=27). In terms of injuries, **traumatic amputation** (n=4) had very high rating, followed by lacerations (n=11).

Traumatic contact with materials consisted largely of being struck by tree branches or contact with logs etc. Slips and falls to a lower level included falls from trees as well as falls off logs.

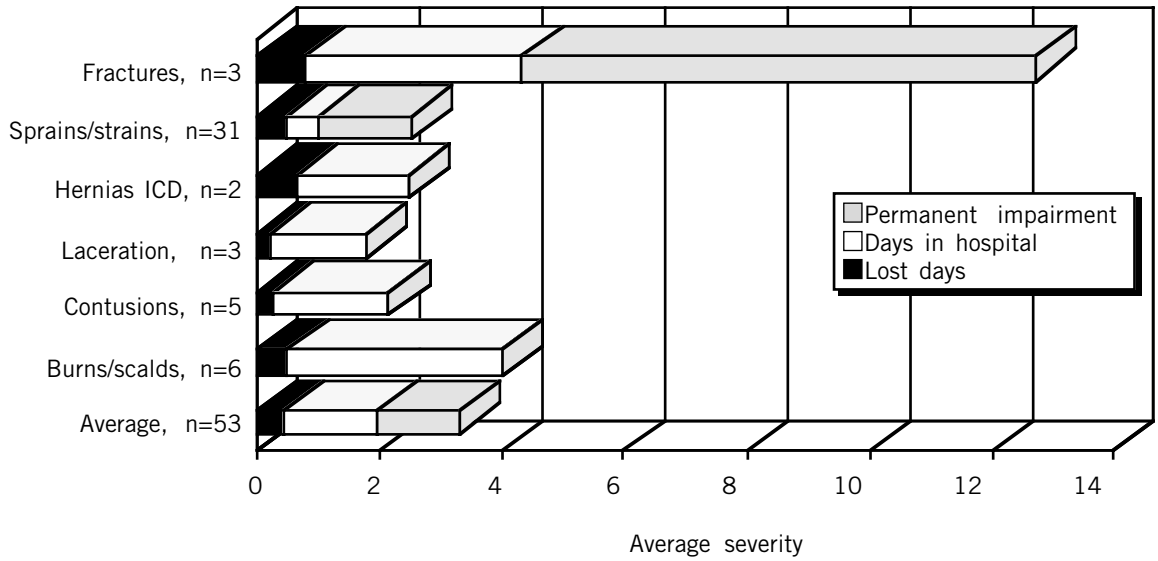
Some example cases are:

- "hand drawn into saw by timber" -tip of finger amputation"
- "lacerated fingers while cutting top off post with chain saw"
- "struck by falling branch fracturing head and shoulders"
- "fractured ribs and shoulder when struck by tree limb"
- "fractured right leg when log rolled onto it"
- "fractured right wrist as a result of falling off log"

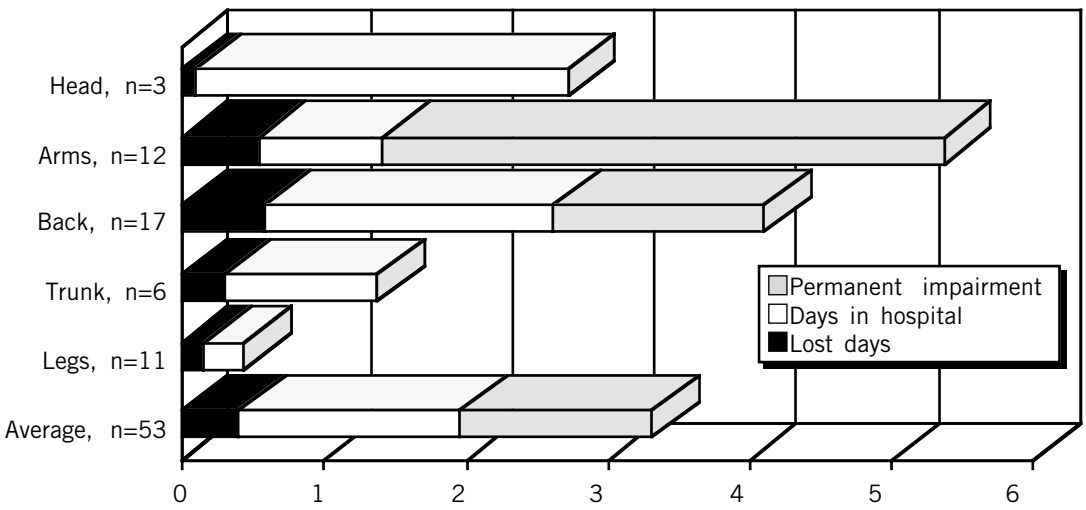
Linesmen (n=53); Types of accident mechanisms associated with lost time injuries 1.12.92 - 31.3.94 and average severity.
(87% of LTI for the occupational groups during the period)



Linesmen (n=53); Types of afflictions; (94% of LTI for the occupational groups during the period)



Linesmen (n=53); Body location; (92% of LTI for the occupational groups during the period)



(x) Group 11 "Linesmen" (n=53)

This group comprises Occupational Groups 656, 657, defined as "linesmen, electrical & cable jointers, foremen-electrical"; and has a "two star*" severity index rating.

Lost days index	Maims index	Hospital days index	Total index
0.41	1.37*	1.54*	3.32

The distribution of SI by mechanism; by types of affliction; and by body location are shown in Graphs a, b, c, opposite.

The highest rating is shown for **'overexertion- lifting etc'** (n=18), and traumatic contact with materials (n=9). Associated injuries with high ratings are fractures (n=3) and burns (n=6).

The category "traumatic contact with materials" consists mainly of **electrocution and burns,** associated, of course, with electrical equipment.

Some case examples are:

- 'contact with electric live wire-burns to lower back and right knee
- 'explosion of transformer while testing new equipment-burns to hands'
- 'cutting cable and strained left wrist'
- 'moving ladder up pole-strained muscles in lower back'

3.4 Alternative Analyses - by cause of injury (Agency)

While the major analyses undertaken in this report is based on occupation groupings, additional preliminary analyses were carried out by focusing first on the cause of injury, classified as 'agency' in this database. This approach provides another perspective and focuses on a point in the chain of events leading to injury and provides an overview of injury causation across all industry groups and other parameters.

The data can, of course, be cut initially in other ways which could aid in determining target areas for preventative measures. Analysis of body region injured can also be important to helping to direct areas for development of injury countermeasures. For example, if all injuries to the head region were analysed, this could lead to investigation of potential preventive measures (eg improved helmet design to deal with particular groups of injury mechanisms).

A second cut of the main dataset - all claims for the period Dec 1, 1992 - March 31, 1994 - was made to explore, to a limited extent, other approaches to the WorkCover data for the purposes of identifying major injury problems for prevention. This approach helps to ensure that injury problems are not missed because the same issue occurs diffusely across injury groupings or other selection criteria. The variable 'agency' is defined as 'identifies the object or cause of injury' (IRS column definitions, July 1994). **Table 1 (Appendix 2)** shows the distribution of agency by compensation type for the full fifteen month dataset.

