Title	Recovery of capital in modern accounting : studies in postwar Japan
Sub Title	
Author	Minemura, Shinkichi
Publisher	
Publication year	1965
Jtitle	Keio business review Vol.4, (1965.) ,p.95- 175
JaLC DOI	
Abstract	
Notes	
Genre	Journal Article
URL	https://koara.lib.keio.ac.jp/xoonips/modules/xoonips/detail.php?koara_id=AA00260481-19650000-03919642

RECOVERY OF CAPITAL IN MODERN ACCOUNTING

........Studies in Postwar Japan

by

Shinkichi Minemura

(1) *Introduction*

Postwar Japan, like any other modern, industrialized country in the world, has been experimenting on new types of accounting methods which had rarely been tried out before. The most representative is the so-called special depreciation system.

Japan's special depreciation system witnessed an improvement several years after the outbreak of the Korean War, but it was not until around 1955 that the system was really adopted in earnest.

That this new system has contributed greatly to the Japanese economy is eloquently indicated in the phenomenal growth rate of the economy since its adoption.

Just as one of the major factors which contributed to the economic miracle witnessed in West Germany after the war had been the adoption of this special depreciation system, this system has also played a great role in the growth of the Japanese economy.

The special depreciation system is a measure which had not been mentioned in theories concerning corporate accounting and still has a number of problem points.

However, since the favorable effect of this system is considerably large when it is actually implemented, there is a strong possibility that this system will be increasingly utilized in the future. The system today is one of the most important causes which have tended to separate theories on corporate accounting from actual accounting practices.

This system is an effective accounting measure in coping with the problem of superannuation and drop of efficiency of equipment and facilities in case a drop in the value of currency is witnessed.

However, this problem has not been fully studied under the various theories of modern corporate accounting.

Japan implemented a revaluation of equipment and facilities three times after the war—in 1950, 1951 and 1953—to cope with the deterioration of the value of the yen currency.

This new accounting system was considerably instrumental in solving the abovementioned problem.

This paper attempts to analyze the character of accounting procedures for charging the cost of assets to expense at the current price level, as well as to find out the calculation methods to determine the life of the equipment and facilities while paying due consideration to their superannuation.

This theme concerns the problem of what amount of capitals can be recovered in what period of time.

Another problem which has not been studied sufficiently in modern accounting practices, is that concerning the utilization of the mean value. In other words, studies have not been sufficiently carried to modernize the methods of the utilization of the mean value to meet the requirements of corporate accounting in this age when the volume of office work has increased conspicuously and there is a necessity of simplifying calculation methods.

When studies in this problem are insufficient, the adoption of the mean value will not make it possible to change the costs of assets into appropriate expenses. In other words, the recovery of capital will become unreasonable.

This paper takes up this issue as a problem of accounting measures concerning the pooling of cost.

As evident from the above, this study aims at providing a solution to the problem of why actual corporate accounting practices are being isolated from theories.

(2) Special Depreciation System

The concept of special depreciation is quite different from that of extraordinary depreciation. Extraordinary depreciation is reasonable, on certain conditions, in the present accounting system. Extraordinary depreciation is made as a result of the decrease in value (service-potentials, in the rigid sense) of a plant unit.

Meanwhile, the concept of special depreciation is, according to the prevailing opinions, to write off the cost of a plant unit without regard to the decrease in value, for promoting investments, relieving the expeled or the damaged. It is often put into practice in the taxation system. It is one of the national financial policies which are contained in the taxation system.

From the standpoint of the accounting concept of capital recovery, it is not reasonable in most cases.

Special depreciation is seen not only in Japan, but also in various countries such as England, Canada, West Germany, etc. after the war.

This system can influence investment decisions. It raises the prospective rate of return, which is usually indicated by i in the following formula;

$$C=\sum_{j=1}^{n_1}\frac{C_j(1-\alpha)}{(1+i)^j}+\alpha\sum_{j=1}^{n_2}\frac{D_j}{(1+i)^j}$$

C...Original Cost
D...Depreciation Deductions by n_2 Use (Applicable Only to Tax Returns)

G ...Gross Operating Profits
α ...Income Tax Rate
n_1...Estimated Life
n_2...Life Applicable Only to Tax Returns

To clarify the effect of special depreciation, in accounting, it is advisable to use the compound interest procedure, under which the prospective rate of return is regarded as the rate of interest and the after-tax profits are regarded as a series of annuity. For instance, let us assume that C, G_j, n_1, and n_2, are regarded as 1,000,000 yen, 237,400 yen, 5 years, and 2 years, respectively, in this formula. In this case, the prospective rate of return is 4.9% if the tax rate is 30%.

In case the prospective gross operating profits are realized, the after-tax profits and the earning rate are as follows;

Year	Gross Operating Profits (1)	Depreciation Charge in Accounting* (2)	Tax (3)	After-Tax Profit (1)−(2)−(3) (4)	Book Cost (at Beginning of Year) (5)	Earning Rate (4)÷(5) (6)
1	237.4	267.18	−78.78**	49	1,000	4.9%
2	237.4	280.27	−78.78**	39.91	732.82	4.9
3	237.4	144.01	71.22	22.17	452.55	4.9
4	237.4	151.06	71.22	15.12	308.54	4.9
5	237.4	157.48	71.22	8.70	157.48	4.9

Unit: 1,000 yen

* The depreciation charges in accounting are computed as follows:
$C_j(1-\alpha)+D_j\alpha-C_ji$=Depreciation Charge of jth Year
C_j............Book Cost at Beginning of jth Year (then, $C_1=C$)

** The depreciation deductions for tax purpose are computed by the straight-line method. The negative figures indicate that which can be subtracted from the profits of other plant units, if any.

This fact indicates that annual after-tax profits clarify how far the earning rates deviate from the prospective rate of return. One of the defects is that extraneous profits resulting from the tax incentive are not discriminated from operating profits.

In special depreciation, importance is attached to funds which are retained within an enterprise through the depreciation procedure (the procedure for renewal provisions, in the rigid sense) and exemption from taxes or postponement of taxation which results from treating capital expenditures as current depreciation charges.

However, attention should be paid to the fact that some defects in present depreciation accounting is closely related to the prevalence of special depreciation. For instance, the treatment of an obsolete asset in revaluation is defective in covering funds for replacement (that is, funds for modernizing an existing asset). Aside from this problem, the measures for restating costs at the current price level, implemented by the Government, are not always reasonable, from the standpoint of absorbing costs at the current price level.

