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MEASURING THE TOTAL COST OF INJURY IN NEW ZEALAND:

A REVIEW OF ALTERNATIVE COST METHODOLOGIES

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1 EXECUTIVE SUMMARY....................2

2 WHAT IS THE TOTAL COST OF INJURY....................3

2.1 DIRECT COSTS....................4

2.2 INDIRECT COSTS....................8

2.3 INTANGIBLE COSTS....................10

3 WHAT ARE THE 'CORE' METHODS OF VALUATION....................11

3.1 DIRECT COST METHODS....................11

3.2 INDIRECT COST METHODS....................13

3.3 INTANGIBLE COST METHODS....................19

3.4 TOTAL COST METHODS....................24

3.5 A SUMMARY OF THE CORE METHODS....................27

4 HOW HAVE THE CORE METHODS BEEN 'HYBRIDISED'....................28

4.1 COMBINING EARNINGS WITH WTP....................28

4.2 INCLUDING HEALTH STATUS INDICES....................28

4.3 MONETISING HEALTH STATUS INDICES....................28

5 WHAT ARE THE POTENTIAL WAYS FORWARD....................30

5.1 DIRECT COSTS....................30

5.2 INDIRECT COSTS....................30

5.3 INTANGIBLE COSTS....................31

5.4 A POTENTIAL FRAMEWORK....................32

6 REFERENCES....................33

1 EXECUTIVE SUMMARY

This report has been prepared by Business and Economic Research Ltd (BERL) to assist the Department of Labour to develop a robust and practical methodology for measuring the cost of injury in New Zealand. The purpose of this report is to review the methods of valuation that have been applied elsewhere, and to indicate how these methods might be applied in New Zealand. Thus, this report provides a basic framework for measuring the total cost of injury in New Zealand.

Note that this report focuses on methods used to value the *cost* of injuries as opposed to methods for assessing whether programs or new investments designed to mitigate these costs yield *net benefits* from an economic or societal perspective. However, these methods of assessment (Cost-Benefit, Cost-Utility, etc) all require some measure of loss in order to assess the merits of such programs. The framework outlined in this report therefore recognises that different organisations can have different policy objectives and methods of assessment.

2 WHAT IS THE TOTAL COST OF INJURY

This section describes the total cost of injury with cost elements categorised into direct, indirect and intangible costs, which is consistent with the literature in health economics. These costs are not limited to the individual and include costs that filter through to other aspects of economic and societal wellbeing. The below table shows the composition of total cost across two dimensions with the direct, indirect and intangible cost components identified according to their potential impact on economic and societal wellbeing. Thus, total cost can be defined as the sum of all direct, indirect and intangible costs across this socioeconomic dimension.

Table 2.1 The composition of the total injury costs

TOTAL INJURY COSTS	Individual	Family	Employer	Economy	Societal
Direct Costs					
Accident costs *(i)*	✓		✓	✓	✓
Medical costs	✓		✓		
Non-medical costs	✓	✓	✓		
Indirect Costs					
Absenteeism			✓	✓	
Productivity losses:					
i) reduced activity/ability	✓			✓	
ii) reduced participation	✓			✓	
Family worker substitution		✓			
Worker replacement/substitution			✓		
Taxation				✓	
Intangible Costs					
Loss of life	✓	✓			✓
Loss of life expectancy	✓	✓			✓
Loss of quality of life	✓	✓			✓
Physical suffering	✓	✓			✓
Mental suffering	✓	✓			✓

(i) not strictly a cost of injury
Source: BERL

Total cost covers a range of social and economic interactions which in turn depend upon a number of variables including the level of functional impairment caused to the injured person. This can be regarded as the temporary and permanent change in the health status of an individual following an injury event. Change in the health status of the individual plays a central role in determining the impact of an injury event, with the magnitude of the change in individual health status affecting the ability of the individual to work and the permanence of intangible costs such as pain and suffering.

The direct, indirect and intangible costs of injury events are discussed in more detail in the rest of this section. Some general observations are also made regarding the impact of these injury costs. However, these impacts are not discussed in more detail until section 4 of this report. This is because the methods of valuation (in section 3) are based upon different theoretical frameworks, which lead to different and sometimes opposing views regarding the impact of injuries, and therefore the total cost of injury events.

2.1 DIRECT COSTS

Direct costs are expenditures and damages relating to the occurrence and the prevention of an injury. These can be categorised as accident costs, medical costs, and non-medical costs as shown in the table 2.1 above.

2.1.1 Accident Costs

Accident costs are comprised of physical property damages as the result of an incident and include assets such as vehicles, buildings and equipment. Although these damages are strictly 'accident costs' as opposed to 'injury costs', these costs are often included in Economic Impact Assessments (EIAs) of events or accidents.

The definition of an accident cost can be widened to include the value of other physical assets such as the environment. Thus, events such as environmental disasters could be assessed through estimating the costs from both the damage to physical assets as well as the cost of human injuries and fatalities. The impact of accident costs can therefore span across the socioeconomic dimension from the individual too societal wellbeing (eg the environment).

The importance of accident costs will tend to differ according to the event that is being assessed. In some cases such as natural disasters, accident costs will be quite significant especially when the resulting losses also lead to 'downstream' impacts upon production. Downstream impacts relate to the loss of economic production (ie GDP) that occurs as a result of these assets being unavailable for use in the production process. An illustration of how accident and injury costs can be incorporated is given in the box below, which assesses the economic impact of industrial fires in New Zealand.

Profile of Industrial Fire Costs (BERL, 2002)

The report entitled '*An Economic Assessment of Industrial Fires*' which was completed for the New Zealand Fire Service Commission (NZFSC) provides an example of including injury costs in economic impact assessments. In this report, building damages from industrial fires was combined with estimates of NZFSC operational costs, downstream production losses, and injury costs.

The downstream production losses were estimated from company insurance claims data for business interruption in combination with input-output tables, which together gave a measure of the resulting losses in industrial production (ie GDP). Injury costs were estimated using injury data contained in the Fire Incident Reporting System (a database maintained by Fire Service personnel) and the Land Transport Authority's measure of the Value of Statistical Life. Note that the LTSA's measure of the Value of Statistical Life is discussed in section 3 of this report.

The composition of economic costs from industrial fires for the year 2000 is shown below. Material damages, which includes insured assets such as plant and buildings, stock, machinery and equipment accounts for about 40% of the total economic costs and can be thought of as 'direct accident costs'. The operational costs of the NZFSC were also high at about 30% of the total economic costs. However, the cost of fire related injuries were quite low in this study, reflecting the fact that relatively few industrial injuries occurred.

Cost Component	$Mn
Material damages	36.1
NZFSC costs	23.3
Production losses	18.4
Injuries and fatalities	8.5
Total costs	**86.3**

Source: An Economic Assessment of Industrial Fires in New Zealand. BERL. 2002.

While direct accident costs can be quite significant, the purpose of this report is to focus on the methods of valuing injury. Therefore, accident costs have been put to one side for the rest of this report, except to note that the valuation methods applied in other fields such as environmental economics have often been adopted for valuing injuries in health economics. These methods are discussed in section 3 of this report.

2.1.2 Medical Costs

Direct medical costs are comprised of expenditures on goods and services relating to the medical care of patients, and capital investment in facilities, staff training and research. Medical goods and services are those used in the prevention, detection, transportation, treatment, and rehabilitation of the patient.

