FIRST CLASS PERSONAL DAMAGE CONTROL
STEP 1 - INDUSTRY CLASS I TAXONOMY

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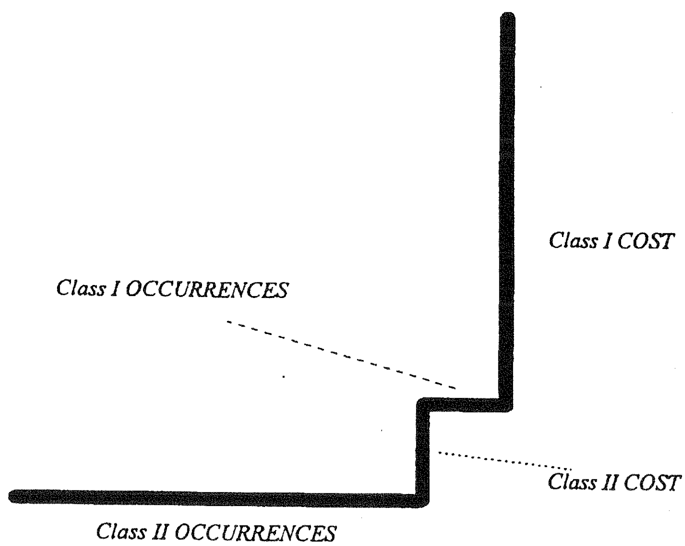
As a result of work, people become damaged (injury or illness). The damage falls naturally into one of three groups. The person's life is permanently altered (Class I), temporarily altered (Class II) or inconvenienced (Class III).

The Industry Commission (1) reported the number of damaging occurrences (my words) and the $20 billion cost of these. McDonald (2) used the Commission's figures to show Class I damage accounted for 82% of cost and Class II for 18% of costs. **Figure 1** is a line motif summarising this data

87% of occurrences were Class II and gave 18% of costs
13% of occurrences were Class I and gave 82% of costs

Figure 1. *Class I - Line Motif*



Class I damage occurs rarely, yet the cost is enormous - $16.4 billion of the $20 billion annually.
According to the Industry Commission (1995) figures, Class I damage comprises:

Fatal - 70

Non-Fatal - 50,000
- Never work again - 20,000
- Lower paid job - 30,000

Safety is essentially a Class I problem and for effective management the potential Class I damage has to be predicted. Individual experience is relatively meaningless, eg. during the 1960's and 1970's fatalities from tractors were the second most frequent work fatality in Australia after motor vehicles. There were 100 fatalities per year from 300,000 tractors in Australia. A fatality occurred once every 3,000 tractor years. This is the frequency which must be understood to enable effective management of Class I damage.
People are damaged as the result of an energy exchange which goes outside tolerable limits. This damaging energy exchange occurs as the climax to one or more sequences of events, collectively known as a damaging occurrence in which essential and contributory factors are identifiable. A damaging occurrence is the logical outcome of the system of work, of the energy stored and utilised within the system, and of the characteristics of the participants (human, machine, environment) interacting within that system. It must be

recognised clearly that the production of damage and the onset of pain are separate and sometimes related occurrences.

For effective safety management potential Class I damage must be predicted.

The prediction of Class I damage potential is the prediction of Class I Damaging Energy Exchange Potentials (D.E.E.P.s).

Class I Prediction requires:

- Damaging Occurrence Investigation
- External Class I Taxonomy
- Internal Taxonomy (Class II and III)
- Workforce Information (eg. Critical Incident Recall)
- Relevant Body of Knowledge of Science

Once these have been collected it is possible to do:

- Physical Inspections
- Mental Reviews of Work Procedures
- Behaviour Observations

On the basis of these eight sources of information, it is possible to make an informed prediction of Class I damage and establish priorities.