A number of agencies stand out as probably worthy of further investigation either because of the high frequency or severity of injury or because of their relatively discrete nature and therefore potential amenability to prevention. **Saws and circular saws** (183 cases); **ladder, mobile ramp, step, stairway** (916 cases, classified under two separate codes) **forklifts** (215 cases) are examples here.

The significant limitation of this type of analysis is that many of the agency codes used most commonly are non-specific, and therefore, as they stand, are of limited use for further injury prevention research purposes. Approximately **56%** of cases fall into this category overall. These included *other machinery nec; other material, substance or object; human body; other agency nec; agency not apparent and agency not known.*

It is important to note that in the main analyses based on occupational groupings, for the selected priority groups, detailed analyses were also carried out by mechanism, affliction and body location. However because of the limitations of the data coding as noted, specific information on mechanism and agency had to be manually identified for each case based on the 'free text' descriptions of the incident, which were generally sufficiently specific for this purpose. Thus improved coding requirements, as set out in the recommendations is an important prerequisite to facilitate this type of analysis.

CHAPTER 4.0
DISCUSSION AND RECOMMENDATIONS

4.1 Coding system

The level of detail of the injury/disease information in the workers' compensation system should be based on the required level of information necessary to settle the claim according to the provisions of the scheme, define and underpin the causal link between work-related exposure and ill health, and provide details of harmful exposure for the use in applied prevention activities, in order for interventions to reduce injury and disease to be evaluated.

The present information in the WorkCover Authority system about harmful exposure, referred to as "pre-event" information in the road safety area, is lacking in precision and reliability. The coding paradigm is based on views and concepts to fit the presentation of general aggregate statistics. If the claims information is to be used for selective identification of severe harmful exposure, and for the evaluation and assessment of the effects of changes in practices and exposures, then more detail of input information, and a different way of recording and retrieving information, should be considered.

We suggest that the WorkCover Authority adopts the proposed new European standard of recording occupational injury and disea se (Heidenström, 1982; Larsson, 1990; Eurostat, 1992; Jørgensen, 1994), which is based on the New Zealand ACC coding system, adopted and further developed in Sweden, Norway and Denmark. This breaks down the narrative of the accident process into **activity, mechanism** and **contact,** and poses three questions on the claims/recording form:

"What were you (the victim) doing?"

"What went wrong?"

"How was the injury inflicted?"

The answers to these questions are recorded as **verbs** (activities, actions) and **nouns** (agencies, exposures) and they can be stored in coded form, as open language verbs and nouns, or as free text descriptions with high-lighted key-words. In this system, up to three different external agencies can be coded; eg. *standing* on *ladder, hit* thumb with *hammer, fell* to the *ground.* The principles of this way of recording are to retain as much of the open language narrative as possible, to structure the accident process temporally and logically at the primary source (claims form or interview with victim), and to perform all selection, reduction, merging, and other types of variable manipulation during the out-data phase, ie. when specific analyses of injury problems are required.

The adoption of this recording principle by the WorkCover Authority would simply mean that the present free-text descriptions ("claim description", "incident text", "accident text", "affliction text", and "bodily location text"), which have been heavily relied upon in the present analysis, be re-structured and linked to three questions posed on the claims form.

The "post-event" information of the system is, as expected in a workers' compensation system, of good quality, but certain areas, eg. types of medical procedures, could be investigated to contribute more detailed information on the tail-end of extremely severe occupational trauma. Days spent as in-patient in hospital should be compulsory information for all relevant cases, whether it be public or private hospital care.

The 1981 occupational code used by the WorkCover Authority should be substituted with the present 4-digit ASCO, so that exposure can be related to occupation according to census and labour force estimates.

4.2 Severity Index

One important task for this pilot study has been to establish a preliminary measurement of injury severity, to be used as a criteria in assessing priorities for prevention activities.

There will always be several different underlying assumptions regarding the measurement of severity in relation to traumatic injury and the consequence of disease. Obviously, severity expressed in terms of the risk of dying, usually assigned a value with the help of the Abbreviated Injury Scale (AIS), is a relevant, but not sufficient, criteria when dealing with claims for compensation (refer Section 2.2).

The question of permanent medical impairment would seem to be an important aspect of injury/disease outcome, which furthermore is measured by insurance organisations around the world, in a similar manner (AMA, 1984).

A third important aspect of severity would be the duration of the temporary incapacity suffered in relation to injury or disease.

These three aspects were suggested as the combined measurement of injury severity by the European Conference on Priority-Setting in Accident Prevention organised by the European Consumer Safety Association (ECOSA) in Vienna in September 1994 (ECOSA, 1994). The three severity aspects will be of general relevance for all sorts of traumatic injury, and should be linked to the ICD code (diagnosis).

In the present study, preliminary indicators of these three aspects of severity were used. As a variable indicative of medical severity (risk of dying), **days admitted as in-patient to hospital** was used. As a measure of permanent medical impairment, all possible indication of **maims** in relation to the injury were recorded. And lastly, as a measure of temporary incapacity due to injury, the **duration of earnings related compensation payments** was recorded.

Obviously, these variables should be viewed as preliminary and approximations, but still, in our view, reflect the optimal way of expressing injury severity in the present system. It should also be noted, that there are no alternative ways of securing severity indicators in relation to occupational trauma in Australia.

Validation analyses confirmed that the variables, presented as a severity index, represented separate and different aspects of injury consequence, and that the variables seemed to identify those occupational groups with the most substantial injury problems.

The cost of claims is highly related to compensation paid for **lost time,** which is the normal way of describing injury consequences in the Workers" Compensation system. However the variables of the severity index have been combined in such a way that increased weight has been given to days in hospital and maims, underlining further that severity is different to cost.

Thus this preliminary severity index was considered to perform well in regard to its objective of helping to identify high injury severity groups. However it is also important to highlight that further development and refinement of the index is appropriate, and in addition to develop other indices to identify specific priority areas in terms of selected injury type and cost. In this way a robust set of indices will be developed, useful for both identifying priority areas and subsequent evaluation studies.

4.3 Suggested interventions/ priority areas

From the detailed analyses of the 11 occupational groups identified as having significant above average "injury severities", the following initial priority areas are suggested. The initial five projects are focussed on the large groups of "Construction Workers" and "Fitters and Turners".

(i) **Falls to lower level among Construction Workers** indicate a need to assess the possibilities of changing practices and upgrading equipment for work on height (equipment for working on roof, ladders, trestles, scaffolding). This would be specifically needed in the area of single-family, residential construction, where perceptions of risks and present equipment and practices should be addressed on an industry basis.

(ii) **Traumatic contacts with vehicles among Construction Workers** point to the complicated area of pedestrian-vehicle interaction at construction sites (road, bridge, etc. but also residential and non-residential construction). Pedestrians directing vehicle movements, the successive storing of building materials during the construction period, together with problems of access/egress of vehicles and pedestrians on the site during different phases of the construction period are areas of concern.

(iii) **Handling of glass** seemed to be a prominent problem among workers in the Construction Industry. Different solutions would probably apply in storing and transporting glass, compared to the requirements for safe handling of glass at the construction site or when mounting glass products in buildings.

(iv) **Traumatic contact with machines among Fitters & Turners** was, not surprisingly, the major explanation for severe occupational trauma among these groups. An in-depth investigation of the problems of handling material and work-pieces in working with rotating machines (lathes, drilling machines, grinding machines, etc), including cleaning and maintenance procedures, would be appropriate.