While the case for medical goods and services to be included as a direct cost is obvious, the case of including capital investment is perhaps less apparent. However, the inclusion of capital investment is based on the concept of 'opportunity cost' - where investment in these health services constitute a missed opportunity to use these expenditures for other investment or consumption activities. Hence, overhead medical charges such as interest expenditure and administration costs are also included as direct medical costs.

There is a range of issues regarding the correct process for estimating direct costs, with the biggest problem being that prices charged in health care to consumers are distorted and rarely reflect true economic value. The interaction between insurance plans and the regulatory system yield a gap between accounting and economic (opportunity) costs. To calculate total health care costs in New Zealand's multiple payer system of health care financing, contributions from several public and private sources need to be considered and corrected for double accounting.

In New Zealand, few medical services are provided on a strictly commercial basis. The ACC does, however, have a set of standard or maximum charges where costs are quite explicit and so these conceptual issues can be addressed. Specifically, it may be possible to obtain adequate estimates of average direct costs over a range of relevant medical procedures. The ACC also has a rich database of injuries and treatment costs, which can assist in the estimation of direct costs. The main elements missing from these costings are those medical and non-medical expenditures by individuals and employers that are not covered by the ACC. Some of these expenditures may be available from the private medical insurers through their policies, some of which provide full cost reimbursement.

The ACC scheme can be regarded as a '24-hour no-fault compensation' scheme and in this sense the medical costs of injuries have been socialised in New Zealand. Hence, the impact of actual medical costs is not borne by the injured person but by individuals and employers in aggregate through the ACC levy system. Because this system is socialised, the impact of direct costs is more complicated. But generally speaking, the impact of the injury costs via the ACC levy will depend on the ability of enterprises to pass-on the ACC levy to employees or to consumers. However, the issue of who bears the cost of ACC does not affect the level of actual total costs involved.

2.1.3 Non-Medical Costs

Direct non-medical costs consist of expenditures on goods and services incurred as a result of the injury event, but which are not related to the medical care of the patient. Non-medical costs include those of non-emergency transport, informal care, household help, vocational and family counselling, and alterations to the home and business.

Table 2.2 presents a summary of the direct medical and non-medical costs considered in five studies. This table has been adapted from a report by Beeck & Mulder (1998). The authors note that large differences exist in the selection of direct cost elements and that in some studies important costs are lacking. They also note that these differences could reflect international differences in the structure and financing of medical care. It is also evident from these studies that the data required will be dependent on the nature of the injury and the extent to which on-going care or rehabilitation services are required.

Table 2.2 direct medical and non-medical cost elements by various studies

DIRECT MEDICAL AND NON-MEDICAL COSTS	Den Toom & Schuurman (1998)	Rice et al (1998)	COST (1998)	SWOV (1996)	CPSC (1990)
Emergency Services					
First aid			🗐		
Transport	🗐	🗐		🗐	🗐
Hospital Care					
Tests					🗐
Treatment	🗐	🗐	🗐	🗐	
Medical personnel	🗐			🗐	🗐
Facilities					🗐
Rehabilitation	🗐	🗐		🗐	🗐
Outpatient treatment	🗐	🗐	🗐	🗐	
Re-hospitalisation		🗐			
Non-hospital Care					
Physician care	🗐	🗐			
Physical therapy	🗐	🗐			
Nursing home	🗐	🗐			
Attendant care	🗐	🗐			
Dental care	🗐				
Medication	🗐	🗐		🗐	🗐
Aids & appliances			🗐		🗐
Non-medical Costs					
Home adaptations		🗐	🗐		
Special transportation			🗐		
Vocational rehabilitation		🗐	🗐		
Educational rehabilitation			🗐		
Administration insurance costs		🗐			

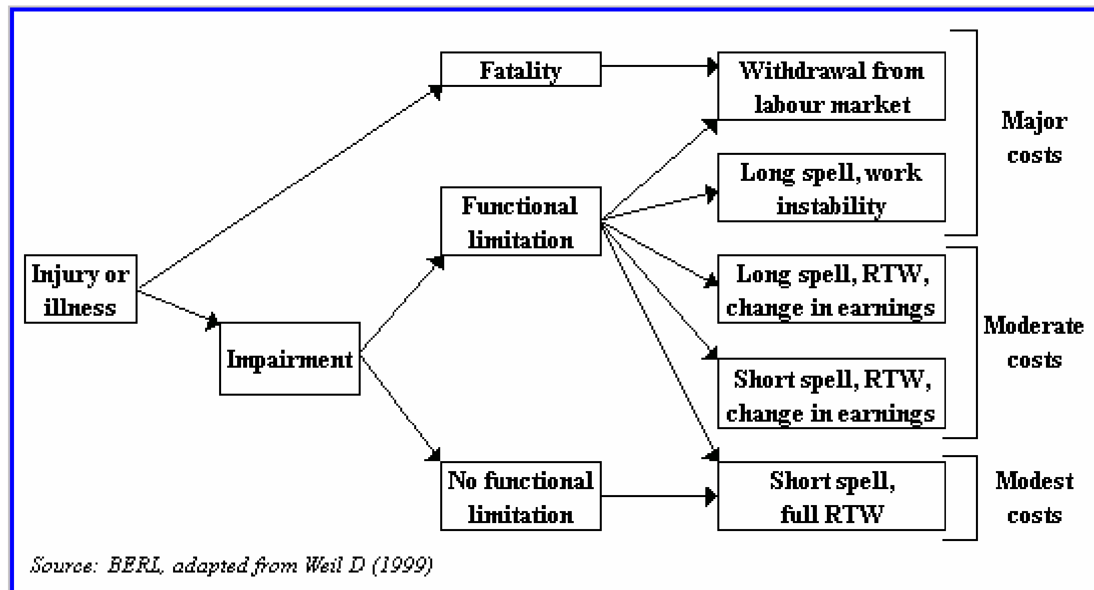
Source: BERL, adapted from Beeck, E & Mulder, S. (1998)

2.2 INDIRECT COSTS

Indirect costs can be defined as the output losses resulting from an injury event. For the individual these costs consist of output losses due to morbidity or mortality. In the case of morbidity, output losses can be the consequence of reduced productivity and reduced participation in the workforce. In addition, injuries may cause unwanted job changes for the individual and lost opportunities for promotion and education.

Generally speaking, the size of these output losses will tend to relate to the individual's level of functional impairment over the short, medium, and long term. The figure below shows how functional impairment can impact upon an individual's participation in the workforce, their ability to earn and therefore, the broad magnitude of the indirect impact upon the individual.

Figure 2.1 Disability pathways and the labour market



However, there remains considerable debate within the economics profession regarding the impact of these indirect costs. While this issue is discussed in more depth in section 3 of this report, the broad question is whether or not these losses for the individual have an impact upon the output of the firm and hence to total economic output. This question reflects the different theoretical approaches taken in the Human Capital Method (HCM) and the Friction Cost Method (FCM). Nonetheless, the figure above does illustrate the relationship between functional impairment and its influence on the individual's return to the workforce, and is especially relevant for interventions relating to rehabilitation, occupational counselling, etc.