The New South Wales Minerals Council and the Queensland Mining Council commissioned the study by Geoff McDonald & Associates of 1231 damaging occurrences in the Queensland and New South Wales Coal Industries, 1990-1995. These occurrences represent the best approximation to Class I occurrences that the Industry could manage and the result of the study is the production of an external taxonomy which is the second item in the list above for the prediction of Class I damage. The occurrences considered resulted in greater than 90 days lost, fatality or lump sum payment. The New South Wales data included the actual monies paid out whilst the Queensland data contained the number of days lost for each occurrence and a daily monetary figure was supplied. The cost of fatalities, for example was calculated in accordance with the recommendation of **AS1885-1976 WORKPLACE INJURY & DISEASE RECORDING STANDARD**. According to this a fatality is calculated as 220 days lost. With the figure supplied this gave a value of a little over $30,000 per fatality. You will no doubt agree with the author that this figure is farcical and points out the absurdity of that aspect of AS1885. In the detailed costing by the Industry Commission of 1995 the cost of a typical fatality was estimated at the lower level of $425,560 and a upper value of $446,900.

The individual occurrences were sorted into a taxonomy based on the type of energy involved in the damaging energy exchange. **Figure 2** shows the taxonomy of the total Industry and from that figure it can be seen that human energy, gravitational energy and machine energy accounted for 92.7% of the occurrences and 94.8% of the total cost.

Figure 3 shows the taxonomy for Underground Mining where human energy, gravitational energy and machine energy account for 93% of occurrences and 94% of the cost.

Figure 4 shows the taxonomy for the Open Cut Coal Mining Industry where human energy, gravitational energy and machine energy account for 92.3% of occurrences and 95.6% of the cost

Total	Category	Taxon	Occurrences	Cost	*Page*
	Human Energy	*Taxon 1*	491	$ 49,752,622	*2*
	Gravitational Energy	*Taxon 2*	398	$ 45,423,891	*24*
	Machine Energy	*Taxon 3*	254	$ 28,912,057	*45*
	Object Energy	*Taxon 4*	36	$ 2,653,961	*59*
	Thermal Energy	*Taxon 5*	16	$ 919,499	*63*
	Chemical Energy	*Taxon 6*	12	$ 1,624,877	*65*
1231	Susceptible Part	*Taxon 7*	7	$ 378,186	*64*
	Anxiety/Stress Disorder	*Taxon 8*	7	$ 171,557	*64*
$130,863,363	Oxygen Deprivation	*Taxon 9*	1	$ 205,723	*66*
	Heart Attack	*Taxon 10*	1	$ 20,288	*66*
	Biological Energy	*Taxon 11*	1	$ 19,574	*66*
	Specialised Shape	*Taxon 12*	2	$ 65,307	*66*
	Insufficient Information		5	$ 715,821	

Figure 2. *Taxonomy Of Accidents In The Coal Mining Industry - New South Wales and Queensland.*

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892 $99,607,379	Human Energy	*Taxon 1*	375	$ 41,049,966	*2*
	Gravitational Energy	*Taxon 2*	309	$ 35,762,477	*22*
	Machine Energy	*Taxon 3*	144	$ 17,231,192	*43*
	Object Energy	*Taxon 4*	27	$ 2,066,040	*57*
	Thermal Energy	*Taxon 5*	14	$ 825,383	*61*
	Chemical Energy	*Taxon 6*	10	$ 1,585,728	*62*
	Susceptible Part	*Taxon 7*	3	$ 225,493	*63*
	Anxiety/Stress Disorder	*Taxon 8*	3	$ 79,972	*61*
	Oxygen Deprivation	*Taxon 9*	0	0	
	Heart Attack	*Taxon 10*	0	0	
	Biological Energy	*Taxon 11*	0	0	
	Specialised Shape	*Taxon 12*	2	$ 65,307	*63*
	Insufficient Information		5	$ 715,821	

Figure 3. *Taxonomy of Accidents in the Coal Mining Industry - New South Wales and Queensland - Underground Mines.*

