〈Research Paper〉

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A Model to Determine the Appropriate Monetary Redress for Accidents Involving Compensable Injury to Person*

Seong-in Kim**

Abstract

A System of evaluation is developed which determines a uniform and individualized monetary redress. It can be applied not only to permanent disability but to temporary disability cases and considers all factors affecting monetary redress in determining process.

As objects of compensation this model considers five factors, the degree of injury, the change of earning capacity, medical fee, job suspension and the degree of contributory negligence. For each object is defined a subfunction measuring its magnitude. Then by assigning reasonable weighted values to these five subfunctions according to their relative importance, we get main function which determines appropriate monetary redress.

I. Introduction

The subject of disability has reached a greater point of interest as society has broadened its conscience toward the problem of human welfare. Modern inventions and the growth of industrial activity has greatly increased the frequency of accidental injuries such that the average number of dead and injured per month in industry exceeds those sustained in war.

In the past the problem of disability concerned only the person who was unfortunate enough to receive the injury. He solved the problem by his own ability to adapt his depreciated physique and earning capacity to the circumstances of his environment. Of late years organized socity has assumed the responsiblity by providing monetary compensation and social rehabilitation.

There are four principal mechanisms or systems for determining monetary redress prescribed by laws regulating social responsibilities for the injured. These are IACI (Industrial Accidents Compensation Insurance), NC (National Compensation), AACI (Automobile Accidents Compensation Insurance) and LS (Labor Standard).

However, there are many weak points in those current systems. For instance they apply only to permanent disability and not to temporary disability cases despite the fact that many of the compensable injuries are of a temporary nature.

Moreover, current systems omit many importnt factors. In evaluating the change

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**Department of Industrial Engineering, Korea Advanced Institute of Science.

of working capacity, they do not consider two other important factors: age and occupation of the injured. Also they compensate only for the change of working capacity, medical fee and job suspension. Thus they do not consider two other important factors: the change of earning capacity andthe degree of contributory negligence on the part of the injured.

The standards of these systems for determining monetary redress are so vague, rough and unreasonable that uniformity and individualization of monetary redress can not be hoped for. Needless to say, similar monetary redress should be determined for similar injuries occurring in similar environment. Also where the environmental fac tors differ in some material aspect, the difference should be reflected in the monetary redress. Unless determination is placed on such an individualized bases, scarce resources may be wasted on those persons who cannot benefit from particular programs. Moreover, persons who should benefit may be precluded where judgement is based solely on subjective criteria.

In this context, there has developed a need for a system of evaluation which can be applied not only to permanent disability but temporary disability cases; which considers all factors, and which determines a uniform and indivdualized monetary redress objectively and without bias for cases of similar severity or magnitude.

A properly derived mathematical model to facilitate uniform and individualized monetary redress provides a possible solution to the above problems, by attempting to achieve prediction capabilities through increased objectivity by proper selection of input factors and reasonable assignment of weighted values. Monetary redress for each individual would be the result of the sum total of factors, taking into account different weights accorded each factor. This model is designed to insure that all similary situated injuries receive similar monetary redress. The algorithm properly derived insures that differences in situation are consistently reflected in the monetary redress.

Ⅱ. System Images

In the developing of the model, empirical rather than theoretical cases and date were used in order that the results could bet ested and compared with monetary compensations which were presently being determined.

In evaluating the degree of permanent d isability, the study uses the values of "Evaluation of Permanent Disability" which are

Table-1. Evaluation of Permanent Disabity

Clinical state of disability at the end of healing period	Ordinary manual labor: Age 30	Occupational Grading of Permanent Disability toTotal Body (%) (For occupation and applicabe variation select numeral to 9, Table-2)								
		1	2	3	4	5	6	7	8	9
11. Malformation in long bond	10	2	3	4	6	8	10	12	14	17
Forearm										
1. Both above wrist amputation	88	78	80	82	84	86	88	89	90	92
2. Above wrist amputation.	59	51	54	56	58	59	61	63	64	65
Hand										
1. 5 fingers amputation in both hands	78	68	70	72	74	76	78	79	80	82
2. Complete disability of 5fingers in both hands.	68	58	60	62	64	66	68	69	70	62

currently used by the IACI. It classifies the injured part of body into 14 parts and contains 113 clinical states of disability at the end of healing period, a part of which is presented in Table-1.