Indirect costs include the output losses of other family members in cases where informal patient care replaces non-labour market activities such as housekeeping which otherwise would have been performed. In the case of long-term injury, family members may need to enter the workforce or work longer hours to compensate for lost household earnings, a situation described as family worker substitution in table 2.1. Although it is possible to value non-labour market output losses and family worker substitution using standard methods, these costs are seldom included in empirical studies due to the lack of accurate information. There can also be indirect costs to the employer as caused by absenteeism resulting from an injury. As an illustration, the opposite effect is discussed in below.

Absenteeism Benefits from Improved Health & Fitness

BERL's study on the *'Economic Impacts of Sport'* for the Hong Kong Sports Development Board (HKSDB) included a review of the indirect benefits of improved health and fitness upon productivity and absenteeism. The table below shows the impact on absenteeism as recorded by a number of studies on the introduction of health and fitness programs at the firm or organisational level. Most of these studies show quite a strong correlation between the introduction of a program and lower absenteeism, with the link presumably being both physical and psychological for program participants.

Company or Survey	Program Type	Impact on Absenteeism
Survey f Top 500 Companies	Fitness	Reduced absenteeism over five years
Blackmores Australia	Gym	40% reduced absenteeism
Johnson & Johnson	Fitness in factories	25% reduced absence in control group
Mesa Corporation	Health promotion	Absences were down by 50% after five years
Du Pont Corporation	Health & fitness programmes	14% less sick days than control group
Signature Corporation	Fitness	Less likely to be absent
UK Household Survey	Active sport	33-50% reduced absenteeism
Westpac Bank	Fitness	29% reduced absenteeism
Cyanamaid	Fitness	1.8 days less absence than others, savings on fifty participants of 44,500 British Pounds per annum

Source: Cyanamaid data from Sport England (1999b)

A number of these studies also reported positive impacts on employee productivity levels from the introduction of health and fitness programs. Again, this correlation was linked to physical and psychological factors such as improved cognitive functioning, reaction time, stamina and attitude.

Source: The Economic Benefits of Sport. BERL. 2000.

2.3 INTANGIBLE COSTS

Intangible costs are the reductions in the welfare of people due to physical, mental and behavioural problems as the result of an injury event. There are a number of adverse health outcomes typically associated with reductions in welfare including, mental and physical suffering, the quality of life, and the length of life expectancy. Because these reductions in health status also affect individual welfare, economic theory suggests that people are willing to pay to restore their health or to avoid the risk of such outcomes.

Injuries can also impact upon the welfare of family members through deteriorations in mutually dependent relationships with the injured person. These intangible costs include the mental suffering of siblings and spouses, and social problems such as divorce. With mental illnesses or drug addition, these social problems can include other costs such as bankruptcy, violence and criminal convictions.

The intangible costs of injury are primarily borne by the individual or family members. However, the concept of consumer willingness to pay is also interesting when assessing the impact of intangible costs because it considers how people value the risk of avoiding such costs. This approach suggests that people's sense of welfare is also a function of altruistic concerns for the welfare of others in society (eg societal wellbeing).

A recent study by Strand (2001) provides some interesting insights into intangible costs by estimating the composition of peoples Willingness To Pay (WTP) to avoid certain health risks. His results showed that about one-third of the total WTP measured in his research was motivated by pure self-interest, about one-half was attributable to concerns for the family and the remaining share was attributable to altruistic concerns for other people in society. Other studies have found varying degrees of concern for individual wellbeing, family wellbeing, and societal wellbeing.

3 WHAT ARE THE 'CORE' METHODS OF VALUATION

3.1 DIRECT COST METHODS

Direct costs can be measured by using either a 'top down' or 'bottom up' approach to allocating health expenditures across groups. The incidence (or bottom up) method has the advantage of enabling costs comparisons at a fine level of aggregation compared to the prevalence (or top down) method, but has the disadvantage of requiring detailed data sources which can be time consuming to generate.

3.1.1 The Prevalence Method

In the prevalence method, direct health care costs are assigned 'top down' to each injury classification. Direct costs are those total expenditures considered to be relevant within a certain health sector, which is then distributed to sub-categories of patients according to their respective share in total prevalence. Usually, total prevalence is measured using a consistent indicator such as the share of total hospitalisation days.

Note that the prevalence method provides an estimate of average as opposed to marginal costs. Thus, it is not possible to estimate the true costs incurred from treating a single or additional patient. In other words, some caution is warranted when interpreting the level of health care savings that may result from programs designed to reduce the occurrence of specific injury groups. This is especially be the case if the indicator of prevalence is an inexact measure of marginal costs because for example, the resource required even in similar groupings of injury patients differs by a significant amount.

3.1.2 The Incidence Method

The incidence method takes a 'bottom up' approach to estimating costs and is based on the resource costs of treating well-defined patient groups at a fine level, which are then aggregated towards the desired level of patient grouping. The incidence method has the advantage of enabling researchers to compare patient costs at a fine level of aggregation when compared to the prevalence method, but has the disadvantage of requiring detailed data sources, which are generally not available and can be time consuming to generate. Generally speaking, the incidence method may be less likely to gloss over distortions caused through the aggregation process, especially when the gaps between marginal and average costs between patient groups are quite large.

The Operational Costs of the NZFSC using the Prevalence Approach

In BERL's report entitled *'An Economic Impact of Industrial Fires'* the prevalence method was used to allocate the operational costs of the New Zealand Fire Service Commission to industrial fire incidents. Firstly, the relevant level of expenditure had to be identified. The Fire Service's annual report showed that the cost of emergency response was just 9% of the total $172 million expenditure on operational costs, and that much of this total was actually related to operational readiness. However, these emergency responses could not have been made if the Fire Service is not kept in a state of operational readiness and thus, the total operational costs (eg $172 million) were taken as the relevant figure.

A fairly simple prevalence approach would have been to allocate these costs across all incidents on the basis of a standard indicator. For example, the share of each type of incident relative to all emergency incidents. With industrial fires accounting for about 8% of all active incidents this approach would have allocated about $13 million in operational costs to industrial fires in New Zealand. However, would this indicator provide a fair representation of the quantum of resource used across different types of emergency incidents?

Instead of using the simplified approach above, this study allocated operational costs according to the broad quantum of 'resource' used in response to various emergency incidents. The table below shows a summary of how this allocation was made. Most importantly, the table shows that the average industrial fire required 81 appliance minutes compared to 47 appliance minutes for all active incidents. Thus, on average, the quantum of resource delivered to industrial fires was significantly higher than all active emergency incidents. With industrial fires accounting for about 14% of the total resource delivered (eg total appliance hours), the study estimated that about $23 million in operational costs should be allocated to industrial fire indicants.

Resource Delivered	Number of Incidents	Average Appliance Minutes	Resource Delivered (appliance hrs)	% of Resource Delivered	Allocation of Operational Costs ($000)
False alarms and good intent calls	**24,372**	**46**	**18,721**	**…**	**…**
Non-fire incidents	**14,915**	**40**	**9,989**	**37%**	**63,254**
All fire incidents:	**20,059**	**52**	**17,375**	**64%**	**110,024**
Other / miscellaneous fires	10,212	43	7,330	27%	46,417
Residential fires	7,128	54	6,372	23%	40,353
Industrial fires	2,719	81	3,672	14%	23,253
All Active incidents	**34,974**	**47**	**27,157**	**100%**	**171,974**

Source: BERL (2002)

This approach also highlighted a number of interesting questions regarding the operational costs of the NZFSC and the potential impact of reducing (or targeting reductions in) certain types of emergency incidents. For example, how might a long-term reduction in industrial fire incidents, which are resource intensive, impact upon the level of operational readiness (eg capacity) that is required by the NZFSC? And how would this change affect the level of the NZFSCs operational costs in total and on average across all emergency incidents?