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312 $25,875,390	Human Energy	*Taxon 1*	104	$ 6,918,646	*2*
	Gravitational Energy	*Taxon 2*	78	$ 6,320 949	*21*
	Machine Energy	*Taxon 3*	106	$11,510,039	*36*
	Object Energy	*Taxon 4*	10	$ 587,921	*45*
	Thermal Energy	*Taxon 5*	2	$ 94,116	*48*
	Chemical Energy	*Taxon 6*	2	$ 39,149	*49*
	Susceptible Part	*Taxon 7*	3	$ 67,400	*49*
	Anxiety/Stress Disorder	*Taxon 8*	4	$ 91,585	*48*
	Oxygen Deprivation	*Taxon 9*	1	$ 205,723	*50*
	Heart Attack	*Taxon 10*	1	$ 20,288	*50*
	Biological Energy	*Taxon 11*	1	$ 19,574	*50*
	Specialised Shape	*Taxon 12*	0	0	
	Insufficient Information		0	0	

Figure 4. *Taxonomy of Accidents in the Coal Mining Industry - New South Wales and Queensland - Open Cut Mines.*

In the full taxonomies the groups shown above are progressively sub-divided, and the taxonomy of the combined Industry extends for 66 pages; for the Underground Mining Industry this extends for 63 pages and for the Open Cut Mining, 50 pages. This taxonomy represents a concise summary of past Class I damage in the Industry and as such warrants very detailed and careful examination and interpretation to help develop the prediction base, forward planning and action.

Some of the major overview considerations are presented as illustrative of the taxonomy.

It must be emphasised that attention must be paid to the whole of the taxonomy, not simply the major percentages, but the occurrences resulting in the major percentage of the damage cannot be ignored. The fractions and percentages in what follows refers to one of the major taxa (Human, Gravitational, Machine) of which they are a part.

A brief summary for underground shows that within human energy, work action accounts for two thirds of the damage, whereas body relocation and movement, ie. people slipping without falling over results in one fifth of the damage. Work action involves lifting, pushing, pulling and the like. Within gravitational energy, falling objects accounts for a little under half of the damage, with the falls of people fairly evenly divided between falls involving a change of height, and falls to the same level.

Within machine energy approximately 80% of the damage is associated with mobile equipment. Roughness of ride is involved in about half the machine energy cases but accounts for only a little over one third of the cost. Ancillary workers and pedestrians struck by machines come from 5% of Machine Energy cases but produce 15% of cost, while 7% of cases involved people caught between machine components resulting in 16% of the machine energy costs.

The areas for focused attention in Underground Mining involve human energy (manual handling and moving about), gravitational energy (falling objects and falls of people including both change of height and to the same level), and machine energy (roughness of ride, becoming caught between machine components, and ancillary workers and pedestrians struck by machines). A more detailed picture of these occurrences is available by reference to the progressively sub-dividing taxonomy.

Within the Open Cut Mining operations human energy, work action (ie. lifting, pushing, pulling, etc.) accounts for almost two thirds of cases and cost. Body relocation and movement accounted for just over one quarter of cases and cost. Within gravitational energy under one quarter of the cases and over one third of the cost involving falling objects, with the remainder being falls of persons, with falls involving change of height involving 60% of cases and 39% of cost. Access to mobile equipment played a major part in the change of height falls.

Within machine energy, vibration/jarring accounted for three quarters of the cases and nearly 90% of the cost. The term 'ride disturbance' would include vibration and jarring, a person being struck on the interior of the machine, a vehicle being struck in the loading process or having load dropped in the back. Cases in these groups involve a total of 29% of the total cases in the Open Cut Mining and involve 47% of the cost.

From the above it can be seen that in both underground and surface operations manual handling, slips and falls of people and ride disturbance are major problem areas.

The damaging energy exchanges which produce damage to people can be classified according to the time intensity characteristic of the energy exchange into Type A (single, traumatic), Type B (repeated), and Type C (continuous) as shown in **Figure 5**.