(v) **Traumatic contact with forklift trucks** is still one of the biggest problems of occupational trauma in Victoria. This problem is high-lighted among the Fitters & Turners, as it would be among a number of other occupational groups. Specifically, the use of forklift trucks in the manufacturing industries should be focused, and questions such as in-house traffic systems, pedestrian/vehicle separation, forklift-free work-stations should be investigated.

(vi) **Targeting Occupational "blackspots"** In addition to these projects it became apparent from the analyses that each occupation group has its own particular "blackspot" areas, which is characteristic and most likely peculiar to that occupation. For example "**millers and bakers**" have a high severity rating for **traumatic contact with materials (substances/burns) and machine power tools**, but related to the particular equipment used in that industry. Similarly "**printers**" injuries are conspicuous by their association with **traumatic contact with machines** (printing presses etc). Each occupation has associated with it, particular equipment, processes and practices and injury type and circumstances.

These observations suggest that a powerful and effective injury prevention program utilises the concept of "black spot analyses" as used in the road safety area, but applied systematically to each occupational groups (and particular industry site). Of course countermeasures developed in one area may well be able to be applied in other areas, directly or appropriately modified, but as found in road safety each site must be investigated and treated individually.

This type of "blackspot" analysis could similarly **focus on specific agencies of injury** identified in terms of high frequency and severity occurring across occupational groups. In this category, some examples would include, ladders/stairways; forklifts; and saws.

(vii) **Manual handling.** As part of, and in parallel to, the systematic treatment of each occupation a specific focus can also be placed on manual handling related injuries pertinent to each occupational area. As manual handling (in its many forms) constitute some 50% of claims overall, the WorkCover Authority"s program can address not only the high injury severity areas, but also high claims frequency and cost areas.

As manual handling issues and problems can be similar across various occupational groupings, a focus would also be placed on **specific agencies or manual handling activities** identified in terms of high frequency and severity.

4.4 Suggested Further Activities

It is recommended that:

(i) A three-year plan for the prevention of severe occupational trauma in Victoria is developed, involving in-depth investigation into priority areas, discussion and development of intervention programs into severe occupational trauma together with core industries, and the formulation of a framework for selected cost-effectiveness measurement in certain areas of intervention.

(ii) To support the injury prevention program data needs, a program of information system upgrading within the WorkCover Authority is considered, and that functional resources for this, and for the analytical and developmental requirements needed on the output side, is allocated and budgeted within the Authority,

(iii) Research and intervention activities be undertaken by suitable institutions like Monash University Accident Research Centre, University of Ballarat, IPSO Australia and others, according to the priorities set forth by the WorkCover Authority, based on continuing analyses of the claims material.

(iv) A study of the Latrobe Valley, where regionalised WorkCover data, VISS[2] data, regional census data, and data from local, participating companies could be combined to produce a regional occupational injury prevention plan to be implemented together with the big employers and groups of small employers. Employers (among others) should, of course, see the benefit of a more complete screening of injuries and of establishing criteria to rank the problems according to severity, and act upon this ranking. This would be an approach to occupational injury prevention with a significant public health appeal and perspective.

[2]The Victorian Injury Surveillance System (VISS), managed by MUARC, collects detailed patient presentation information from six major Victorian hospitals and is an additional and rich source of information on the circumstances of work related injuries. VISS data for certain types of occupational trauma can provide more detailed information on the injury, and also has significant potential in providing regional exposure estimates for certain occupational hazards. The hospital data on occupational trauma thus complements the workers' compensation data and can, specifically, point out medically significant injury problems.

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APPENDIX 1
VALIDATION OF SEVERITY INDEX AND DATABASE

1. Introduction

This paper describes the methods and results of the validation of the proposed occupational injury severity measure and the Victorian WorkCover Authority database used to develop this measure. The investigation covers both validity of the database contents in relation to calculation of the severity index along with tests of the power of severity index in consistently reflecting true injury severity.

The overall severity index is a sum of three components:

MAIM INDEX = (7500 x (65-age at claim) x maim indicator) / average
DAYS INDEX = (Days compensated x 120) / average
HOSPITAL INDEX = [(public hospital days x 400) +
(private day surgery x 200) +
(private hospital costs x 0.8)] / average

The variables from the database used to calculate these three components are:

MAIM_IN	Indicator for a maim claim either payed or pending
AGE_NB	Difference between claimant's age and 65 years
DAYSCOMP	Number of days compensation payed
EPDYS_N2	Number of public hospital days
PT_67_CT	Private day surgery presentations
PT_65_AM	Private hospital costs

Calculation of the index is based on the value of these variables for the 21449 cases in the database which have days compensated greater than zero and injury date in the range 1/12/1992 to 1/3/1994.

2. Variable Descriptives

The first and most fundamental validation process is to check the information contained in the relevant fields of the database used to calculate the severity index components. This is carried out by checking for the presence of missing values in each field as well as examining the distribution measures of each variable, in particular the statistics mean, minimum, maximum and standard deviation. These summary statistics are given for each variable used in calculating the severity index in Table 1.

Table 1. *Variable Summary Statistics*

VARIABLE	MEAN	ST. DEV	MIN.	MAX.	No. Valid of 21499
MAIM_IN	1	0	1	1	605
AGE_NB	27.42	12.09	1	50	21449
DAYSCOMP	43.02	66.53	1	652	21499
EPDYS_N2	.58	3.59	0	164	21499
PT_67_CT	.03	.22	0	4	7226
PT_65_AM	1212.71	3377.29	0	98658	7226

The descriptive statistics for each variable listed in Table 1 indicate good accuracy and completeness in these variables. The MAIM_IN variable was coded 1 only for claims with an accepted or pending maim payment and left missing otherwise. This explains the zero variation and range in this variable whilst the 605 valid cases represent the number of maim claims in the database. The 7266 valid cases for the payment 65 and 67 variables reflects the number of claims with a private hospital component of compensation. The mean, standard deviation and range of each variable in table 1 are consistent with what would be expected for each with no apparent abnormalities.

3. Correlation Analyses

Correlation analyses of a set of variables indicates the strength of linear relationship between each variable in the set with correlation of 0 indicating no linear relationship and correlation of ± 1 indicating perfect linear relationship. Correlation analysis of the three index components and the total severity index was carried out with the results presented in Table 2.

Table 2. *Correlation of index components and total index*

	MAIM_IX	HOSP_IX	DAYS_IX	TOT_IX
MAIM_IX	1.0000	.0815	.1196	.8266
HOSP_IX	.0815	1.0000	.2835	.6012
DAYS_IX	.1196	.2835	1.0000	.4109
TOT_IX	.8266	.6012	.4109	1.0000
				N of cases: 21449

The low correlations between each of the three index components indicates a high level of independence between the components of injury severity reflected by each index component. The correlation of each index component with the total index indicates the relative influence each component has on the total index. Table 2 shows the maim component has the most influence on the total index followed by the hospital and days index in that order.

4. Index Relation to Other Severity Measures

As a test of the power of the severity index in accurately reflecting relative injury severity it is desirable to compare the index against some direct or surrogate measure of severity which can be found in the database. As no direct measure of severity exists in the database, a surrogate measure must be used.