Source: An Economic Assessment of Industrial Fires in New Zealand. BERL. 2002.

3.2 INDIRECT COST METHODS

Methods of valuing only indirect costs focus on measuring the output losses caused by an injury event through examining the relationship between an injured person and the workforce, and thus the impact upon the aggregate economic output.

3.2.1 The Human Capital Method

The Human Capital Method (HCM) is the traditional valuation method used to measure the indirect cost of injury events. Using the HCM approach, indirect costs are equivalent to the production that would have been produced in the absence of the event, including the loss of productive life years due to fatal injury events. These production losses are measured as the discounted stream of future income foregone by the individual. This future income is discounted because the future value of capital is less than the current value, and because of time preference.

The fundamental presumption of HCM is that people are a valuable economic resource. People represent a source of productive capital that is used to produce a future stream of production. An injury reduces or destroys that future stream of production and therefore these events reduce the total quantum of human capital available to the economy and the economy's capacity to produce goods and services. At this level, the HCM assumes that this loss of capacity reduces both actual and potential future production. Hence, the total indirect cost of injury at the macroeconomic (economy-wide) level is simply equivalent to the aggregation of discounted future income losses from all injury events.

Given these assumptions, the impact of an injury event on individual earnings is central to the HCM approach. At this level, the HCM approach measures the discounted future value of income foregone from temporary and permanent reductions in productivity as a result of the injury. Therefore, the HCM rests on the assumption that earnings reflect productivity. However, this is not to say that each employee receives the value of his or her personal contribution to output, but that each worker receives the value of output added by the marginal (or last hired) worker.

The HCM is frequently criticised because some groups of individuals are undervalued relative to other groups due to the observation that human capital values are higher for men than women, for whites compared to minorities, and for the middle aged compared to the young and elderly. The premise underlying this criticism is that earnings for these groups do not necessarily reflect the relative value of their marginal product.

The HCM approach has a long history and several derivatives have been developed over time. One derivative is to measure an individual's net input into the aggregate economy by measuring earnings net of consumption. This is based on the concept that net input is equivalent to the individual's contribution to total savings, which equals the individual's contribution to total investment in the economy. But generally speaking, consumption is no longer netted out of HCM estimates. Most estimates have included earnings gross of taxes (to reflect the social loss from foregone earnings), and have tended to exclude non-labour market income with the rationale for this exclusion being that non-labour income would not be lost to society even with the death of the individual.

A second derivative of the HCM has been developed in response to alternative methods of estimation such as the Contingent Valuation approach. These methods have tended to focus on individual welfare as opposed to aggregate economy-wide costs. In response, a number of studies have attempted to provide a more individualised estimate of human capital. The leading authors here are Landefeld and Sekin (1982) who individualised their HCM measure by estimating earnings net of taxation, including non-labour market income, using an individual (rather than social or market) discount rate and including a risk aversion factor.

However, a significant criticism of the HCM approach (including the derivatives above) is that intangible costs remain outside of the scope of study. Given that intangible costs can be a significant component of individual welfare, especially with severe long-term injuries, this omission can have a significant impact on the magnitude of total costs. Nonetheless, the justification of the HCM is not that it measures the full value of life but that it provides a useful measure of indirect costs. This is an important component of total cost and is of considerable interest to policy makers and so forth.

3.2.2 Whole Economy Cost of Human Capital

The HCM presumes that people are a valuable economic resource, or unit of productive capital that produces a future stream of production. Injury reduces the future productive capacity of that resource and thus the present value of that productive human capital. The economic implication of this presumption is that the reduction in production from the injured person cannot readily be replaced by some presently unemployed human resource being mobilised to maintain the past level of production. The contra situation (that unemployed labour can in all cases be mobilised) is assumed in the Friction Cost Method (FCM) discussed below.

In situations where the HCM presumption is an accurate representation, the capital (eg capacity, skills, etc) of the injured person is not readily replaceable from unemployed resource, and thus the future production from that person in their previous occupation is reduced or lost. When this occurs there will be upstream and downstream multiplier effects, representing reduced demand for inputs used in that work position and reduced income available for consumption spending within the economy.

Thus, the impact upon economy-wide production will be more than the lost production of the injured person. The total quantum of the reduced economy-wide production can be estimated in a partial equilibrium sense using multiplier analysis.

When the indirect cost of injury is being measured for a large number of individuals (in a certain industry, or in certain skill sets or across the economy) the aggregate impact of these injuries would be a significant reduction in the total labour supply. Because this reduction in labour supply would lead to an increase in the price of labour, the indirect costs of injuries should then be measured in general equilibrium terms, by assessing the impact on the economy of changes in the supply and price of labour. This indirect cost can be measured by running a General Equilibrium Model (GEM) with a base case scenario and then a scenario with the labour supply reduced due to injury. In this model the injury cost to the economy would be the difference in GDP achieved between the two scenario runs of the model.

BERL has a GEM of New Zealand with 49 industries and 40 occupations in the core matrix. This model enables simulations of the supply of labour in various industries and occupations to be tested as to the re-allocation of labour amongst all industries and thus, the level of GDP which can be achieved with the reduced labour available. This method would then give an estimate of the economy-wide indirect cost of injuries.

A Measurement of Indirect Health Benefits

Measurement of indirect costs of injury requires an assessment of the loss of production as a result of injury at the individual and/or the economy-wide level. There are a number of studies providing evidence of the positive impact on the economy from a gain in production due to improved health and improved work functionality. These studies (some of which are listed in the table below) have shown increases in productivity associated with introduction of corporate exercise programs.

Company	Program Type	Productivity Improvement
Union Pacific Railroad	Exercise	80% more productive, 75% more concentration
Johnson & Johnson	Fitness	Positive Attitude
NASA	Exercise Control	Stamina, endurance & decision-making 12.5% higher than non-participants
Canadian Life Assurance	Fitness	Participants 7% more productive, non-participants 4.3% more productive
Signature Corporation	Fitness	8% more productive, non-members negative productivity. Frequency of exercise correlated with productivity and absenteeism
Worksafe Australia	Lunchtime exercise	Mood, productivity, cognitive functioning, reactive time, sensory motor perception compared to to control group

Source: BERL

A further example comes from a Canadian Government discussion paper that estimated that a 25% increase in the 1995 physical activity participation rate increased labour productivity in the whole economy by between 0.25 and 1.5%. And finally, a 1992 Canadian National Workplace Survey showed that more than 60% of companies with fitness programs realised improved productivity, reduced absenteeism, reduced employee turnover and led to fewer accidents.