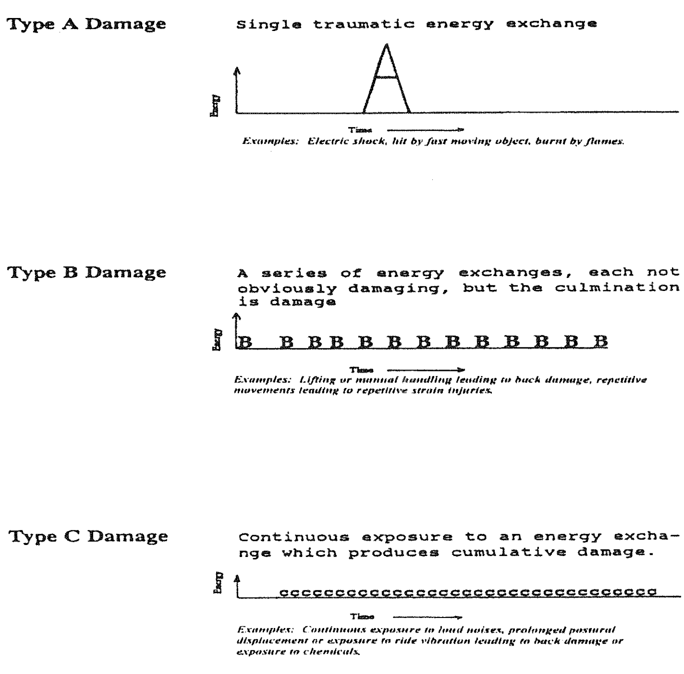

Figure 5. *Types of Damaging Energy Exchange.*

Whilst many of the incidents classified in the taxonomy are reported as a result of the onset of a pain episode, the final damage is often the result of an accumulation of Type B and Type C damage, with possibly a relatively small Type A damage providing the final episode. Others are undoubtedly Type A occurrences.

Effective elimination of much of the damage shown in the taxonomy will not be achieved by reacting to individual occurrences, but will be achieved by the development of understanding and application of effective management strategies.

The understanding will come from selection of relevant information from the Body of Knowledge of Science and Harvesting of Relevant Experience. Quality scientific information on the production of musculoskeletal damage and back damage in particular has existed in readily useable form since 1981. The author's experience is that such quality information has been virtually ignored and is relatively little used throughout industry as a whole. Good quality information has also existed in relation to slips and falls for many years. Information on grip requirements of surfaces can be established and before underground miners draw attention to the difficulties of the natural surface occurring within the mine, it should be recognised that where a slip has occurred and the person has fallen to the same level, 27 cases involved man-made surfaces or objects taken into the mine by humans, as compared to 30 on natural surfaces.

A report by Geoff McDonald & Associates (3), 1989, reported findings on mobile equipment access damage occurrences and gave design guidelines for access systems. It is regrettable that seminars were not held to communicate the findings of this research project to the industry.

There is a wealth of scientific knowledge on ride vibration, and resulting damage, but its application within the industry could be better organised both by reference to the taxonomic detail of occurrence and by the harvesting of experience. Having one or two operators sit on committees to consider such problems does not take maximum benefit of the experience existing in operations. (Remember 3000 tractor years for a fatality).

As part of the preparation for a recent Court case in the USA involving ride vibration of a coal hauler, a taxonomy of ride disturbance was developed and is shown as **Figure 6**. This showed the variety of ride disturbance experiences by the operator and was based on interviews with 47 haul drivers