The first surrogate measure considered was the affliction code. The average value of each index component as well as the total index for each affliction type in the database was calculated and is presented in Table 3. Only affliction types which appear more than 25 in the database have been included in table 3 to minimise the possibility of spurious results due to chance variation in the index for affliction types with small numbers of observations. The index value can be compared with a nominal relative severity assigned to each affliction type to asses the index performance. For example, traumatic amputation should exhibit a higher average severity index than say, superficial injury.

Table 3. *Average index by affliction code*

		INDEX AVERAGE			
AFFLICTION	No.CASES	MAIM	DAYS	HOSPITAL	TOTAL
Occ. Dermatitis	83.00	.34	1.04	.01	1.38
Other Injuries	44.00	.45	.66	.46	1.56
Supfcl Splinter wound	312.00	.96	.15	.45	1.57
Other Nervous Disease	34.00	.00	1.23	.58	1.81
Concussion	81.00	.38	1.00	.89	2.27
All sprains strains	11971.00	.71	1.11	.65	2.47
Mental Disorder	512.00	.41	1.48	.64	2.53
Abrasion burn	64.00	1.31	.35	.91	2.57
Hernias ICD	873.00	.05	.69	1.93	2.67
Unspec open wound	37.00	1.13	.42	1.18	2.73
Contusion, crush NEC	1275.00	1.30	.66	.93	2.89
Tenosynovitis	438.00	1.20	1.36	.39	2.96
Other laceration	2127.00	1.63	.51	.84	2.97
Burns & Scald unspec	311.00	.65	.36	2.02	3.03
Other supfcl wound	32.00	1.05	.38	1.83	3.25
Dislocation - unspec	32.00	.00	1.21	2.42	3.63
Other dislocation	100.00	.71	1.28	1.70	3.69
All fractures	2159.00	.93	1.12	2.04	4.10
Other burns & scald	43.00	1.43	.64	2.55	4.63

Displ vertibr disc	27.00	1.61	1.92	1.42	4.94
Disloc of vertibrae	35.00	1.28	1.41	2.87	5.56
Ischaemic hear dis.	29.00	.00	2.28	3.86	6.14
Multiple injuries	180.00	2.40	1.58	5.63	9.61
Traumatic amputation	261.00	12.55	1.04	2.99	16.59

Table 3 shows a clear increase in the seriousness of affliction with increase in average severity index value. The more superficial injuries such splinter wounds and strains and sprains have low average severity indexes whilst the serious and permanently debilitating afflictions such as ischaemic heart disease or traumatic amputations have high associated severity index values as would be expected.

Another surrogate measure against which the severity index can be compared is the maim type for which compensation is being sought. There are 605 claims for maim benefits in the database which have a maim description recorded in the field Benefit Applied For Number 1. It is not expected that this code would offer the same power for comparison with the severity index as the affliction code considered above because of the much smaller number of cases with maims. The average of each severity index component along with the total index was calculated for each maim type coded in the Benefit Applied For 1 field. The results are presented in Table 4.

Table 4. *Average index by benefit applied for 1*

		INDEX AVERAGE		
MAIM TYPE	MAIM	HOSPITAL	DAYS	TOTAL
Impairment of neck	26.11	.00	2.17	28.28
Loss of part lower leg	20.98	3.44	4.16	28.58
Incurble loss mental power	25.18	.00	4.28	29.46
Impairment of the pelvis	29.38	.00	.12	29.50
Loss of toe (not big toe)	21.92	7.20	.73	29.84
hearing loss, both ears	31.48	.36	.93	32.77
Loss of left arm	27.42	2.24	4.73	34.39
Loss of leg	31.58	.40	2.63	34.60
Impairment of back	30.61	1.68	3.16	35.45
Loss of right arm	33.92	1.37	1.22	36.51
Loss of foot	19.58	14.46	2.58	36.62
Loss of sight - one eye	32.17	1.76	4.79	38.72
Total hearing loss	37.78	.00	2.58	40.35
Loss of fingers/low arm L	39.82	1.03	.57	41.43
Loss first joint MRL fing	39.17	1.95	.45	41.57
Loss of little/ring finger	41.85	1.00	.68	43.53
Loss of thumb RH	36.37	7.58	2.23	46.18
Loss of middle finger	43.83	1.92	.76	46.51
Loss of thumb LH	43.60	1.51	2.51	47.63
Loss of forefinger RH	44.97	1.60	1.20	47.77
Partial sight loss one eye	42.57	3.57	1.79	47.93
Total loss thumb joint	47.10	.72	1.02	48.84
Loss of fingers/low arm R	46.87	1.18	.90	48.94
Loss of forefinger LH	50.64	.81	.57	52.02
Loss first jnt forefing L	53.16	.18	.54	53.89
Loss joint big toe	54.56	.00	.14	54.70
Loss 2 jnt ring/little fng	61.56	4.32	.72	66.60
Loss frst jnt forefing RH	65.75	1.44	3.51	70.70
Loss sight of only eye	55.26	47.58	2.86	105.70

The relationship between maim type and the severity index shown in table 4 is not as clear as that demonstrated in the comparison with affliction. The reason for this may be largely due to the lack of natural severity ordering of the maim types appearing in the database. A large proportion of the maims listed in Table 4 describe full or partial loss of various limbs or individual fingers or toes which are difficult to assign a relative severity order. In practice actual severity of these maims would be determined on a case by case basis making generalisation difficult. These points, along with the small number of maims on which the average index values are calculated, mean the results of Table 4 must be viewed with caution.

The final surrogate severity measure considered was the total claim cost. As total claim cost is a continuous variable, the methods used in the two cases above can not be employed here. Instead a linear regression approach has been used with a multiple regression of total cost against each index component being carried out. A stepwise approach was used as it allowed each index component to be included or excluded from the regression equation based on its predictive power. A component being excluded from the regression equation would indicate no relationship between that component and total cost.

The final regression equation reached by the stepwise procedure contained all three index components indicating each has explanatory power against total cost. The final regression output is given in Figure 1. The standardised regression coefficient (Beta) indicates the relative explanatory power each index component with a larger coefficient representing greater explanatory power. The regression output shows the days index to have the most bearing on total cost followed by the hospital and maim indexes respectively. This is the reverse order of influence than found in the correlation analysis of the individual index components with total index. This indicates that the total index gives a much higher weighting to maim claims and time spent in hospital in reflecting injury severity than does total cost.

FIGURE 1 – *Final Stepwise Regression Output*

* * * * M U L T I P L E R E G R E S S I O N * * * *

Equation Number 1 Dependent Variable.. PAYMTALL ALL COSTS

Variables in the Equation

Variable	B	SE B	Beta	T	Sig T
DAYS_IX	3844.703527	16.690715	.678381	230.350	.0000
HOSP_IX	904.850511	6.177017	.429737	146.487	.0000
MAIM_IX	91.525821	3.801329	.068225	24.077	.0000
(Constant)	545.980598	29.421283		18.557	.0000

6. Consistency Within Occupational Groupings

The original occupation coding in the database were collapsed in to a smaller number of broader groups for the purposes of calculation of the severity index. Of interest is whether there is consistency of index value for each original occupation grouping within each broader occupational group to validate the use of the reduced number of new codes. To asses this, the average value of the each index component along with the total index was calculated for each old occupation group and is displayed in Table 5 grouped by new occupation category. The description of the old and new occupation codes appears in Appendix 5. It should be noted that the severity index in the new occupation group will be an average of those in the old occupation groups weighted by the number of cases in each.