Working from this base of information, a study by Tasman Asia Pacific, Ernst & Young (1998) simulated the effect on the Australian economy of increased worker participation in sport and recreation to participation of 100%. They assumed this would result in a 4% sustainable increase in labour productivity. The simulation was made using a general equilibrium model (GEM) to estimate the gain to the economy. The purpose of the simulation was to highlight the impact and implications of productivity improvements on the Australian economy as a whole. A 4% increase in labour productivity equated to a 2.8% overall increase in Australia's productivity, which was distributed across all industries in the model, in order to estimate the change in industry output and other macroeconomic consequences. Resulting GDP increased by 3.3%, consumption by 4.1%, investment by 3.7%, exports by 4% and imports by 4.2%. The top 25 industries would increase activity by 5% to 11%. Employment would increase by 1.4%.

Relevance to New Zealand

In New Zealand, if injury effects upon productivity (for specific or total injuries) were available for specific occupations or industries, the BERL GEM could be used to estimate the economic costs of injury in the same way as Ernst and Young used a GEM above to estimate the economic benefits of sport. In the injury case it would be possible to estimate the indirect costs of injury at the economy level and thus provide supporting information on the indirect impacts of health or injury programs.

Source: The Economic Benefits of Sport: A Review. BERL. 2000.

3.2.3 The Friction Cost Method

The Frictional Cost Method (FCM) can be regarded as a critique of the Human Capital Method (HCM) of measuring indirect costs. The proponents of the FCM argue that the HCM overstates indirect costs at the economy-wide level, because the HCM measures potential as opposed to actual production losses.

The FCM argues that the actual production loss is limited because several mechanisms in the labour market move to limit the impact of individuals on actual production. Over the short-term, the work that would have been undertaken by the injured individual can be postponed or reallocated to colleagues. Over the long-term, unemployed workers can substitute for those injured workers. Hence, the FCM measures indirect costs as only the temporary production loss due to an injury event and the financial expenditures required in recruiting and training new employees. These costs could still be quite considerable. For example, if a top executive or professional is lost to the economy, an unemployed person may be trained to move onto the bottom rung of the ladder and a chain of people each take a step up the ladder to fill the vacant professional post. The frictional training cost at each step could therefore be quite considerable.

The economic and labour force scenarios represented by HCM and FCM estimations of injury cost are quite different and therefore they measure completely different aspects of labour market operation. The HCM assumes that the capacity lost through injury cannot be replaced and therefore measures the value of future production lost. The FCM scenario is that the injured capacity lost can be quite quickly replaced by recruiting and training another (presently unemployed) person to the position left vacant by injury. The FCM therefore concentrates on measuring temporary production loss only, costs of recruitment and training (formal and also informal by colleagues on-the-job) to give the indirect cost of injury. In this scenario, the assumed infinite availability of unemployed labour enables future production to be maintained and therefore there are no future costs to the whole of the economy, and no need for multiplier or GEM analysis.

The HCM and FCM approaches make assumptions at two extremes in relation to the capacity of the economy. The HCM measure assumes that the value of labour lost is not replaced and thus implicitly that the resources within the economy are operating at full capacity with no possibility to replace human capital losses. Alternatively, the FCM method implicitly assumes that there is an endless pool of unemployed people who can be trained to substitute for anyone lost to the production process.

The business cycle is also relevant. In an economy growing strongly, the rate of growth is likely to become constrained by total skill availability and the HCM will be closer to the production loss than the FCM. The skills and human capital that has been created in the economy will be fully utilised and the loss of some of this human capital will reduce actual total capacity. In a sluggish economy, with substantial unemployed labour, the FCM is likely to be a closer representation of indirect costs, because labour capacity is unlikely to be a factor limiting long-term productive capacity.

Empirical studies using the FCM naturally produce estimates of indirect costs that are much lower than comparable HCM estimates. Koopmanschap et al (1995) estimated the indirect costs of disease using the FCM to be 1.2% of net national income compared to 18% when measured by HCM. A study by Van Beeck (1997) produced FCM estimates, which were about 20% of the HCM.

An Australian Measure of Job Change Frictional Cost

The Australian Productivity Commission (APC) measured the cost of job-change as a result of problem gambling - namely the Frictional Cost. The three elements they identified were:

- Loss of income over the period of unemployment before a new job is found;
- The financial cost of the job search; and
- The cost to the employer of finding and training a replacement.

The APC noted the effect of benefits in transferring a substantial part of the loss of income from individuals to the taxpayer, or the economy or society. Their estimates for the three elements were as follows:

- Period between jobs of 6 weeks, average earnings of $743 per week gives loss in income of $4,300.

- Cost of job search was taken to be $2,357, which an earlier paper had quoted as being "approximately half of the cost reported by major job search firms".

- Cost of staff replacement by the employer. This conceptually included hours of staff spent hiring, hours of formal training, hours of informal training by management and hours of informal training by co-workers. Using other sources, the APC assumed employer search and replacement cost equals 10% of annual salary, or $3,862.

Additionally the APC noted that some of the people who change jobs also receive unemployment benefits transferred from government. This amounted to an average of $1,482 per person overall. The APC estimate of frictional cost of job change is thus a total of $12,000 on average for all people who change job.

Source: Australia's Gambling Industries. Australian Productivity Commission. 1999.

3.3 INTANGIBLE COST METHODS

Methods of valuing only the intangible costs of injury, namely the costs of pain and suffering focus upon analysing the choices made by people as individual or collective decision-makers. The quantum of these intangible costs can be determined in monetary terms by analysing the court awards made for injury compensation or can be taken from compensation schedules for injuries established by public administrations. Alternatively the quantum can be measured in utility terms and expressed in an index of health status.

However, it is important to note that some methods used to value total costs can also be specified to value intangible costs only. These methods are discussed in section 3.4 on total cost methods. Generally speaking, these methods take the stated preferences of the public in order to make estimates of total or intangible costs (note the methods used to develop health status indices in section 3.3.3 can also be based on stated preferences).

Specifically, Contingent Valuation is that main method which can be used to measure either total or intangible cost. When this method is used to measure only the intangible costs of injury, it is important to ensure that other sources of the public's perception of total cost is filtered out of their responses. That is, the method has to be tightly specified to gain an accurate representation of the public's perception of the intangible costs.

3.3.1 Injury Compensation

Court awards for injury compensation provide one source of information regarding the collective view of people of the intangible costs of injuries through their deliberations as jurors. These awards can reveal people's collective preferences regarding compensation for intangible costs such as pain and suffering.

For example, Rodgers (1998) examined a total of 843 jury awards for pain and suffering in personal product liability cases involving non-fatal injury. The Rodgers study showed four award categories relating to different levels of injury severity as shown in the table below. The average awards for economic loss ranged from $7,000 for the less severe (category 1) injuries to $39,400 for the most severe (category 4) injuries. On average the awards for pain and suffering were orders of magnitude greater than for the associated economic loss, being $35,700 for category 1 and $315,400 for category 4 injuries.

Awards for Economic Loss, Pain and Suffering by Injury Category					
Injury Severity	**Mean Awards ($US) For:**		**% of Total Awards**	**% of Cases**	**% of Awards**
	Economic Loss	***Pain & Suffering***	***Pain & Suffering***		
Category 1	$7,048	$35,678	84%	16%	8%
Category 2	$17,709	$49,889	74%	43%	35%
Category 3	$20,747	$76,939	79%	37%	43%
Category 4	$39,437	$315,410	89%	3%	14%
Average	$17,782	$66,158	79%	…	…
Total	…	…	…	100%	100%

Source: Rodgers, 1998

The study also showed that the proportion of the total award that was given for pain and suffering was reasonably constant over the categories, averaging 79% of the total award. Or in other words, the awards for pain and suffering were about four times those of the economic losses. Another observation is that a small number of severe injuries (just 3%) attract a high proportion of the total awards (at 14%).