Occupational variations are not recognized by the compensation laws. Unquestionably, the type of occupation upon which the individual depended for his livelihood forms an important factor in readjustment when disability occurs. The rating of disability may be adjusted according to whether the prospect for return to the established fiield of labor is favorable or unfavorable.

Compensation laws do not recognize the age factor. The scheduled ratings at the average of 30 may be raised or lowered when age is an exceptional factor, unfavorable or favorable toward rehabilitation of working capacity. Assuming that the age of 30 is the average of industrial activity, each year over this age adds to the handicap of re-employment, re-education and readjust ment, while at younger age thers are greater opportunities for readaptation.

The study intrduces the method of modifying these values accoring to factors of age and occupation of the injured as suggested by Earl D. McBride (1963). ltlists 278 occupations, a part of which is represented in Table-2.

Table-2. Grading of Occupations to Injury Variants

Occupation	Injury Variants. Selected numeral to be referred to corresponding injured part in rating table (Table-1)													
	Eye	Ear	Nervous System	Head	Spine pelvis	Abdomen &chest	Arm	Forearm	Hand	Thumb	Fingers	Hip, knee & thigh	Leg	Foot
Actylene generator tender	4	5	5	4	5	4	4	4	4	4	4	4	4	4
Adding machine iepairman	6	5	5	5	5	4	6	6	7	7	7	4	4	4
Air cnmpressor	4	6	5	4	5	5	4	4	4	4	4	4	4	4
Armature winder	6	5	4	5	6	4	7	7	7	7	6	4	4	4
Artificial ice maker	2	4	3	5	6	6	5	5	5	5	5	6	6	6
Asbestos spinner	4	4	4	4	4	4	5	5	4	4	5	4	4	4
Assembler: Automobile	5	5	5	7	7	8	6	7	6	7	6	6	6	6
Shoe	5	3	5	5	5	4	5	6	6	5	5	5	5	5
Awning maker	5	4	4	6	7	5	5	5	5	6	6	6	6	6
Baggage man, railroad	5	6	5	6	7	7	7	6	6	6	6	7	7	7
Baker	3	3	4	4	5	5	5	5	5	5	3	5	6	6
⋮														

For the cases of temporary disability, however, the study develops a distinct and unique methods of evaluation. It contains 72 clinical states, a part of which is represented in Table-3.

The values of Cl and C2 in Table-3 were obtained by analyzing the answers to direct inquiries consisting of 310 questions from three medical doctors. However, they can only be considered as an estimate until a much broader sample is obtained.

Table-3 Coefficients for Temporary Disability

Diagnosis	Part of Body	C1	C2
	tarsal	0.017	2.155
	tibia	0.011	3.704
	ulna	0.013	2.121
Disloca-	shoulder	0.014	2.354
tion	elbow	0.002	2.792

The inquiry consits of the definiton of

the degree of injury, two examples of how to answer the questions and 310 questions which are subdivided into 7 parts. The questions are arranged so as to obtain succeeding comparisons which the answerer is not conscious of.

In measuring the changes of earning capacity, the study uses the normalization of figures of Standard Compensation By National Compensation Act, a part of which is Table-4.

Table-4. Evaluation of the Change of Earning Capacity.
(Upper values for male, lower values for female)

f1＼age	~10	~20	~30	~40	~50	~55	56~
78	0.3953	0.5271	0.6434	0.5271	0.3178	0.0853	0.0388
〃	0.2636	0.3488	0.431	0.3488	0.2171	0.0581	0.0233
69	0.3411	0.4494	0.5581	0.4494	0.2791	0.0775	0.0348
〃	0.2248	0.3023	0.2558	0.2093	0.1240	0.0310	0.0116
59	0.2248	0.3023	0.3798	0.3023	0.1860	0.0504	0.0194
〃	0.1550	0.2093	0.2558	0.2093	0.1240	0.0310	0.0116
50	0.1783	0.2326	0.2946	0.2326	0.1395	0.1349	0.0155
⋮	0.1240	0.1628	0.2015	0.1628	0.1008	0.0233	0.0078