Table 5. – *Severity Index by Old Occupation Group*

OCC CODE		INDEX AVERAGE				
NEW	OLD	MAIM	DAYS	HOSP	TOTAL	No.CASE
1	1	.00	1.56	.77	2.33	7.00
1	2	.00	.29	.48	.77	7.00
1	3	12.59	1.61	2.69	16.89	3.00
1	4	.00	1.28	.92	2.20	11.00
1	5	.00	.02	.00	.02	1.00
1	7	.00	2.23	9.56	11.79	1.00
1	8	.00	.51	.00	.51	1.00
1	9	.00	.65	3.12	3.77	7.00
1	10	3.96	2.22	2.60	8.78	6.00
1	11	.00	.58	.20	.79	5.00
1	12	.00	.54	.21	.76	10.00
1	13	.00	.56	.00	.56	1.00
1	16	.00	1.12	.00	1.12	1.00
1	17	.00	.32	1.32	1.64	4.00
1	18	.00	.71	.00	.71	6.00

1	19	.00	.53	.00	.53	1.00
1	21	2.10	.85	.48	3.42	8.00
1	22	.00	.14	.00	.14	1.00
1	28	.00	.15	.09	.23	5.00
1	29	.00	.16	.00	.16	1.00
1	30	.00	.59	1.72	2.31	3.00
1	31	.00	.45	.54	.99	3.00
1	32	.00	.07	.00	.07	1.00
1	33	.00	2.00	.00	2.00	1.00
1	35	.00	.42	.00	.42	5.00
1	36	.00	3.12	.00	3.12	1.00
1	37	.00	1.17	1.02	2.20	11.00
1	59	.00	1.25	.92	2.17	2.00
1	60	.00	.30	.00	.30	1.00
1	61	.00	3.18	5.73	8.91	4.00
1	63	.00	2.81	.00	2.81	3.00
1	64	.00	1.88	.47	2.35	7.00
1	66	.00	.20	.56	.76	4.00
1	79	.00	1.80	.79	2.59	12.00
1	80	.00	1.06	1.72	2.78	46.00
1	81	.55	.99	.59	2.14	76.00
1	82	.00	1.91	2.29	4.21	8.00
1	83	.00	.84	.22	1.06	10.00
1	84	.00	1.30	.25	1.55	6.00
1	86	.00	1.53	4.06	5.59	8.00
1	87	.00	.78	.00	.78	6.00
1	88	.00	1.54	6.99	8.53	7.00
1	91	.00	.71	.74	1.45	17.00
1	100	.00	.98	.72	1.70	8.00
1	101	.00	.27	.15	.42	23.00
1	102	.00	.78	2.79	3.56	5.00
1	104	.00	.34	.34	.68	2.00
1	105	.00	.12	.00	.12	7.00
1	106	13.99	.63	3.87	18.49	6.00
1	108	.00	.09	1.08	1.17	2.00
2	23	.54	1.12	.76	2.42	691.00
2	24	.25	.75	.23	1.24	132.00
2	25	2.11	1.05	.19	3.36	49.00
2	26	.28	1.12	.52	1.93	128.00
2	27	1.99	1.20	.04	3.23	19.00
2	818	.00	.40	.00	.40	6.00
2	820	.00	1.59	.83	2.43	36.00
2	822	1.00	1.09	.80	2.89	142.00
3	38	.00	.39	2.50	2.89	3.00
3	39	1.30	.55	1.52	3.37	14.00
3	40	.00	.39	.58	.97	16.00
3	41	.00	.66	.09	.75	12.00
3	42	1.12	.86	1.77	3.75	15.00
3	43	4.20	.81	.05	5.06	7.00
3	44	.00	.49	.84	1.33	34.00
3	45	.71	.96	.80	2.48	141.00
3	46	.00	.73	2.01	2.74	50.00
3	47	.00	.87	.86	1.72	32.00
3	48	.36	.64	.54	1.53	86.00
3	49	.00	.57	.12	.69	32.00
3	50	.00	.36	.15	.51	23.00
3	51	.00	.78	.80	1.59	55.00
3	52	.00	.45	.72	1.17	15.00

4	62	.00	1.11	.10	1.21	5.00
4	65	.00	.57	.19	.76	56.00
4	817	2.42	.61	1.28	4.31	11.00
5	67	.00	.48	.01	.49	11.00
5	68	.00	3.56	5.72	9.28	1.00
5	69	1.81	.68	.85	3.34	24.00
5	70	.00	.63	.53	1.16	11.00
5	71	16.09	.67	12.37	29.12	2.00
5	73	.00	.05	.00	.05	1.00
5	74	.00	.64	.83	1.47	21.00
5	75	.00	.63	.00	.63	9.00
5	76	.00	2.47	.09	2.56	4.00
5	77	.00	.11	.00	.11	2.00
5	78	.00	1.72	6.58	8.30	2.00
105	114	.00	.36	1.10	1.46	7.00
105	115	.00	3.08	6.57	9.64	6.00
105	116	.00	.77	3.07	3.84	6.00
105	117	.00	.55	.57	1.12	7.00
105	118	.00	1.47	.87	2.33	15.00
105	119	1.11	1.57	1.47	4.15	39.00
105	150	.27	1.39	.39	2.05	52.00
105	151	.70	.97	.81	2.47	48.00
105	152	.00	1.37	1.79	3.16	61.00
105	153	.00	1.57	.82	2.39	54.00
105	154	.21	.96	.91	2.08	94.00
105	155	.55	1.02	1.04	2.61	140.00
110	110	1.55	1.38	2.04	4.98	172.00
111	111	1.11	.72	1.32	3.15	29.00
112	112	.00	1.19	1.60	2.79	16.00
113	113	.00	1.49	1.20	2.68	67.00
200	200	.00	2.22	1.38	3.60	3.00
200	201	.00	1.46	1.64	3.10	10.00
200	202	2.40	1.42	6.93	10.76	46.00
200	203	.00	1.72	1.34	3.07	6.00
200	204	.00	.81	3.32	4.13	3.00
200	205	.63	1.19	.81	2.63	436.00
200	206	.00	1.90	1.71	3.61	6.00
200	207	.00	.96	.59	1.55	16.00
200	208	.00	1.76	.82	2.58	12.00
200	209	12.24	2.08	.00	14.32	4.00
200	210	.00	.46	3.22	3.68	4.00
200	211	.61	1.17	1.93	3.71	73.00
300	300	.00	.20	.47	.67	2.00
300	302	.00	.73	.36	1.09	6.00
300	303	.00	.40	.00	.40	2.00
300	304	.00	1.35	2.19	3.54	10.00
300	307	.00	.84	12.80	13.64	1.00
300	308	.00	.28	2.16	2.44	3.00
300	309	2.45	1.47	1.17	5.09	24.00
300	310	.00	.93	.93	1.87	6.00
300	311	3.23	.61	.22	4.05	13.00
300	312	.00	5.49	.24	5.73	1.00
300	313	.00	2.14	.54	2.68	4.00
300	314	.00	.62	.53	1.15	14.00
300	315	.04	.73	.22	1.00	66.00
300	316	.00	1.30	2.04	3.34	20.00
300	317	.00	.72	.00	.72	3.00