Special depreciation has gone far towards solving the problem of the defects in the present depreciation system, although it has caused considerable misunderstandings and confusions as regards the concept of depreciation. There are more reasonable remedies than special depreciation to solve the defects in the present depreciation system.

To illustrate the effect of the special depreciation system in Japan upon the plant investment, let us compare the ratios of the semi-annual ordinary and special depreciation charges to the book costs, with the annual plant investments as follows;

Table 1 Ratio of Depreciation Charge to Book Cost

		Ordinary Charge	Special Charge	Total	Adjusted Annual Investment (See Paragraph 3)	Rate of Growth (See Paragraph 3)
					bilion yen	
1955	First Half-year	7.2%	—%	7.2%	1955 777.4	2%
	Second Half-year	7.4	0.7	8.1		
1956	First Half-year	7.9	0.9	8.8	1956 1,239.9	6
	Second Half-year	8.0	0.9	8.9		
1957	First Half-year	7.8	1.3	9.1	1957 1,544.9	8
	Second Half-year	7.2	0.7	7.9		
1958	First Half-year	7.2	0.5	7.7	1958 1,631.7	7
	Second Half-year	7.4	0.6	8.0		
1959	First Half-year	7.7	1.1	8.8	1959 2,098.8	9
	Second Half-year	7.8	2.1	9.9		
1960	First Half-year	8.1	2.0	10.1	1960 2,934.5	10
	Second Half-year	8.2	1.9	10.1		
1961	First Half-year	9.6	1.4	11.0	1961 3,685.5	11
	Second Half-year	9.6	1.2	10.8		

Note: The ratios of the depreciation charge to the book cost are computed by using the ratios of the total semi-annual charge, including both the ordinary and special charge, to the book cost and the ratios of the semi-annual special charge to the total semi-annual charge; both of which have been published by the Ministry of International Trade and Industry. This study covers 250 major companies, in all industries.

As clarified above, plant investments in Japan have increased remarkably since 1956. It is mainly due to the special depreciation system. The ratio of the ordinary charge to the book cost also shows a slight upward tendency, but the principal reason for the remarkable expansion of plants in Japan lies mainly in the noticeable increase in depreciation charges, resulting from the enforcement of the special depreciation system. Especially, in 1959 and in 1960, the ratio of the special depreciation charge to the book cost amounts to approximately 2 percent, and as a result, an annual investment shows a remarkably higher rate of growth than before.

These circumstances are more clearly shown in the manufacturing industry. As shown in the following table, the ratio of the special depreciation charge to the book cost amounts to more than 4 percent, in the second half-year of 1959 and in the first half-year of 1960, although the ratio of the ordinary depreciation charge to the book cost shows approximately 10 percent.

In the special depreciation system, importance is attached to the problem concerning the acquisition of plants and equipment, vessels, or schafts, which are urgently needed for the development of the national economy, the problem of modernizing existing plants and equipment, the problem of developing new mineral and forest resources and moreover, the problem of accelerating technical research and experimentation. These circumstances are clearly shown in the cases of the manufacturing and mining industries.* **

* The ratios of the charge to the book cost in the manufacturing and mining industries are as follows;

Table 2 Ratio of Depreciation Charge to Book Cost
...... in the case of the manufacturing industry

		Ordinary Charge	Special Charge	Total	Adjusted Annual Investment (See Table 4)
1955	First Half-year	10.5%	—%	10.5%	1955 1,729 hundred million yen
	Second Half-year	10.4	1.5	11.9	
1956	First Half-year	10.6	2.0	12.6	1956 3,593
	Second Half-year	10.8	2.0	12.8	
1957	First Half-year	10.6	3.0	13.6	1957 4,704
	Second Half-year	10.5	1.5	12.0	
1958	First Half-year	10.3	1.2	11.5	1958 4,643
	Second Half-year	10.6	1.4	12.0	
1959	First Half-year	10.6	2.5	13.1	1959 6,868
	Second Half-year	10.4	4.9	15.3	
1960	First Half-year	10.4	4.2	14.6	1960 6,896
	Second Half-year	10.7	3.8	14.5	
1961	First Half-year	13.0	3.0	16.0	1961 8,986
	Second Half-year	12.7	2.3	15.0	

Note: The increase of the ordinary charge in 1961 seems to be influenced by the 1961 revision of lives in tax accounting.

Table 3 Ratio of Depreciation Charge to Book Cost
...... in the case of the mining industry

		Ordinary Charge	Special Charge	Total	Adjusted Annual Investment (See Table 5)
1956	First Half-year	15.2%	0.7%	15.9%	1956 296 hundred million yen
	Second Half-year	14.6	1.2	15.8	
1957	First Half-year	13.8	1.7	15.5	1957 403
	Second Half-year	12.1	2.8	14.9	
1958	First Half-year	11.7	1.2	12.9	1958 401
	Second Half-year	9.6	1.4	11.0	
1959	First Half-year	11.8	1.0	12.8	1959 393
	Second Half-year	11.5	1.7	13.2	
1960	First Half-year	11.1	2.0	13.2	1960 446
	Second Half-year	11.6	2.8	14.4	
1961	First Half-year	13.0	1.1	14.1	1961 468
	Second Half-year	13.2	1.6	14.8	

Note: These figures are computed from the same sources as the foregoing ratios for the manufacturing industry.

** The other cases for special depreciation are found in the case of writing off additionally, costs for houses for rent, costs for machine and other facilities for trading abroad, etc. As the special depreciation procedures are procedures which are temporarily permitted, some of the foregoing cases are now eliminated.