3.3.2 Administrative Compensation

Compensation decisions made and schedules set by various public administrations can also be a source of valuable information regarding the revealed preference of collective or administrative decision-makers. This information could be described as 'derived revealed preferences', because it takes preferences as revealed through a range of administrations determining the value of compensation for one set of pain and suffering, and applies this value to a second set of conditions of pain and suffering.

The APC's report on gambling looked at such measures to obtain estimates on pain and suffering from problem gambling[1]. The APC's approached was to collect data on the levels of compensation paid across States and Territories of Australia for victims of crime. The APC then surveyed empirical studies of jury awards in the US for pain and suffering. Compensation levels in a number of States are up to $50,000 each for serious harm (Queensland being high at about $75,000). New South Wales offers compensation of $5,000 to $15,000 for cases of chronic psychological or psychiatric disorders that are moderately disabling and $30,000 to $50,000 for disorders that are severely disabling.

[1] Appendix J of *Australia's Gambling Industries.* The Australian Productivity Commission. 1999.

The APC then applied these compensation figures to a range of emotional costs that are associated with problem gambling, as shown in the table below.

Emotional Costs Associated with Problem Gambling

Amounts of $5,000 to $15,000 for:

- Emotional costs for immediate family of severe problem gamblers
- Relationship breakdown
- Depression suffered often to always

Amounts of $15,000 to $30,000 for:

- Divorce or separation
- Seriously thought of suicide
- Attempted suicide for immediate family

Amounts of $30,000 to $50,000 for:

- Attempted suicide for the gambler
- Divorce or separation
- Attempted suicide for immediate family

Source: Australia's Gambling Industries. APC. 1999

The estimates shown above provide another means of estimating the level and scale of intangible costs as revealed by individuals and/or public administrations. While the jury awards approach taken by Rodgers focused on pain and suffering, the above approach also incorporates social costs such as divorce or separation.

3.3.3 Health Status Indices

Health status indices can be used measure the intangible costs of an injury and despite being a relatively new phenomenon these indices have gained considerable momentum in the field of health economics. This index approach allows different health states to be assessed using a single health status measure such as Quality or Disability Adjusted Life Years (eg QALYs or DALYs).

Stated preferences (or 'utility scores') are critical variables in calculating these health indices. Utility scores can be elicited by various methods, such as pairwise comparisons, standard gambles, time or person trade-offs, direct ratings from visual analogs and Contingent Valuation. Hence, the impact of an injury event upon health can be mapped across different dimensions such as such as pain and suffering, life expectancy, quality of life and so forth. Thus, the approach enables different dimensions to be measured both separately and in total.

There are a number of indices available for assigning values to health status. All indices use a scale running from 0 (death) to 1 (no impact). However, each measure is different in both the conceptualisation of health and in the sensitivity to changes in health status. To some extent, these differences reflect that health status indices are a new area of investigation and that there remains some disagreement within the health profession as to the most appropriate measure of health status. However, some differences also reflect that these indices can be designed to focus on certain aspects of health status.

Indices as a Measure of Health Status

There are a number of indices internationally that can be used assign values to various health states. Eric Nord (1997) identified ten such indices in an OCED review of these measures.

- the Rosser/Kind Disability/Distress Index
- the Quality of Well-Being Scale (QWB)
- the Health Utilities Index, mark II (HU12)
- the Health Utilities Index, mark III (HU12)
- the EuroQol instrument (EQ-5D)
- the Index of Health Related Quality of Life (IHRQOL)
- the Quality of Life and Health Questionnaire (QLHQ)
- the Australian Quality of Life Instrument (AQOL)
- the Years of Healthy Life Measure (YHL)
- the 15-D

Source: A Prescription for Pharmoeconomic Analysis. PHARMAC. 1999.

In New Zealand, the Ministry of Health uses a Disability Adjusted Life Year (DALY) index, which provides a measure of health status derived from adding the years lost to disability and the years lost to premature death. Thus, one DALY represents the loss of one year of healthy life.

One of the key variables in the DALY index is the weight attached to disability. These weights were taken from Dutch disability weights estimated by Stouthard et al (1997) using the person trade-off method. These disability weights were chosen in the absence of preferences derived from the population of New Zealand. Some health status indices also apply an age weighting to give more weight to a year of life lived in adulthood than in childhood or old age. The Global Burden of Disease Study completed by Murray and Lopez (1996) is one such example. However, the Ministry of Health does not apply age-weights to the DALY index.

The health index approach has the obvious advantage of being able to convert intangible costs into a common unit of account. In addition, these intangible costs have the added advantage of having been derived from the revealed preferences of individuals, which is consistent with the notions of utility and consumer welfare in economics. However, the main disadvantage of this approach is that intangible costs are valued using a different unit of account than direct and indirect costs.

Therefore, the health index approach does not enable full Cost Benefit Analyses (CBA) of health programs to be undertaken. For this reason the merits of health programs have tended to be assessed using Cost Utility Analysis (CUA). This approach assesses health programs by dividing program expenditures by the QALYs or DALYs saved as a result of the program. Thus, the CUA approach allows for comparisons between programs that impact upon intangible costs, but because direct and indirect costs are not measured, no concept of the net benefit emerges from the assessment.

3.4 TOTAL COST METHODS

Some methods of valuation measure direct, indirect, and intangible costs with all three of these cost components bundled into a single value. These methods are variants of an approach known as Willingness-To-Pay (WTP), which proposes that the value of health can be deduced from the amount that people as consumers are willing to pay to reduce the probability of an injury occurring. One advantage of this approach is that it allows for the fact that people can attach a value to goods and services that are not marketed including intangibles such as pain and suffering.

The WTP approach is a measure of individual welfare, and in the neo-classical tradition of economics one of the guiding principles in determining consumer welfare is to measure consumers' willingness to pay. These amounts are the values that consumers attribute to the goods and services they purchase or the cost of foregone consumption opportunities. When this principle is applied to changes in mortality or morbidity risk, WTP measures the change in income, coupled with the change in risk that leaves the consumers utility unchanged.

The WTP approach is concerned with measuring ex ante values (eg at the moment that choices are made) rather than realised ex poste changes in health. A common criticism of the approach is therefore, that individuals may not have a realistic understanding of the actual costs involved or of the probabilities attached to these outcomes. While WTP has the advantage of allowing for unique preferences for risk reduction, it has also been criticised because much of the variance in WTP estimates reflects income differences rather than unique preferences. This is because health is regarded as a normal good and therefore, people's preferences towards risk reduction will tend to increase with income. Thus, much like the Human Capital Method, WTP estimates tend to show lower values for those groups earning lower incomes (minorities, etc).

The key variables in measures of WTP are the risk of an injury event occurring and the average value of the peoples willingness-to-pay for a marginal reduction in the risk of that event occurring. These two variables are transformed into a Value of Statistical Life (VoSL) by dividing the average value of WTP by the reduction in the risk paid for. For example, if the average WTP per person for a risk reduction of 10 in 100,000 is about $50 then the VoSL is about $500,000.