300	319	.54	1.12	.34	1.99	99.00
300	320	2.89	1.82	.24	4.95	29.00
300	321	.83	.68	.90	2.41	37.00
300	322	.30	1.04	.87	2.20	85.00
300	323	.00	.68	.89	1.56	34.00
300	324	.00	.51	.40	.92	128.00
300	325	1.54	.77	.60	2.91	41.00
300	326	.00	.47	.18	.65	4.00
300	327	2.37	1.07	1.07	4.51	39.00
300	328	3.40	1.53	3.76	8.69	14.00
300	329	.00	1.46	.79	2.25	13.00
300	330	2.85	.64	.23	3.72	26.00
300	331	3.18	1.24	1.61	6.03	44.00
300	332	.00	.34	.56	.90	8.00
301	334	.00	1.53	2.55	4.09	4.00
301	335	.00	.68	2.38	3.06	4.00
302	336	2.60	1.23	1.87	5.70	63.00
302	337	2.28	1.09	1.70	5.07	19.00
400	400	.00	1.74	7.34	9.08	5.00
400	404	6.68	1.26	8.33	16.28	9.00
400	406	.00	.83	.99	1.82	18.00
400	407	1.40	.79	1.02	3.21	31.00
400	408	1.92	1.35	3.55	6.83	16.00
400	410	.00	.72	.27	1.00	6.00
400	411	.00	.86	8.63	9.49	3.00
400	412	.00	1.43	.64	2.07	3.00
400	413	.00	.13	.36	.49	2.00
400	414	3.00	1.12	4.42	8.54	14.00
500	500	.00	2.54	.86	3.40	5.00
500	501	48.96	.95	3.89	53.80	1.00
500	502	.00	1.62	1.50	3.12	20.00
501	503	.00	.49	.72	1.21	5.00
501	504	.00	.09	1.76	1.85	1.00
502	505	.61	.35	.25	1.22	114.00
502	506	.00	.71	.03	.75	11.00
502	507	.00	7.95	2.00	9.95	1.00
502	514	1.68	.52	.99	3.19	54.00
502	515	4.20	1.12	.25	5.56	11.00
502	516	.00	.42	.99	1.41	13.00
502	517	1.27	.83	.10	2.20	22.00
502	518	1.56	.29	.05	1.91	34.00
502	519	.00	.50	.26	.76	14.00
502	520	2.52	.43	.67	3.62	10.00
503	508	.97	.74	.99	2.70	118.00
503	509	.00	.28	.16	.44	49.00
503	529	.41	.46	.19	1.06	85.00
504	510	.33	1.38	.74	2.46	71.00
504	511	1.15	1.03	1.17	3.35	760.00
504	512	.00	.45	.96	1.41	3.00
504	513	.57	.91	.85	2.33	578.00
505	521	.00	.46	.00	.46	1.00
505	523	.00	1.46	.00	1.46	1.00
505	524	.00	1.13	.00	1.13	2.00
505	528	.00	1.52	1.26	2.78	44.00
505	530	5.13	.32	.39	5.84	9.00
506	531	1.11	.90	.74	2.76	226.00

601	600	.00	.87	.65	1.52	12.00
601	601	.00	2.14	1.33	3.46	5.00
601	602	.00	1.83	.50	2.33	6.00
601	603	4.90	1.17	1.31	7.38	10.00
601	604	.00	1.30	.45	1.76	16.00
601	605	.00	.77	1.11	1.87	21.00
601	606	.00	1.94	.64	2.58	11.00
601	607	.00	.14	.00	.14	1.00
601	608	30.78	1.33	.00	32.10	2.00
601	609	.00	3.21	1.72	4.93	4.00
601	610	8.16	1.28	1.80	11.24	6.00
601	611	.04	1.50	1.02	2.56	35.00
601	612	.00	2.24	1.65	3.89	16.00
601	613	3.50	1.36	.43	5.29	76.00
601	614	.00	2.23	.36	2.59	8.00
601	615	.00	.74	.06	.80	6.00
601	616	.00	.14	.00	.14	4.00
601	617	2.18	1.91	.24	4.33	9.00
601	618	5.13	.30	.74	6.16	6.00
601	732	1.63	.98	.78	3.39	357.00
602	619	.00	.91	.24	1.14	24.00
602	620	.00	.43	.81	1.24	5.00
602	621	.00	1.43	.60	2.02	4.00
602	622	.00	1.21	2.21	3.42	13.00
602	623	3.77	1.25	1.52	6.54	13.00
602	669	.00	2.81	.24	3.05	3.00
603	624	.00	.05	.00	.05	1.00
603	625	.00	.21	.88	1.09	2.00
603	627	.00	1.26	1.12	2.38	1.00
603	628	.00	.23	.00	.23	1.00
603	629	.00	.66	.35	1.01	14.00
603	630	.00	1.29	.00	1.29	5.00
603	631	.00	.43	1.76	2.19	4.00
604	632	1.30	.83	1.24	3.37	415.00
604	633	.94	1.32	1.25	3.52	49.00
604	634	1.64	.99	1.40	4.02	130.00
605	635	1.45	.78	1.11	3.34	180.00
605	636	1.83	.76	1.11	3.70	304.00
605	637	1.13	.46	.93	2.51	41.00
605	638	.82	.49	.48	1.79	89.00
605	639	.00	.27	.00	.27	2.00
605	640	.00	.68	1.13	1.81	64.00
605	733	.90	1.23	1.23	3.35	25.00
606	641	.69	.83	1.46	2.98	313.00
606	642	.60	.67	.23	1.51	44.00
606	685	.00	1.11	3.03	4.14	9.00
607	643	1.49	1.14	1.11	3.73	191.00
607	644	.18	.60	.77	1.55	199.00
608	645	.00	1.35	1.28	2.63	7.00
608	646	2.01	.87	2.86	5.74	32.00
608	647	.98	.85	1.37	3.19	239.00
608	648	4.97	1.51	1.98	8.47	9.00
608	649	3.08	1.07	.97	5.12	59.00
609	650	1.67	.82	.68	3.17	244.00
609	651	.57	.64	1.24	2.44	47.00
609	659	1.80	.99	.74	3.52	21.00
610	652	.00	.42	2.88	3.30	1.00