Chart 1 Comparison of Special Depreciation Charges and Investments in Japan (incl. All Industries)

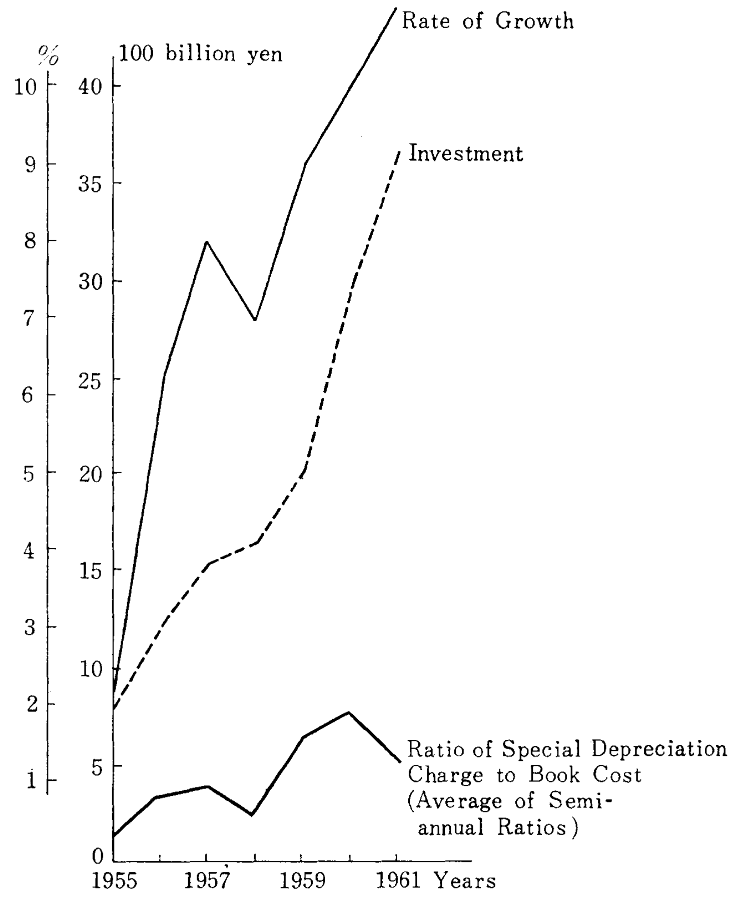
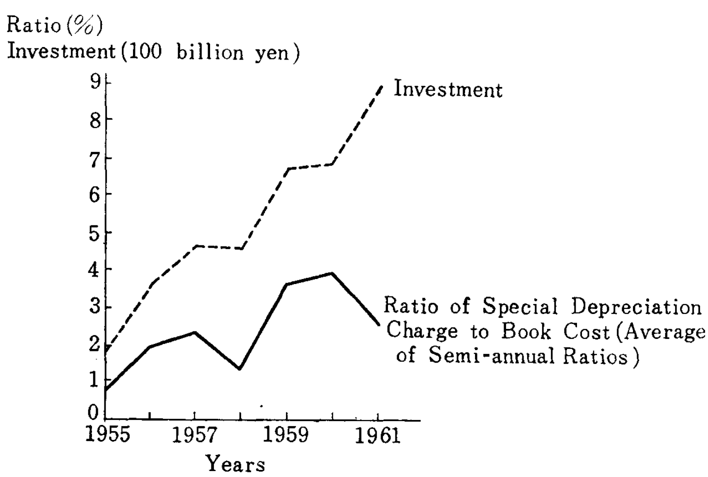


Chart 2 Comparison of Special Depreciation Charges and Investments in Japan
...... in the case of the manufacturing industry



The foregoing circumstances are clarified by the charts of relations between special depreciation charges and investments. (See Charts 1–3).

As regards the effect of special depreciation upon the depreciable cost for the ordinary depreciation procedure, there are, generally speaking, two kinds of treatments in absorbing costs.

One of them is that the additional charges of special depreciation will be subtracted from the depreciable costs which would be absorbed in future by means of the ordinary procedure if special depreciation had not been made. In this case, the future ordinary charges will be reduced, to the extent that it is offset by the special depreciation charge which has been recorded. From the standpoint of taxation, the collection for taxes on income equivalent to the special charge, which would be assessed if special depreciation had not been made, is postponed, pending the set-off of the special charge by the future ordinary charge. From the aspect of the accounting concept of capital recovery, the section of a plant cost, which will benefit future periods, is absorbed, as expense against current revenue, prematurely. Although there may be not much material undesirable effect on either taxation or accounting, in the long run, over the period during which a plant unit is devoting its service to operations, periodic income is not reasonably measured.

In view of the fact that the tax rate for corporations has shown a downward tendency as a result of economic development recently in Japan, it may be properly mentioned that the burden of taxation is lightened to an extent that the tax rate is reduced.

In the case of such a treatment for special depreciation, attention should be directed to the fact that special depreciation is not regarded as a remedy for covering completely the insufficiency of current cost depreciation charge in the inflationary period. Neutralized profit, which is temporarily eliminated from periodic income under special depreciation, will be treated as real income during the period covering the life of a plant unit.

Therefore, special depreciation is an incomplete alternative, from the aspect of absorbing a plant cost at the current price level.

Table 4 Investments (Manufacturing Industry)

	Nominal Annual Investment	Price Index of Production Material (%)	Adjusted Annual Investment
1955	1,729	100.0	1,729
1956	3,977	110.7	3,593
1957	5,155	109.6	4,704
1958	4,693	101.1	4,643
1959	7,101	103.4	6,868
1960	7,213	104.6	6,896
1961	9,875	109.9	8,986

Unit: 100 million yen
Source: Japan Development Bank

Chart 3 Comparison of Special Depreciation Charges and Investments in Japan ...... in the case of the mining industry

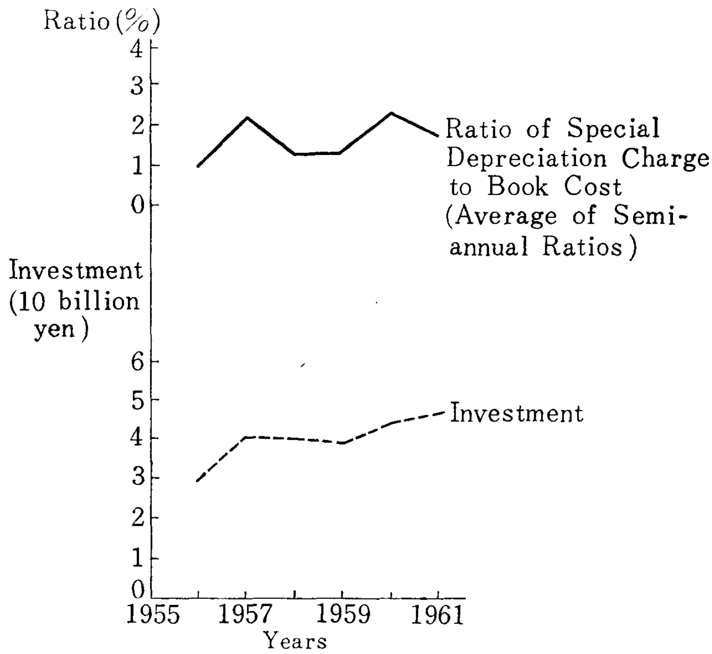


Table 5 Investments (Mining Industry)

	Nominal Investment	Price Index of Production Material (%)	Adjusted Annual Investment
1956	328	110.7	296
1957	442	109.6	403
1958	405	101.1	401
1959	406	103.4	393
1960	466	104.6	446
1961	514	109.9	468

Unit: 100 million yen
Source: the Ministry of International Trade and Industry

Assuming that the book cost, from which the nominal profit (the difference between current price level and original price level) is subtracted, is, under reinvestment depreciation, treated as the base for computing annual charges, there is a common characteristic between reinvestment depreciation and special depreciation, in that the nominal profit is, in the long run, treated as income.