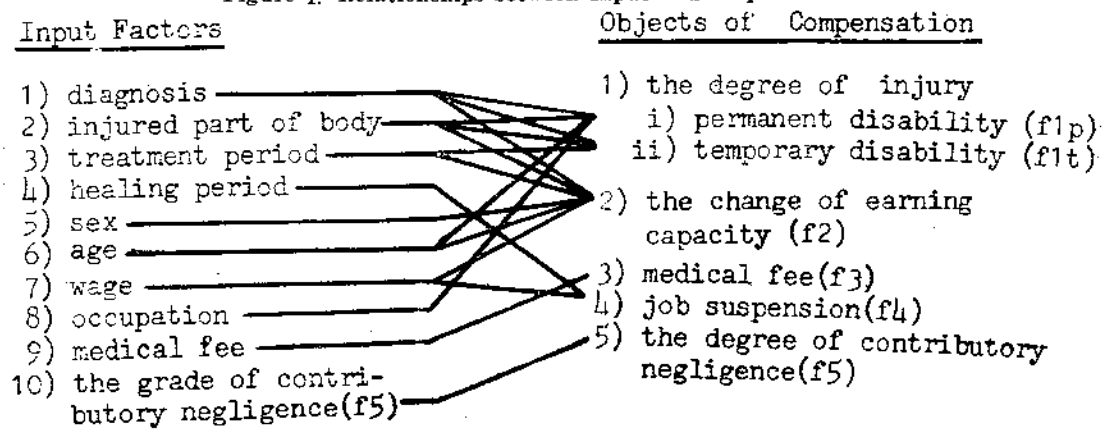
Table-5 shows evaluation of the degree of contributory negligence. It requires difficult and subjective judgement to determine the grade of negligence. It may be possible to set some objective criteria in determining the grade of contributory negligence, but this has been omitted in this study.

Table-5. Evaluation of the Degree of Contributory Negligence

the grade of negligence	minor	moderate	severe	very severe	extremely severe
the degree of negligence	1.0	0.9	0.8	0.6	0.5

The development of system images should combine both theoretical and empirical methodologies and should constantly be on guard against flaws in the data collection, statistical evaluation, and patently incogrous medians derived from each approach. A reform of this nature should not be static but should be capable of constant updating so that changes in social norms and expectations as well as changes in the law can immediately be incorporated into the determining model.

Figure-1. Relationships between Input and Output Variables.



Ⅱ. The Model

1. Subfunctions

The obuects of compensation are measured by five subfunctions of ten input factors. Figure-1 shows the relationships between input factors and objects of compensation.

The subfunctions are defined as follows.

1) f1 to measure the degree of injury

i) Permanent disability case

The degree of injury

=f1p(diagnosis, injured part of body, age, occupation)

Step-1. Find the grading corresponding to occupation and injured part of the injured in Table-1.

Step-2. Find the value in row corresponding to diagnosis and injured part of body and in column corresponding to grading of occupations in Table-2. Then,

f1p = the value in Table-2 obtained in step-2.

Step-3. Modify the degree of injury accoding to age of the injured such that

f1p = the value obtained in stpe-2 +0.75(age-30)

ii) Temporary Disability cases

The degree of in injury

=f1t(diagnosis, injured part of body, treatment period)

Find the values C1 and C2 in Table-3 corresponding to diagnosis and injured part of dody. Then

f1t=0.04(treatment period C1+C2)−0.04

2) f2 to masure the change of earning capacity

The change of earning capacity

= f2(age, sex)

= the value in Table-4.

3) f3 to calculate the medical fee

Medical fee

=f3(medical fee)

=medical fee

4) f4 to calculate the job suspension

Job suspension

=f4 (healing period, wage)

=wage healing period

5) f5 toomesure the degree of negligigece

The degree of negligence

=f5 (the grade of negligence)

=the value in Table-5.

2. Formulation of Main Function

The following form of the mainfunction is used in formulating the main fuction.

Appropriate monetary redress

$=(\text{wage}\cdot(A(W1\cdot f1+W2\cdot f2)+B)+f3+0.6\cdot f4)\cdot f5$

The first item, wage$(A(W1\cdot f1+W2\cdot f2)-B)$ represents the monetary redress for the degree of injury and the change of earning capacity. The coefficients of W1 and W2 whose sum is 1.0 represent the weight of relative importance of the degree of injury and the chage of earning capacity respectively.

Let the ratio of relative importance be 4 to 1. Then W1 and W2 become 0.8 and 0.2 respectively. To determine the relative importance between the degree of injury and change of earning capacity requires difficult and subjective judgement. In this first attempt to consider the change of capacity as an object of compensation, the study gives small weight to this factor.