610	653	.00	.09	.81	.90	1.00
610	654	.00	.19	.29	.47	9.00
610	655	4.20	1.28	1.57	7.04	6.00
610	658	.00	1.00	.00	1.00	1.00
611	656	1.46	.43	1.55	3.43	50.00
611	657	.00	.20	1.28	1.48	3.00
612	660	.91	1.12	.80	2.84	336.00
612	661	5.05	1.13	.63	6.82	31.00
612	662	.00	.53	.86	1.39	16.00
612	663	1.11	.97	.47	2.55	107.00
612	664	2.80	1.03	1.73	5.57	21.00
612	738	.00	.42	.77	1.19	10.00
613	665	.83	1.13	1.08	3.04	443.00
613	666	3.33	1.03	1.33	5.70	102.00
613	667	2.19	1.07	3.45	6.71	23.00
613	668	3.23	.82	1.05	5.09	36.00
613	670	.00	1.15	1.24	2.39	6.00
613	671	2.13	1.06	1.38	4.57	61.00
613	672	4.20	.94	1.28	6.42	10.00
613	673	.00	.45	.52	.97	19.00
613	674	.00	2.10	.00	2.10	2.00
613	675	1.25	1.42	1.70	4.37	28.00
613	734	2.37	1.34	1.00	4.71	23.00
614	676	1.22	1.44	1.94	4.60	54.00
614	677	1.02	1.09	1.46	3.58	97.00
615	678	1.15	2.10	1.76	5.01	50.00
615	679	.87	1.65	1.67	4.19	48.00
615	680	1.45	1.50	.79	3.75	80.00
615	681	.00	.96	.50	1.46	39.00
615	682	.00	.83	.47	1.30	35.00
615	683	.31	1.29	3.42	5.02	36.00
615	684	.00	2.11	1.85	3.95	13.00
615	686	.00	1.33	1.72	3.05	150.00
615	740	1.21	1.40	2.09	4.70	131.00
616	687	.00	5.14	8.30	13.44	1.00
616	688	2.38	.68	2.40	5.46	64.00
616	691	.00	.72	.94	1.67	13.00
616	692	.00	.85	.71	1.56	33.00
616	715	.00	.72	.72	1.44	1.00
617	693	.00	.24	.00	.24	8.00
617	694	.00	1.80	1.71	3.51	7.00
617	695	.00	.30	.19	.49	6.00
617	696	.00	1.48	2.74	4.22	8.00
617	697	1.94	.43	.59	2.96	18.00
617	698	.00	.32	.42	.74	17.00
617	716	4.90	1.17	.50	6.57	8.00
617	718	.00	1.12	.97	2.09	8.00
617	736	.00	.75	.07	.81	12.00
701	699	2.39	1.02	.94	4.35	24.00
701	700	3.48	1.05	.81	5.35	55.00
701	701	1.00	1.46	.84	3.30	35.00
702	702	.00	.95	1.25	2.20	18.00
703	703	1.56	.79	.77	3.13	466.00
704	704	.48	1.27	.36	2.12	29.00
704	705	.68	.90	1.11	2.69	76.00
704	706	.00	.23	.00	.23	1.00

704	707	.60	1.29	.51	2.40	88.00
704	711	.00	.23	4.94	5.17	1.00
704	735	1.49	.77	.38	2.64	63.00
705	708	1.01	.80	1.30	3.11	47.00
705	737	.00	.92	1.52	2.44	9.00
706	709	.00	.65	.00	.65	2.00
706	710	2.10	1.60	.85	4.54	10.00
706	712	1.97	1.09	1.69	4.74	32.00
706	713	1.75	1.15	.77	3.66	28.00
706	714	.00	.53	.41	.93	4.00
706	717	4.76	.96	.63	6.35	10.00
706	719	1.49	1.02	.61	3.13	193.00
707	720	1.60	1.19	.84	3.64	177.00
708	721	.00	.65	1.03	1.68	16.00
708	722	.00	.76	.78	1.54	8.00
708	723	.44	.64	1.22	2.30	38.00
709	724	1.37	1.37	1.41	4.15	47.00
710	725	1.61	.96	1.31	3.88	104.00
710	726	.67	.97	1.11	2.75	148.00
710	727	.00	.09	.62	.71	2.00
711	728	.26	.62	.55	1.43	49.00
711	729	.45	.91	.68	2.03	652.00
711	730	1.69	.93	.82	3.44	71.00
711	739	.37	.80	.58	1.74	99.00
711	742	3.29	.72	.36	4.37	20.00
712	731	1.37	.88	.22	2.48	53.00
713	741	1.27	.76	.74	2.77	109.00
714	743	1.37	.91	.82	3.10	1143.00
715	744	.00	.28	1.00	1.28	90.00
716	745	.99	1.16	1.06	3.21	393.00
716	746	1.18	.80	1.64	3.62	132.00
717	747	3.98	1.11	1.26	6.35	188.00
800	800	.47	.29	.36	1.12	66.00
801	801	.49	.89	1.10	2.49	356.00
801	802	.89	.68	1.16	2.72	156.00
802	803	.00	1.29	.78	2.07	4.00
802	804	.00	1.15	.21	1.37	27.00
802	808	.36	1.48	.41	2.25	141.00
802	809	.62	1.13	.73	2.49	151.00
802	812	.00	1.25	.55	1.79	29.00
802	815	2.76	1.64	.66	5.06	35.00
803	805	.65	1.00	.77	2.42	225.00
803	806	.44	1.31	.27	2.02	99.00
803	807	.88	1.15	.71	2.74	264.00
803	810	2.49	.72	.23	3.44	46.00
803	811	.00	1.25	.38	1.63	45.00
803	823	.25	.73	.63	1.61	85.00
804	813	.91	1.45	.95	3.31	421.00
805	814	.00	2.09	.08	2.17	14.00
806	816	.00	.86	1.34	2.20	143.00
807	819	.00	.92	.93	1.86	68.00

808	821	.30	.62	.84	1.76	75.00
809	824	.00	2.19	10.07	12.26	1.00
809	829	.00	1.00	.00	1.00	2.00
809	831	.00	2.35	.00	2.35	1.00
865	865	.94	1.14	1.30	3.38	1621.00

Table 5 indicates some disparity of average index values in some of the larger aggregations of occupation grouping. This appears to be largely due to small numbers of observations in some of the old occupation groupings. If only the old occupations with more than 30 cases are considered, the severity scores for the old occupational groupings show much greater uniformity within the new occupational groupings.

7. Summary

Validation of the severity index for occupational injury claims calculated from the Victorian WorkCover Authority was carried out in this paper. The database variables used to calculate the severity index all appeared to be complete and had means, standard deviations and ranges within expected bounds. Correlation analysis showed each component of the index to independently describe different measures of severity with the total severity index to be most strongly related to the maim index component ahead of the hospital and days index components in that order. The total severity index showed good relationship to the relative severities of coded claimant afflictions. The relationship of the total index with maim type was less clear due to the small number of maim claims in the database. Claim total cost showed strong relationship with all three index components with the days component being strongest followed by the hospital and maim component in that order. This suggested the index gave much more weight the maims and hospital components in reflecting total claim severity than did total cost. Some inconsistency was found in the severity index of occupations collapsed to make the new, broader occupation groups for analysis. This was attributed mainly to the small number of cases in some of these groups.

APPENDIX 2

Analyses by Cause of injury (agency)

A second cut of the main dataset - all claims for the period Dec 1, 1992 - March 31, 1993 - was made to explore, to a limited and preliminary extent the distribution of agency by compensation type for the full fifteen month dataset. The following table presents the results of this analysis (refer Section 3.4 for discussion of this analysis).