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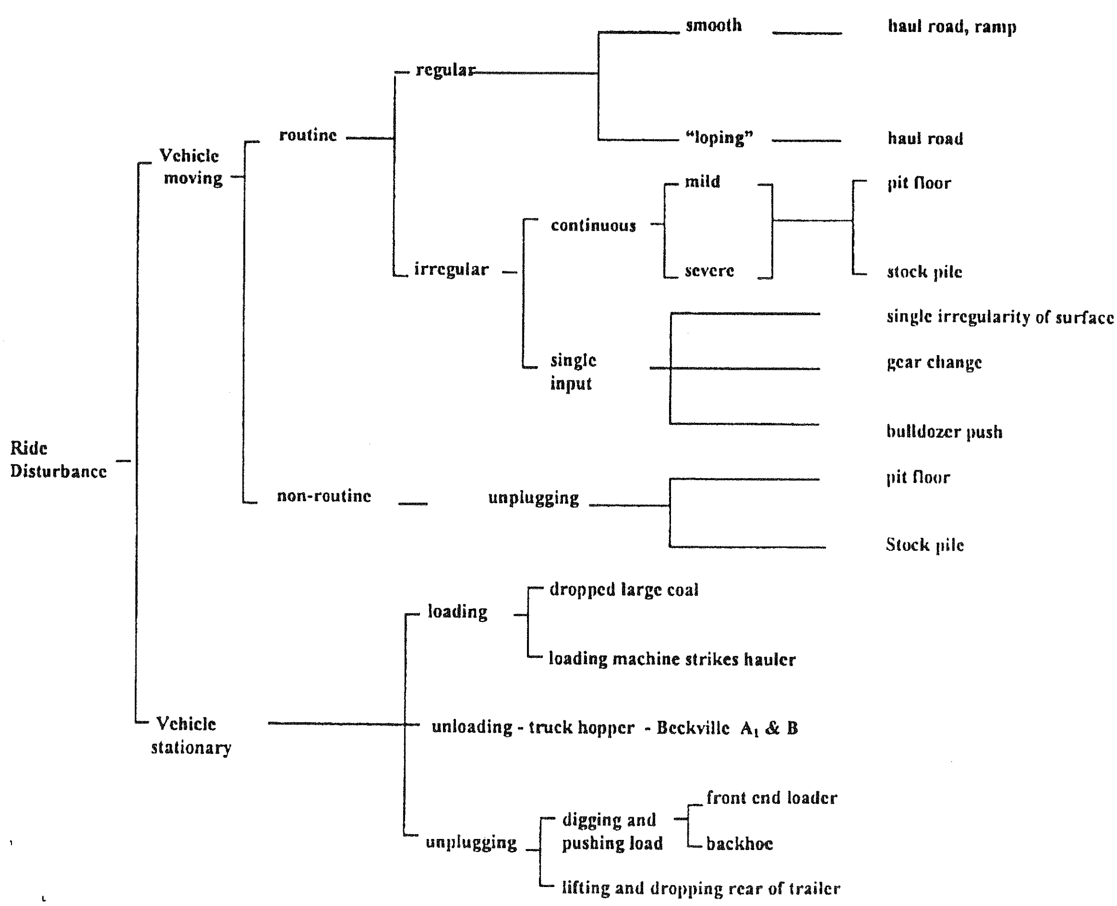

Figure 6. *Taxonomy of Ride Disturbance of Coal Haulers.*

These haulers developed a self induced loping, at times reared up during automatic gear changing (top of ramp), in wet weather were pushed up ramps by bulldozers, had large coal "plug" the bottom dumping doors, and were used to crush coal through bars of the unloading hopper.

While it is assumed many of these practices do not exist in our mines, it is only by interviewing operators in a supportive and non-threatening manner that the experience can be harvested effectively. Until this is done the problems to be confronted are unknown.

VIPAC (4) showed that the typical suspension seat is ineffective or amplifies risk at 2Hz which is a typical dominant frequency for these types of machines. A different solution is required by either smarter seats or suspended cabins, as are now being introduced on forwarders - scraper like log transporters, L fgren (5).

The efficiency of control of damage to people from work will be greatly increased by a cohesive industry approach. While specific projects can be identified from the taxonomy, the prediction steps of Internal, Taxonomy, Workforce Information, and Relevant Body of Knowledge of Science should now to be followed so that the most effective Physical Inspections, Mental Reviews of Work Procedures and Behaviour Observation can be conducted. In the meantime, the full Taxonomy warrants careful study and should be the subject for seminars within the industry.

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