The constants A and B represent the level of compensation. The higher the standard of living, econmic prosperity, conscience of the employer, etc: the larger the constants. The study fits A and B to the Standard Compensation of IACI by least square method. However, it does not mean that the current level of compensation of IACI is a

appropriate one. It has been demanded to increase the rate of insurance payment because IACI has earned much profits. The author wishes to make it clear that dermining the appropriate level is beyond the scope of this study, but will be the subject of his next work. The results of regression are A=1517.6 and B=8.8.

Subfunction f3 represents the monetary redress for medical fee. Subfunction f4, for job suspension. Only 60 per cent of job suspension redress is comensated by law.

Since the model assumes that negligence of the injured affects all objects of compensation, all of the above items are multiplied by subjunction f5.

Thus the study has obtained the following function.

Appropriate monetary redress
$=$ (wage $\cdot$ $(1517.6(0.8f1+0.2f2)+8.8)+f3+0.6f4) \cdot f5$

Ⅵ. Application of the Model

1. Illustration by a Case Study.

The procedures of the model will be illustrated by the following example.

Example:

A 35 year-old, male automobile assembler twhose wage is ₩40,000 ($80) per month suffered the amputation of one arm beween elbow and wrist repuiring 2 months treatment period and 5 months healing period and ₩ 100,000($200) treatment expense due to the bad condition of his working enviroment.

1) procedure-1. Input data given are:
   (1) diagnosis: amputation
   (2) injured part of body: forearm
   (3) treatment period: 2 months(60 days)
   (4) healing period: 5 months (150 days)
   (5) age: 35
   (6) wage: ₩ 40,000 per month(₩ 1,333 per day)
   (7) occupation: automobile assembler
   (8) sex: male
   (9) medical fee: ₩ 100,000
   (10) the grade of negligence: minor
2) Procedure-2. The values of the subfunctions are:
   (1) The above example applies to permanent disability.
   step-1. Grading of automobile assembler is 7 in Table-2.
   Step-2. The degree of injury
   $=$flp(amputation, forearm, 35, 7)
   $=0.63$ in Table 1.
   Step-3. flp
   $=0.63+0.0075(35-30)$
   $=0.6675$
   (2) The change of earning capacity
   $=$f2(male, 35, 0.6675)
   $=0.4494$ in Table-4.
   (3) Medical fee
   $=$f3(₩100,000)
   $=$₩100,000
   (4) Job suspension
   $=$f4(₩1,333,150)
   $=$₩199,950
   (5) The degree of ngeligence
   $=$f5(minor)
   $=1.0$
3) Procedure-3.
   Appropriate monetary redress
   $=$ (₩1,333(1517.6(0.8$\cdot$0.6675+0.2$\cdot$ 0.4494)+8.8)+₩100,000 +0.6$\cdot$₩ 199,950)$\cdot$1.0
   $=$₩1,493,785($2,988)

2. Applicability of the Model Comparison by Simulation

Since there is no available data or statistics, the comparisons of monetary redress by the model with those imposed under the current system are made by simulation. Also due to the absence of data and statistics, the following assumptions should be

made in simulation process.

The probability of occurance is the same for:

1) each injured part of body among 14 parts,
2) each diagnosis of injury in one injured part of body,
3) each occupation of the injured,
4) each age of from 20 to 60.

The following Table-6 shows the comparison of the monetary redress destermined by the model with the one imposed under the current system in the case of the previous example.

Table-6 · Comparison with the Current System.

Current system		₩ 1.273,040(790 days)
The Model		₩ 1,493,785(956 days)
Difference		₩ 220,745(166 days) ···17.3%
due to		
Regression	₩ −5,332(−4 days)·····−0.4%	
Occupation	₩ 63,984(48 days)····· 5.0%	
Age	₩ 61,318(46 days)····· 4.8%	
Farning C.	₩ 101,308(76 days)····· 8.0%	

Five hundred cases are simulated by computer. The result of the computer simulation shows that the average variation of the model from the current system is 18.3%, of which 10.1% is due to considering the change of earning capacisy, 6.7% due to occupation, 4.8% due to age factor, and −0.3% due to regression.

V. Conclusions

The determining process of monetary redress of the model is more rational in that it considers the variation of the degree of injury due to age and occupation of the injured. Also the model is more complete in that it considers the change of earning capacity as an object of compensation. Thus a more systematic, uniform, individualized and equitable monetary redress can be determined.

The results of computer simulations have proven that the model is compatible with the level of compensations imposed under the present systems. It is the author's hope that the model is used as an aid or guideline for insurance companies, judges and jurors as well as a method for determining moneytary redress by IACI, or AAI.

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