In New Zealand, the Land Transport Safety Authority (LTSA) has completed several studies using the Contingent Valuation methodology (discussed in section 3.4.2 below) to estimate the VoSL for road accident deaths. The Contingent Valuation was specified to measure the intangible cost of road accident deaths. The VoSL from the LTSA's first study was valued at about $2 million in 1991 prices, or about $2.5 million in June 2000 prices.

We understand that the LTSA has since investigated VoSL values based on a variant of the WTP approach called the Willingness-To-Accept (WTA) which shows a VoSL 3-5 times larger than than the WTP based value[2]. The WTA approach represents the amount the public would require to receive in exchange for an increase in risk or in other words people's perception of the amount necessary to compensate for an increase in risk.

The two methods commonly used in overseas studies of the WTP are the Compensating Wage Differentials (CWD) approach and Contingent Valuation (CV). These approaches are discussed below.

3.4.1 Compensating Wage Differentials

The Compensating Wage Differentials (CWD) method is based on the assumption that workers trade-off the risk of being injured in a workplace accident against wages when choosing between jobs associated with different risk levels. The implicit assumption in this approach is that workplace risks are well understood by workers and that the wage premium workers demand and receive when they are employed in more risky occupations reflects their risk choices.

Thus, by collecting information about the different characteristics of a large number of occupations it may be possible using regression analysis to estimate the change in wage associated with a marginal change in the risk of being injured. Therefore, an advantage of the CWD approach is that it is based on actual labour market behaviour.

However, critics of CWD have outlined numerous situations in which the labour market assumptions underlying the approach are unrealistic. These situations include a lack of perfect information for workers relating to workplace risk, problems in shifting between jobs and the lack of other job opportunities.

[2] Leung J & Guria J. The Social Cost of Road Crashes and Injuries: June 2000 Update. Land Transport Safety Authority of New Zealand. 2000.

In addition, there is the possibility that workers in high-risk jobs may simply be less risk opposed than average. In these cases, the wages paid of workers would not reflect the true premium needed to encourage the average risk opposed person to assume a certain level of risk.

The main stumbling block for CWD method has been the lack of consistent estimates. The variation in estimates has been partly caused by differences in the target population, where differences in age, education and wealth of the population studied have all lead to large variations in the WTP values when applied to the general population.

At an empirical level, CWD estimates have also encountered two problems. First, CWD models have had problems accounting for other job characteristics such as prestige or more flexible hours that might substitute for wages in compensating for risk. Second, the studies have had problems in untangling wages premiums for non-fatal and fatal risk where the two types of risk are correlated. Thus, failure to account for non-fatal risk leads to bias in the fatality risk estimates.

3.4.2 Contingent Valuation

Contingent Valuation (CV) is a stated preference tool which uses people's responses to hypothetical questions or situations to value WTP. Because of the hypothetical nature of this approach, CV overcomes the problem that information regarding the level of risk is often not available (eg the risk of food causing cancer). CV also removes biases caused by factors such as insurance arrangements. The CV approach was first used to estimate the economic benefits of recreation area in Maine (Davis, 1963) and has since been used in environmental and health economics.

The CV approach takes a sample of people who are asked to imagine there is a market for a particular good or service. These people are then asked questions regarding their willingness to make purchases in this market. The measure elicited from these questions is the dollar value of consumer preferences (the value equivalent to a change in income, coupled with the good, which leaves the respondents utility unchanged). Practitioners also collect data on the demographic and socioeconomic characteristics of the sample population to draw inferences about the whole population. If this can show that the preferences of the sample population are not random but vary according to observable demographic characteristics, then these can characteristics can be used to estimate total demand (eg total WTP).

The main problem with CV is that it doesn't require cash transactions when preferences are being elicited. Thus, it has problems controlling for biased responses, which include incentives for people to misrepresent their true WTP and implied value cues. While these problems tend to plague CV studies, progress has been made by practitioners in developing methods to minimise these factors.

As noted in section 3.3, the CV method can be specified to measure only the intangible costs of an injury. Indeed, there appears to be quite a bit of variation in overseas studies, with some studies using the CV method to measure the public's total WTP and others using the method to measure the public's WTP to avoid intangible costs only. For this reason the WTP approach can be useful in assessing the prospects for hybrid approaches as discussed in section 4.

3.5 A SUMMARY OF THE CORE METHODS

The table below shows which components of total cost that the core valuation methods measure. There are a number of crossovers between the core methods, which highlights opportunities for hybridisation and for cross-checking these hybrid values by comparing them against values derived from the various core valuation methods.

Table 3.1 General coverage of the core valuation methods

VALUATION METHODS	Individual	Family	Employer	Economy	Societal
Direct Costs					
Medical costs	DCM		DCM		
Non-medical costs	DCM	HCM	DCM		
Indirect Costs					
Absenteeism			FCM	HCM and/or FCM	
Productivity losses:					
i) reduced activity/ability	HCM, Index			HCM and/or FCM	
ii) reduced participation	HCM, Index			HCM and/or FCM	
Family worker substitution		HCM			
Worker replacement/substitution			FCM		
Taxation				HCM and/or FCM	
Intangible Costs	WTP				
Loss of life	HCM, Index			HCM and/or FCM	
Loss of life expectancy	Index, Awards				
Loss of quality of life	Index, Awards	Index			
Physical suffering	Index, Awards				
Mental suffering	Index, Awards	Index			
TOTAL	WTP	WTP			WTP

ABBREVIATIONS:

Awards = Compensation awards
DCM = Direct Cost Method
FCM = Friction Cost Method
HCM = Human Capital Method
Index = Health status indices (eg DALYs)
WTP = Willingness to Pay or variants thereof

Source: BERL

4 HOW HAVE THE CORE METHODS BEEN 'HYBRIDISED'

This section discusses how these core methods of injury valuation have been hybridised in attempts to develop a measurement of total cost. In essence, these hybrid methods combine indirect and intangible cost methods so that the magnitude and composition of total cost can be measured.

4.1 COMBINING EARNINGS WITH WTP

An obvious weakness of the Human Capital Method (HCM) is that intangible costs are not measured. However, the WTP approach tends to bundle both indirect and intangible costs into a single measure. Therefore, one hybrid approach suggested by Arthur (1980) and Miller, Calhoun and Arthur (1989) is to subtract earnings from the WTP measure with the residual amount being the value of intangible costs. Miller (1993) was the first to use this method and a number of other authors have since adopted this approach.

A second hybrid approach is to specify the WTP approach so that it measures only the intangible cost, which can then be combined with the estimates of direct and indirect cost using standard Human Capital Methods. This approach has been used by the Land Transport Safety Authority to value the costs of road accidents in New Zealand.

4.2 INCLUDING HEALTH STATUS INDICES

Several studies have used health status indices to develop hybrid measures of total cost. The least controversial approach combines the dollar value of direct and indirect costs with intangible costs as measured in index terms. This approach requires that the index be adjusted to remove variables that account for work-related functioning to avoid the risk of double accounting for indirect costs. This approach provides a measure for each component of total cost, but because these costs are measured using different units of account it is not always possible to draw comparisons between different injuries without making judgements about the weighting to give to dollar and index values.