Table 1. *Variable Summary StatisticAgency By Compensation Type*

Agency	Code	Compensation Days = 0 (n = 16,102)	Compensation Days > 0 (n = 21,449)	Injury Date not within 1.12.93 - 31.3.94 (n = 11,993)
Other motor or source of mechanical power	119	24	73	14
Transmission belt, cable, rope, pulley, pinion, etc	122	13	45	15
Turning, boring, drilling, reaming, milling machine	132	17	44	15
Abrasive, grinding machine	133	33	57	11
Other metal - working machinery	139	63	73	36
Circular saw	141	7	46	7
Other saw	142	45	116	23
Other wood - working machinery	149	27	48	9
Cutting, slicing, mincing, mixing machine	181	32	85	17
Textile, clothing & footwear making machine	191	21	57	28
Machine unspecified	198	106	170	92
Other machinery nec	199	197	454	137
Lift, elevator, or escalator	212	24	51	17
Forklift, pallet truck and the like	215	100	236	68
Other lifting equipment	219	48	97	29
Lorry or truck	232	50	147	28
Car or station wagon	234	152	282	388
Motor cycle or scooter	235	20	51	28
Trailer and caravan	236	25	48	11
Other wheeled transportation	239	120	324	154
Other means of transportation	299	46	144	45
Other electric hand tool/appliance (typewriters)	359	41	50	29
Knife	371	137	363	59
Shovel, spade, hoe, fork, rake and the like	374	45	78	21
Hammer, mallet and the like	375	42	75	36
Broom, mop and similar implement or appliance	378	24	70	15
Other hand tool, implement & appliance, not powered	379	55	80	36

Agency	Code	Compensation Days = 0 (n = 16,102)	Compensation Days > 0 (n = 21,449)	Injury Date not within 1.12.93 - 31.3.94 (n = 11,993)
Scientific & lab, computers & word processors	391	49	33	14
Electrical equipment, nec	392	49	53	31
Furniture and fittings	393	262	421	168
Ladder, mobile ramp, stairway, steps & the like	394	189	532	132
Step, stairway	522	191	351	131
Scaffolding (fixed, suspended or mobile)	395	44	86	14
Other equipment, nec	399	242	426	156
Other basic chemicals	419	49	43	33
Other chemical products nec	429	34	47	22
Brick, slab, tile, paving block, pipe	432	92	168	63
Glass and glassware	434	90	130	30
Dust	435	76	57	32
Oil and fat, animal and vegetable	491	29	56	11
Tree felled for processing, shipboard, plywood, etc	492	57	144	50
Ferrous and non-ferrous metal	493	197	294	102
Bag, bale, bundle, containing goods or materials	494	200	453	160
Crate, box, case, carton, drum, tin, bin	495	739	1648	619
Protruding stake, nail, wire, splinter, etc.	496	55	55	24
Water, beverage, steam	497	22	77	12
Fragment nec	498	52	40	18
Other material, substance or object	499	635	980	370
Traffic and working surfaces	512	53	97	45
Water	513	19	50	7
Tree, branch, other vegetation	515	43	95	34
Gate, fence and the like	516	32	60	28
Other outdoor working environment	519	442	419	305
Floor or other working surface	521	329	707	226
Floor, wall or ceiling opening	523	75	165	61
Indoor environment (eg. lighting, ventilation)	524	1314	23	1086
Other indoor working environment	529	549	273	510
Roof, floor or face of mine or tunnel	531	20	75	12
Live animal	611	111	272	56
Carcass	612	50	189	36
Other animal product	619	13	66	10
Personal condition	632	43	87	43
Human body	639	598	1284	363
Other agency nec	699	3375	4061	2320
Agency not apparent	701	1193	1263	1012
Agency not known	799	2273	1518	1881

APPENDIX 3

Assessment of narrative Quality

Ideally, in any injury surveillance system, narrative data should provide a concise statement of the circumstances and nature of an injury event. It should expand on and enhance the information otherwise available from coded data. Arguably, it should also stand alone as a description of the case.

A random sample of 200 unit records including narratives was extracted from the WorkCover database for the period under study. Some comparisons were made with a similar random sample of narrative data from the VISS injury database. The criteria used for comparison is shown in the following table:.

Factor
Activity (specific)
Location
What went wrong
What actually produced the bodily harm
Product including brand or model name or other agent (person, animal)
Bonus information, re: protective gear, body part injured etc.

On assessment of the WorkCover narratives, it was found that only 40% of the cases provided information on what went wrong, 36% noted the specific location of the injury and 34% the activity. These figures were quite low when compared with, for example, a sample of narratives from the Victorian Injury Surveillance System (VISS) database where 64% specified what went wrong, 78% had a location and 77% specified the activity.

Significantly however, the majority of WorkCover narratives did specify what actually produced bodily harm and in almost all cases the body part injured was noted. There were 4 cases were the narratives provided no relevant information as the victims were suffering from stress rather than injury.

(No information seems to be recorded in the WorkCover narratives on whether protective gear was worn by the victim (eg. safety glasses) or whether safety devices were used on equipment (eg. shields))

Agency Code - "Other Categories"

For the random sample of 200 cases accessed, the narratives were further explored for those cases where a non-specific agency code was used. The narratives (CLAIMDS, ACCNT-TX, INCDT-TX, BODY-TX) were examined to determine whether specific injury causation data were in fact available.

Over half of these cases (110) had an agency code which represented an "other category". Of these, approximately 60% had information in the narrative on the agency involved: eg.

- "Steel plate came off roller causing thumb to become jammed."
  – but coded as '399, other equipment, nec;

- "Acute pain and strain lumbar region, lifting and loading beer cartons"
  – but coded as '219, other lifting equipment'

- "Fell off 10 foot ladder when the ladder started to move & give way"
  – but coded as '799, agency not known'

The agency code has been described as: "object/action causing injury". There seems to be no codes to describe actions and these are therefore coded as an 'other', eg. falls. In many cases a factor has been mentioned in the narrative, eg. "fall from truck" and "slipped on vegetable", and therefore the coding of the factor involved would give a better indication of what happened.

The code "other" seems to be used in cases even where there are more appropriate codes available, eg. "cut hand whilst handling knife on the phone" had been coded as 'agency not known'. In another cases a truck has been coded as "other wheeled transportation" instead of using the code for truck.

In addition to this formal analysis of narrative quality, nearly 2400 cases were also examined as part of the detailed analyses of the 11 selected occupational groups, as reported in Section 3. Overall the free text “Accident description” and “Accident Text” typically provided a good description of the mechanism and agency. The major disadvantage and problem is that these fields had to be searched manually, thus making this exercise impractical for ongoing research and analysis.

The upgrading requirements of the data base are discussed in detail in Section 4.1 Coding System.

APPENDIX 4

Summary of groupings for "Accident type/mechanism" used for manual compilation from the case material, free text fields 'Claims Description', 'Accident text',

Occupation Group:			**WIC Codes:**
(N=)			
Accident type /mechanism	**Tot**	No.	**Case ID**
Traumatic contact with-materials			
-hand tools			
-substances/burns/chemicals			
-dropped items onto limbs			
-hit by animal			
Traumatic contact with machines, power tools			
-electric equipment			
Traumatic contact with vehicles, cranes etc			
Overexertion- lifting pulling pushing & tools			
Overexertion- movement, sport			
Overexertion-repetitive, other			
Slip, trip, fall- same level			
-on to tools, object			
Slip, trip, fall -lower level			
-off ladders/stairs			
-off horse			
Slip, trip, fall- associated with vehicles, machinery			
Motor vehicle accident			
Motor vehicle-rough ride			
Other -stress			
-disease etc			
-assault			
Unknown			
TOTAL N			