If the depreciable cost of a plant unit is divided into two parts, one of which is written off by the ordinary procedure and the other is written off by the special procedure, the additional charge can be computed so that it may produce no effect upon the capital recovery period as a whole.

Let us assume that a plant unit, costing 900,000 yen, has the life of

10 years, its salvage being 10 percent of the cost. If the section of plant cost, amounting to 300,000 yen, is written off by the special depreciation procedure when it is acquired, on condition that the balance of a plant cost is written off over the period covering the life, under the straight-line method, the annual changes are as follows, without producing any effect upon the originally estimated life;

Year	Ordinary Charge	Special Charge	Total
1	51,000	300,000	351,000
2	51,000		51,000
3	51,000		51,000
4	51,000		51,000
5	51,000		51,000
6	51,000		51,000
7	51,000		51,000
8	51,000		51,000
9	51,000		51,000
10	51,000		51,000
Total	510,000	300,000	810,000

Unit: yen

If the declining-balance method is applied in the above example, ordinary charges are computed as follows;

Year	Ordinary Charge		Special Charge (3)	Total (2)+(3) (4)
	Book Cost for Computing Ordinary Charge (at Beginning of Year) (1)	Annual Charge (1)×0.173 (2)		
1	600,000	103,800	300,000	403,800
2	496,200	85,843		85,843
3	410,357	70,992		70,992
4	339,365	58,710		58,710
5	280,655	48,553		48,553
6	232,102	40,154		40,154
7	191,948	33,207		33,207
8	158,741	27,462		27,462
9	131,279	22,711		22,711
10	108,568	18,568		18,568
Total		510,000	300,000	810,000

Unit: yen

The depreciation rate is computed as follows;

$$1-\sqrt[10]{\frac{90,000}{600,000}}=0.173$$

On the contrary, if the depreciable cost for special depreciation is not distinctly distinguished from the depreciable cost for ordinary depreciation, special depreciation has an effect of shortening the capital recovery period which has been estimated.

In Japan, the depreciable cost for special depreciation is not distinctly distinguished from the cost for ordinary depreciation. Even in case special depreciation is made, an annual charge for ordinary depreciation is equivalent to that which is computed without being accompanied by special depreciation. Therefore, the cost of a plant unit is depreciated earlier than the original life.

The annual charge for special depreciation, according to the stipulations (as in effect December 31, 1963), is computed as follows;

1) Plants and Equipment for Modernizing Production Process
The additional charge, which amounts to one-third of the original cost, can be deducted from income, as a rule, during the accounting period a unit is acquired.

2) Steel Ship for Transportation Enterprises
The additional charge, which amounts to 10 percent of the original cost, can be deducted from income, as a rule, during the accounting period a unit is acquired.

3) Plants and Equipment, or Other Exploration Costs, for Discovering New Mineral Deposits
The additional charge, which amounts to the total depreciable cost of a unit (computed by subtracting the salvage value or nominal value from the original cost of a unit), can be deducted during the accounting period a unit is acquired' or the cost is incurred.

4) Mining Rights for Metal Industry
The additional charge, which equals the excess of current annual expenditures for mining rights over the average annual expenditures for mining rights covering the years from 1954 to 1957, can be deducted from current income, to write off the costs of existing mining rights.

5) Machines and Other Facilities for Technical Research or Experimentation
The additional charge, which amounts to one-third or one-tenth of the original cost, can be deducted from income during the first accounting year a unit is acquired.

6) Plants and Equipment, Including Buildings for Production, for Developing Underdeveloped Areas
The additional charge, which amounts to one-third (or one-fifth, in the case of buildings), can be deducted from income during the first accounting period a unit is acquired.

7) Costs for Deforestation
The cost can be written off within five years.

8) Houses for Rent
The additional charge, which amounts to an annual ordinary charge (twice as much as an ordinary charge, in case the life of a unit is longer than fifty years), can be deducted from income

within the period covering five years since a unit is acquired.

9) Shafts for Maintenance (incl. their Accessaries) and Air-shafts for Mining Industry

The cost of the former is treated as current expense and the cost of the latter is prematurely written off under the straight-line method.

As clarified above, costs for plants and equipment or other exploration costs for discovering deposits, and costs for deforestation, are charged against current revenue. Therefore, in these cases, special depreciation clearly changes the life for depreciation.

Also in other cases for special depreciation, the life for depreciation is shortened to some extent. An ordinary charge is not computed so that the estimated life for depreciation may not be influenced by special depreciation.

In the foregoing example, let us assume that the additional charge is computed, according to the stipulation concerning plants and equipment for modernizing production process, referred to above. The capital recovery period is 7 years, although the life of a unit is originally estimated to be ten years, as follows;

Year	Ordinary Charge	Special Charge	Total
1	81,000	300,000	381,000
2	81,000		81,000
3	81,000		81,000
4	81,000		81,000
5	81,000		81,000
6	81,000		81,000
7	24,000		24,000
Total	510,000	300,000	810,000

Unit: yen

Year	Ordinary Depreciation		Special Depreciation	Total
	Book Cost for Computing Ordinary Charge (at Beginning of Year) (1)	Ordinary Charge (1)×0.206 (2)	(3)	(2)+(3)
1	900,000	185,400	300,000	485,400
2	414,600	85,408		85,408
3	329,192	67,814		67,814
4	261,378	53,844		53,844
5	207,534	42,752		42,752
6	164,782	33,945		33,945
7	130,837	26,952		26,952
8	103,885	13,885		13,885
Total		510,000	300,000	810,000

Unit: yen

Also in the case of the declining-balance method, this type of special depreciation has an effect of shortening the capital recovery period. If the declining-balance method is applied to the foregoing example, the capital recovery period is changed into 8 years as above;

The depreciation rate is computed as follows;

$$1-\sqrt[10]{\frac{90,000}{900,000}}=0.206$$

The special depreciation system in Japan is defective in neglecting to compute an annual ordinary charge so that the originally estimated life may not be influenced by special charge. Attention should be directed to the fact that there is no reason to assume that one of the causes for special depreciation lies in revising the originally estimated life. Granting that the periodic apportionments of the cost of a unit are changed, as a result of special depreciation, within the originally estimated life, from the financial aspect, what reason for revising the estimated life would be discovered?