4.3 MONETISING HEALTH STATUS INDICES

The second more controversial approach is to transform the index value of health status into a dollar value through 'anchoring' the index to a baseline health state for which a Value of Statistical Life (VoSL) has been estimated.

The basic premise of this approach is appealing. Because health indices are based on the loss of utility or welfare losses due to deteriorations in health, they provide a measure of the ‘demand curve’ for health. And with the VoSL providing a single point estimate of the willingness-to-pay along this demand curve, the dollar value of various health states can in principle be estimated.

This approach has been applied in studies of non-fatal road traffic accidents in the UK (Ives, Kemp & Thiem, 1993) and the US (Miller, Clhoun & Arthur, 1990) and in food-related illnesses in the UK (Henson & Turner, 1994) and the US (Mauskopf & French, 1991).

However, there appears to be two main problems with this hybrid approach. First, it can be difficult to find a suitable VoSL to which the health status index can be anchored. In this respect, most overseas studies have used VoSL for road accidents as the mechanism for anchoring health indices.

The second issue concerns the marginal utility of a life-year which is assumed to remain constant in the studies noted above. However, it could be that the marginal utility of a life-year is decreasing so that older people are willing to pay less for a reduction in their risk of dying than young people, because they have fewer expected life-years remaining. With respect to health economics, Moore & Viscusi (1988) have previously argued that the VoSL should be converted into a Value Per Statistical Life Year (VoSLY) and that lives saved should be valued by multiplying the remaining life expectancy by this value.

However, this issue remains quite contentious in the field of economics. As an example, a recent study by Alberini (2002) found weak support for the notion that WTP declines with age, but only after age 70. In their Canadian sample of participants, WTP declined by about 30% after age 70 compared to the younger ages, however in their US sample there was no such statistically significant decline in WTP with age.

5 WHAT ARE THE POTENTIAL WAYS FORWARD

5.1 DIRECT COSTS

The measurement of direct cost is straightforward, but requires the collection of suitable data from various health and medical service organisations. Thus, the main requirement would be to develop a database covering the components of direct cost. This would also require the identification and collection of appropriate indicators of resource use.

5.2 INDIRECT COSTS

The indirect costs of injury can be adequately measured using either the HCM or the FCM. However, these two methods exist at either extreme of the spectrum in measuring the effect of injury on production. The HCM almost certainly overstates indirect costs in most instances while the FCM tends to understate the indirect costs. Therefore, further exploration is necessary to determine the feasibility and applicability of each measure to particular considerations in New Zealand.

5.2.1 Human Capital using Micro-simulation

A model to estimate the indirect cost of injury using the HCM could use age-specific census unit records to develop probabilities relating to survival, workforce participation, employment, and expected annual earnings if employed. This information could then be applied in a micro-simulation model using the form shown below.

Stylised Labour Market Costs

$$\Sigma \quad L_{ij} * P_{ij} * E_{ij} * W_{ij} * [(1+p) / (1+r)] *_{(i+c+l)}$$

Where for age i and sex j:

L_{ij} = life table probability of surviving from age i to i + 1
P_{ij} = probability of labour force participation if alive
E_{ij} = probability of employment if participating
W_{ij} = expected annual earnings if employed
(1+p) = the productivity growth
(1+r) = the discount rate
(i+c+l) = the exponent used in deflating to present value

Source: Miller T, Ireland T (2000)

In this respect, appropriate data sources require further exploration. If the records of the IRD and ACC could be matched, this data could then be used to estimate the reduction in the incomes of individuals following injuries of interest. This data would then give a sound basis for estimating the indirect costs under the HCM approach.

5.2.2 Measuring the Economy-wide Impacts

If the above linkages can be made, then the indirect costs of injury could be determined for injuries of interest in specific occupations (as classified by NZSCO) and in specific industries (as classified by ANZSIC). With this database it would be quite possible to estimate the economy-wide impacts of indirect costs from injuries of specific interest to different agencies using either partial equilibrium multipliers or the general equilibrium approach using a General Equilibrium Model (GEM).

5.3 INTANGIBLE COSTS

The most desirable situation for measuring intangible costs in New Zealand is for there to be a single measure of the Value of Statistical Life (VoSL) which is accepted across all government organisations. Furthermore, this VoSL could be specified to measure the intangible costs of injury. However, additional information would still required to be able to estimate the scale of intangible costs across different injuries and injury severity.

In this respect, the VoSL could be used as an anchor to monetise health status indices, which currently use non-monetary units of value. In addition, these health status indices would ideally be based on preferences derived from the New Zealand population (eg a 'KiwiQol'). There are also other dollar measures of pain and suffering from studies of compensation which can provide a cross-reference for the resulting VoSL estimates[3]. These measures would provide a benchmark as to the relativity of pain and suffering costs across different levels of injury severity.

Two hybrid methods could be adopted with the above information. The first would be a traditional method, which includes both a monetised measure of direct and indirect costs plus a non-monetised index measure of the intangible costs. This hybrid would require judgements to be made regarding the relative importance or weight of the monetary and non-monetary measures when making comparisons between different health programs.

[3] For example, the data collected by Rodgers (1998) on jury awards for pain and suffering.

The second hybrid approach would have the same framework as above, but in addition would use methods to monetise the intangible costs as measured by the relevant health status index. As discussed, this hybrid would require anchoring the index to a measure of the VoSL and/or to other monetary measures of pain and suffering.

This hybrid has strong appeal because it overcomes the inherent judgement necessary in the first non-monetised hybrid. To develop this method, it would be desirable to obtain dollar values of pain and suffering for different levels of injury severity from a number of sources. This data would then assist in cross-checking the dollar values that would be estimated in the hybrid method.

5.4 A POTENTIAL FRAMEWORK

The table below shows how the methods of valuation discussed in this section could be integrated into a single generic framework, which would enable each component of total cost to be measured. Note that intangible costs in this framework can be measured using either monetary or index values as appropriate. It is envisaged that this framework could be developed into a template relating to various classes of injuries and individuals.

Table 5.1 A generic framework of injury valuation

Class of Injury Severity *Specific Injury*	**Minor (1)** *a, b, c, etc*	**Moderate (2)** *a, b, c, etc*	**Severe (3)** *a, b, c, etc*	**Death (4)** *a, b, c, etc*	**Lingering Death (5)** *a, b, c, etc*
Direct Costs	Average for specific injury	Average for specific injury	Average for specific injury	Average for specific injury	Average for specific injury
Indirect Costs *(Matrix of capitalised income losses adjusted by injury class and demographics)*	Average of injury class using either HCM or FCM	Average of injury class using either HCM or FCM	Average of injury class using either HCM or FCM	Average of injury class using either HCM or FCM	Average of injury class using either HCM or FCM
Economy Indirect Costs	Multiplier or GEM analysis	Multiplier or GEM analysis	Multiplier or GEM analysis	Multiplier or GEM analysis	Multiplier or GEM analysis
Intangible Costs Health Status Indices	Specific injury or injury class	Specific injury or injury class	Specific injury or injury class	Specific injury or injury class	Specific injury or injury class
Or Monetised Health Status Indices	Average for injury class	Average for injury class	Average for injury class	Average for injury class	Average for injury class

Source: BERL

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