Another type of special depreciation is found in the case of "Investment Allowance" which was enforced in 1954, in England.

Under this type of special depreciation, the additional charge for special depreciation is not subtracted from the depreciable costs which would be absorbed in future by means of the ordinary procedure if special depreciation had not been made. It is not the section of the original depreciable cost of a unit, but profits, that is subtracted from income. If profits mean nominal profits, special depreciation in this meaning is an alternative to neutralize the difference resulting from the change in the price level.

If this type of special depreciation is applied, income, equivalent to the additional charge, is exempt from taxation.

From the standpoint of absorbing costs in accounting, the allowance for special depreciation should be regarded as the surplus resulting from absorbing costs on a basis other than on an actual cost basis.

One of the reasonable cases for absorbing costs under this type of special depreciation is to write off additionally the difference resulting from the change in the price level. If the additional change is subtracted only when a plant unit is acquired, there is no material difference between special depreciation and reinvestment depreciation. If the additional charge is assigned over the period covering several years, special depreciation is a sort of reinvestment depreciation under which the extraordinary charge is carried over to the period covering the early years of the life of a new plant unit.

Under special depreciation, it is not always necessary to absorb the additional charge as soon as a plant unit is acquired. Only in this respect, special depreciation seems to differ from reinvestment depreciation.

Generally speaking, the special depreciation system prevailing in the world seems to be enforced mainly from the standpoint of the national economic policy. In most cases, importance is not attached to the effect of special depreciation upon the accounting structure for measuring income through absorbing the costs of plants. Under these circumstances, it may be advisable to consider that special depreciation is made only in computing the taxable income.

To include special depreciation in the structure for accounting, a certain iron-bound condition must be laid on the procedure for special depreciation.

In the first place, the additional charge should mean the difference resulting from the change in price level.

In restating the cost of a plant unit on a current cost basis, there is a tendency to neglect to correct past depreciation charges on a current cost basis, or to restate an obsolete asset on a selling price basis. If past depreciation charges are not corrected on a current cost basis, or an obsolete asset is restated at the level of selling prices, the insufficiency resulting from such defects in restatement is regarded as the section of cost to be absorbed specially, and therefore, it may be properly solved by special depreciation. Special depreciation for modernizing existing assets may be accepted only in this respect. However, the additional charge for solving such defects should be computed correctly.

Secondly, the additional charge must be treated as the charge for correcting past charges. Special depreciation, in this meaning, is nothing but one of practical alternatives for yielding results that are essentially the same as those yielded by the lifo inventory method in plant accounting, as well as reinvestment depreciation.

If we regard special depreciation as the method for neutralizing the difference resulting from the change in price level, it is necessary, also in this case, to pay attention to the question which is pointed out as regards reinvestment depreciation.

To neutralize the difference resulting from the change in price level, the additional charge should continue to be absorbed, in future, everytime a plant unit will be substituted, in so long as the current price level will not return back to the old price level.

Assuming that special depreciation is made in the example to explain the accounting effect of reinvestment depreciation, to be referred afterwards (Paragraph 5), the additional charges for respective substitutes are computed as follows on condition that the additional charge, meaning the difference between current price level and initial price level, is apportioned over the period

Year	Recorded Cost	Ordinary Charge	Special Charge	Gain Realized by Sale of Salvage	Total Cost Absorbed
1	1,000	225			225
2	775	225			225
3	550	225			225
4	325	225		218	7
(Total Accumulated Cost)					(682)
5	3,180	225	1,090		1,315
6	1,865	225	1,090		1,315
7	550	225			225
8	325	225		2,314	−2,089
(Total Accumulated Cost)					(1,448)

9	24,140	225	11,570		11,795
10	12,345	225	11,570		11,795
11	550	225			225
12	325	225		14,116	−13,891
(Total Accumulated Cost)					11,372

covering the first and second years of the life of a unit;

In the above table, total costs to be absorbed during the first four years, amount to 682,000 yen. If the additional charges of the fifth and six years, first four years, the special depreciation system yields results that are essentially the same as those yielded by the lifo method; which aggregate 2,862,000 yen. Total costs to be absorbed during the first eight years, amount to 1,448,000 yen. If the additional charges of the ninth and tenth years, which total 23,140,000 yen, are added to total costs to be absorbed during the second four years, total charges to be absorbed for the first and second substitutes, amount to 24,588,000 yen (1,448,000 yen + 23,140,000 yen); which is equal to the total charges computed if reinvestment depreciation is made so that results that are essentially the same as those yielded by the lifo inventory method may be, in the rigid sense, yielded.

Meanwhile, if the additional charge means the difference of cost between the retired unit and the existing unit, neutralized profits will be charged against income at the next time of replacement.

It goes without saying that special depreciation under which the additional charge is absorbed only at the time of acquisition is just the same as reinvestment depreciation, as far as the foregoing type of special depreciation is concerned.

(3) Economic Depreciation & National Economy

Recently there has been a remarkable tendency contending that attention should be directed to the effect of the depreciation policy upon the investment policy, especially in the opinions of economists.

Certainly, it is desirable that attention be directed to the relation of the accounting policy with the national economy. However, it is regrettable that this tendency is liable to cause misunderstanding on the concept of depreciation.

Some economists neglect the difference between the concept of depreciation and the concept of providing for renewal funds.

According to their opinions, the concept of depreciation seems to include the providing of renewal funds.

Now that depreciation belongs to the retirement accounting approach and the providing of renewal funds belongs to the replacement accounting approach, it might be properly mentioned that the difference between retirement accounting approach and replacement accounting approach is neglected.

According to some opinion, it is necessary to provide for expenditures for improvements or expansions, on condition that their periodic assignments are treated as current expenses. However, this is a misapplication of periodic assignments of renewal funds for the replacement accounting approach. If rigidly defined, such periodic assignments should be described as "periodic self-financing."

Granting that depreciation indicates periodic self-financing, the depreciation rate should be computed so that estimated expenditures for improvements or expansions may be prepared. It should be computed so that an annual charge may be equivalent to an annual acquisition of plants. Assuming that the trend of an annual acquisition of plants shows a constant curve, its rate of growth should be reflected in the depreciation rate, referred to above.

Generally speaking, the rate of growth is influenced by national economic policies. Sometimes, it is controlled by the administrative authorities.

Under these circumstances, the advocates of economic depreciation, that is, periodic self-financing, if rigidly defined, explain that the depreciation rate should be computed from the standpoint of the national economy.

It should be noted, in this connection, that, although the trend of an annual acquisition of plants sometimes shows a constant rate of growth in the national economy, in which plant acquisitions of individual enterprises are intermingled, the trend of an annual acquisition of plants mostly shows an irregular rate of growth in an individual enterprise. It is only a special case in which a number of homogeneous assets, such as electric poles, meters, or railway-ties, are acquired simultaneously, that shows a constant rate of growth in an individual enterprise.

Accordingly, the purpose of such a depreciation policy cannot be accomplished without being accompanied by a complementary policy for alloting funds, recovered in a certain enterprise, for the expansion of plants in another enterprise. This complementary policy is adopted by a banking organ.

The special depreciation system, stated afterwards, takes the effect of alloting funds, recovered by the depreciation policy, for the expansion of plants within the same enterprise; because funds, recovered by the depreciation policy, are alloted for loans for the expansion of plants. It is a special case in which funds, recovered by the depreciation procedure, are used previously, through the medium of a banking organ, for the expansion of plants. It is not necessary, in this case, to allot funds, recovered in a certain enterprise, for the expansion of plants in another enterprise. The complementary policy, adopted by a banking organ, takes precedence to the depreciation procedure.

It should be noted that the concept of economic depreciation, that is, periodic self-financing, includes special depreciation, now in practice.

If such a concept of depreciation is adopted, importance is attached to the ratio of annual depreciation charge, containing special depreciation charge, to an annual investment. This ratio indicates the effect of the depreciation procedure upon the national economy.

According to the year-book of corporation statistics in Japan, this ratio is as follows;

	1955	1956
Mining industry	1.0562	0.8057

Manufacturing industry	0.6261	0.4064
Public utilities	0.4369	0.4043
Wholesale industry	0.5802	0.3477
Retail industry	0.5203	0.2249
Average	0.5743	0.4102

As to be stated afterwards, the rate of growth indicated a remarkable upward tendency in 1956, in Japan; amounting to 6%, with 1946 as a starting point, although it amounted to 2% in 1955.

When the time-lag between depreciation and investment is considered, these ratios indicate the effect of the depreciation procedure upon the annual investment.

It goes without saying that the special depreciation system is regarded as a sort of practical application of economic depreciation, meaning periodic self-financing.

As clarified above, the concept of economic depreciation, referred to above, deviates from the accounting concept of depreciation.

If rigidly defined, the ratio of an annual depreciation charge to an annual investment shows how much the discrepancy between an annual depreciation charge and an annual investment must be adjusted by other financial policies than the depreciation procedure; for example, the issue of stocks, the creation of credits, the exemption from taxation, or the deferment of taxes.

Special depreciation should be regarded rather as a financial policy for the exemption from taxation or the deferment of taxes.

The comparatively lower ratio of an annual depreciation charge to an annual investment does not always indicate that the depreciation policy, now applied, is not reasonable. It indicates that other financial policies than the depreciation procedure are needed.

Granting that the annual investment shows a constant trend, in the national economy, the ratio of the annual social depreciation charge to the annual social investment can be computed on a certain condition, by the following formulas;

Straight-Line Method

$$\frac{(1-e^{-kn})\,(1-u)}{kn}+ue^{-kn}$$

Declining-Balance Method

$$\frac{r+ke^{-n(r+k)}}{r+k}$$

n ....Life

k ....Rate of Growth

r ....Depreciation Rate

Under the declining-balance method, it is found out by the following formula, assuming that life and salvage percentage are indicated by n and u, respectively;

$$e^{-rn}=u$$

u ....Salvage Percentage

These formulas are illustrated in detail by Prof. Edgar O. Edwards, in his treatise, "Depreciation and the Maintenance of Real Capital". (Depreciation and Replacement Policy, edited by J. L. Meij, pp. 126–136).

As regards the foregoing formulas, attention should be directed to the fact that some assumptions are adopted.

One is that the trend of an annual investment shows a constant regression curve.

The second assumption is that assets, acquired simultaneously, are retired entirely at the end of the *n*th year. It is reasonable only in case a number of homogeneous assets are acquired or in case the life *n* means the functional life of an integrated group.

The third assumption is that the difference between the arithmetical method and the integral method is negligible in finding out the original costs or the book costs for computing an annual charge.

To show the practical application of the foregoing formulas, let us quote a simple example in which the cost for the first acquisition and its life are regarded as 1 and 4 years, respectively, as follows:

In the first place, let us assume that the rate of growth is regarded as O. In this case, an annual investment amounts to 1, every year.

Assuming that the scrap value is 10% of the original cost, the annual charges are as follows;

Straight-Line Method

Year	Annual Acquisition (1)	Original Cost, after Annual Acquisition (2)	Annual Charge [(2)−0.1]×0.25 (3)	Depreciation Allowance (4)	Amount Charged against Depreciation Allowance (5)
1	1	1	0.225	0.225	
2	1	2	0.450	0.675	
3	1	3	0.675	1.350	
4	1	4	0.9	2.250	0.9
5	1	4	0.9	2.250	0.9
6	1	4	0.9	2.250	0.9

Declining-Balance Method

Year	Annual Acquisition (1)	Book Cost, after Annual Acquisition (2)	Annual Charge (2)×0.438 (3)	Book Cost of Retired Asset (4)	Book Cost, at Year-end (5)
1	1	1	0.438		0.562
2	1	1.562	0.684		0.878
3	1	1.878	0.823		1.055
4	1	2.055	0.9	0.1	1.055
5	1	2.055	0.9	0.1	1.055

If the scrap value is 10% of the original cost, the amount of funds to be recovered by the depreciaton procedure is 90% of the original cost. Strictly speaking, therefore, the salvage value should be added to the annual charge in computing the ratio of the annual charge to the annual investment.

Under both the straight-line method and the declining-balance method, the depreciation charge is regarded as 0.9 in and after the fourth year. Now that the annual investment amounts to 0.9, as stated above, the ratio of the annual charge to the annual investment is 100%.

These circumstances are clarified by the following expression.

Assuming that the acquisition in the tth year is indicated by $A(t)$ and the rate of growth is indicated by k, $A(t)$ equals e^{kt}, on condition that $A(o)$ is regarded as 1.

The foregoing example is the case in which k is regarded as zero in this expression. Therefore, the annual investment is shown by e^{o}, which equals 1, and the original cost, the book cost, and the annual depreciation charge, are as follows, at the beginning of the nth year.

Straight-Line method

The original cost at the beginning of the n th year $\quad n \cdot e^{o} = n$

The annual charge $\quad n \times 0.9 \times \frac{1}{n} = 0.9$

Declining-Balance method

The book cost at the beginning of the n th year $\quad \int_{o}^{n} e^{o} \cdot e^{-r(t-p)} \cdot dt = \frac{1-e^{-rn}}{r}$

The annual charge $\quad \frac{1-e^{-rn}}{r} \times r = 1-e^{-rn}$

In this case, e^{-rn} means the scrap value, amounting to 0.1.

Then, $\quad 1-e^{-rn}=0.9$

Also in the $(n+1)$th year, the annual depreciation charge amounts to 0.9, either under the straight-line method or under the declining-balance method. In case the rate of growth is regarded as zero, $e^{-r(n+1)}$, which means the value of the salvage in the $(n+1)$th year, also equals 0.1.

Next, if the rate of growth is regarded as 5 percent, the original cost, the book cost, and the depreciation charge are as follows;

Straight-Line Method

Year	Annual Acquisition (1)	Original Cost after Annual Acquisition (2)	Annual Charge [(2)−0.1]×0.25 (3)	Depreciation Allowance (4)	Amount Charged against Depreciation Allowance (5)
1	1 (e^{0})	1	0.225	0.225	
2	1.05($e^{0.1}$)	2.05	0.46125	0.68625	
3	1.1 ($e^{0.2}$)	3.15	0.70875	1.395	
4	1.16($e^{0.3}$)	4.31	0.96975	2.36475	0.9
5	1.22($e^{0.4}$)	4.53	1.01925	2.484	0.945
6	1.28($e^{0.5}$)	4.76	1.071	2.610	0.99

The annual charge of the fourth year $\quad$ 0.96975

The annual investment at the beginning of the fifth year $\quad$ 1.22

The ratio of the annual charge to the annual investment $\quad \frac{0.96975+0.1}{1.22} = 87.68\%$

The annual charge of the fifth year $\quad$ 1.01925

The annual investment at the beginning of the sixth year $\quad$ 1.28

The ratio of the annual charge to the annual investment $\dfrac{1.01925+0.105}{1.28}=87.83\%$

Declining-Balance Method

Year	Annual Acquisition (1)	Book Cost, after Annual Acquisition (2)	Annual Charge (2)×0.438 (3)	Book Cost of Retired Asset (4)	Book Cost, at Year-end (5)
1	1	1	0.438		0.562
2	1.05	1.612	0.706		0.906
3	1.10	2.006	0.879		1.127
4	1.16	2.287	1.002	0.1	1.185
5	1.22	2.405	1.053	0.105	1.247
6	1.28	2.527	1.107	0.110	1.310

The ratio of the annual charge to the annual investment in the fourth year

$$\frac{1.102+0.1}{1.22}=90.33\%$$

The ratio of the annual charge to the annual investment in the fifth year

$$\frac{1.053+0.105}{1.28}=90.47\%$$

As stated above, the ratio of the annual charge to the annual investment is slightly changeable either in the case of the straight-line method or in the case of the declining-balance method. That is to say, the rates in the fourth and fifth year are, under the straight-line method, regarded as 87.68% and 87.83%, respectively, and under the declining-balance method, regarded as 90.33% and 90.47%, respectively.

Assuming that the difference between the integral method and the arithmetical method is negligible, the foregoing formulas are deducted from the following integration.

Straight-Line Method

The original cost at the beginning of the nth year $\int_o^n e^{tk}\cdot dt=\dfrac{e^{kn}-1}{k}$

The annual charge $(1-u)\dfrac{e^{kn}-1}{k}\times\dfrac{1}{n}$

The annual investment e^{nk}

The ratio of the total of the annual charge and the salvage value to the annual investment

$$\left\{\frac{(1-u)(e-1)}{kn}+e^{o}\cdot u\right\}\div e^{nk}=\frac{(1-u)(1-e^{-kn})}{kn}+u\cdot e^{-nk}$$

Declining-Balance Method

The book cost at the beginning of the nth year $\int_o^n e^{tk}\cdot e^{-r(n-p)}\cdot dp=\dfrac{e^{kn}-e^{-rn}}{r+k}$

The annual charge $\dfrac{r(e^{kn}-e^{-rn})}{r+k}$

The ratio of the total of the annual charge and the salvage value to the annual investment

$$\left\{\frac{r(e^{kn}-e^{-rn})}{r+k}+e^{-rn}\right\}\div e^{nk}=\frac{re^{kn}-re^{-rn}+re^{-rn}+ke^{-rn}}{r+k}\div e^{nk}=\frac{r+ke^{-(r+k)n}}{r+k}$$

If the foregoing formulas are applied for the computation of the ratio of the depreciation charge to the annual investment, the ratio is regarded as 89.34% under the straight-line method, and as 92.66% under the declining-balance method, respectively as follows. Although there is a discrepancy between the artithmetical method and the integral method, the integral analysis referred to above is certainly serviceable to estimate how much the annual charge will cover the funds for substitutions.

Straight-Line Method

$$\frac{(1-e^{-kn})(1-u)}{kn}+ue^{-kn}=\frac{(1-e^{-4\times 0.05})\times 0.9}{0.05\times 4}+0.1\times e^{-4\times 0.05}$$

$$=\frac{(1-0.81968)\times 0.9}{0.2}+0.1\times 0.81968$$

$$=0.893412$$

Declining-Balance Method

$$e^{-r\cdot 4}=0.1,\qquad -4r=-2.3026,\qquad r=0.57565$$

$$\frac{r+ke^{-n(r+k)}}{r+k}=\frac{0.57565+0.05\times e^{-4(0.57565+0.05)}}{0.57565+0.05}$$

$$=\frac{0.57565+0.05\times 0.08197}{0.62565}$$

$$=0.9266$$

The ratio of the annual depreciation charge to the annual investment is influenced by the rate of growth, the life, price fluctuation and, although slightly, the elapsed time.

Granting that errors resulting from the difference between the arithmetical method (the prevailing accounting method) and the integral method or the difference between the life and the elapsed time of a plant unit are negligible, the foregoing calculation shows how much the depreciation procedure should be adjusted by other financial policies.

Generally speaking, the rate of growth does not always show a constant tendency. Moreover, granting that a constant rate of growth is deducted, according to "the law of large numbers", its regression equation cannot be always expressed in the form of $A(t)=e^{kt}$.

In the next place, let us compute the rate of growth in Japan, with 1946 as a starting point, assuming that the regression equation is shown by $A(t)=e^{kt}$.

1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	1957
−20%	−11%	−7%	−6%	−3%	1%	2%	2%	2%	6%	8%
1958	1959	1960	1961*							
7%	9%	10%	11%							

* These figures are computed from the annual investments which are adjusted by the 1955 level price index, as follows;

As clarified above, it is difficult to find out a constant rate of growth. It seems that the irregular tendency of the rate of growth is due to abnormal conditions resulting from restoring war-damaged facilities. If we hope to discover a constant tendency of the rate of growth, it might be advisable to put aside the period covering the years from 1946 to 1952. In this case, the regression equation is expressed in the form of $A(t)=0.834\ e^{0.21t}$ (in this equation, $A(t)$ indicates the annual investment index in the tth year, the annual invesment of 1953 being 1. However, the exponent of e, amounting to 0.21, is not the same rate of growth as mentioned in the foregoing analysis of the ratio of the annual depreciation charge to the annual investment, because $e^{0.21t}$ is multiplied by 0.834.

Considering the above circumstances, there is no alternative but to select a probable rate optionally among the rates which have been experienced.

To clarify the influence of the annual depreciation charge upon the annual investment in relation to the rate of growth, it might be advisable to compute the ratios of the annual depreciation charge to the annual investment (including the salvage value in the annual retirement, that is, 10% of the original cost of the retired), which are computed in accordance with the rates of growth from 1% to 11% and the lives from 5 years to 30 years, as follows;

Table 6 Investments (All Industries)

	Nominal Annual Investment	Price Index of Production Material (%)	Adjusted Annual Investment
1946	37.2	5.5	676.4
1947	94.5	17.1	552.6
1948	211.5	38.7	546.5
1949	288.6	53.4	540.5
1950	389.9	73.6	529.8
1951	609.9	103.8	587.6
1952	712.6	102.3	696.6
1953	800.7	105.3	760.4
1954	760.1	99.0	767.4
1955	777.4	100.0	777.4
1956	1,372.6	110.7	1,239.9
1957	1,693.2	109.6	1,544.9
1958	1,649.6	101.1	1,631.7
1959	2,170.2	103.4	2,098.8
1960	3,069.5	104.6	2,934.5
1961	4,050.4	109.9	3,685.5

Unit: billion yen

Note: The nominal annual investment depends upon the "White Paper on National Income", published by the Economic Planning Agency and the price index is based upon the wholesale index of production materials, published by the Bank of Japan.

Straight-Line Method

	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	−1%	−4%
5years	97.7	94.6	92.0	89.6	87.4	85.1	82.9	81.0	78.8	75.8	75.0	100.5	111.2
10years	94.6	89.6	85.1	81.0	75.8	73.1	69.6	66.5	63.4	60.6	57.9	106.5	127.5
15years	92.0	85.1	78.8	73.1	68.0	63.4	59.2	55.4	52.0	48.9	46.0	107.6	141.2
20years	89.6	81.0	73.1	66.5	50.6	55.4	50.8	46.9	43.4	40.3	37.5	111.2	160.7
25years	87.4	75.8	68.0	60.6	54.2	48.9	44.2	40.3	36.9	33.9	31.3	113.6	182.0
30years	85.1	73.1	63.4	55.4	48.9	43.4	38.8	35.0	31.8	29.0	26.6	118.5	207.2

Declining-Balance Method

	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	−1%	−4%
5years	98.1	96.2	94.4	92.7	91.0	89.3	87.7	86.2	84.7	83.2	81.8	102.0	108.4
10years	96.2	92.7	89.3	86.2	83.3	80.5	77.9	75.4	73.1	70.9	67.7	104.0	117.9
15years	94.4	89.3	84.7	80.5	76.6	73.0	69.8	66.8	64.0	61.4	59.1	106.2	128.8
20years	92.7	86.2	80.4	75.4	70.9	66.8	63.1	59.8	56.1	54.2	51.7	108.4	141.4
25years	91.0	83.2	76.6	70.9	65.8	61.4	57.6	54.2	51.1	48.4	45.9	110.6	155.9
30years	86.3	80.5	73.0	66.8	61.4	56.9	52.9	49.4	46.4	43.7	41.4	112.9	172.6

These tables explain that the rattios are higher under the declining-balance method than under the straight-line method, if the rate of growth shows an upward tendency. If the rate of growth shows a downward tendency, the ratios are lower under the former than under the latter method. This fact means that the declining-balance method is more advisable from the standpoint of financial policy than the straight-line method. However, it does not mean that the adoption of the declining-balance method is unconditionally accepted in accounting practice. It means that it is more necessary to adjust the depreciation procedure by other financial policies in the case of the straight-line method than in the case of the declining-balance method, even if importance is attached to the significance of the depreciation procedure in the financial sphere.

Another point to which attention should be paid concerns the problem that a plant consists of components having different service lives.

Strictly speaking, such an analysis must be made on condition that the costs of assets, regarded as an integrated group, are written off by using a single rate. Or otherwise, it might be desirable to assume that the costs of assets are written off by using a single average rate. In this case, an average life should be discovered beforehand.

The misapplication of this ratio is that the depreciation rate is computed so that this ratio may amount to 100%.

For instance, let us assume that the cost of the first acquisition is regarded as 1% and the rate of growth as 5%. If the life and the salvage value are 4 years and 10% of the original cost, respectively, the rate which makes the annual charge at the fourth year-end, equivalent to the annual investment at the beginning of the fifth year, is regarded as 28.9% under the straight-line method and as 67.4% under the declining-balance method, respectively, as follows;

Straight-Line Method

$$(1+1.05+1.1+1.16)\times 0.9\times r=1.22-0.1 \qquad r=28.9$$

Declining-Balance Method

$$\{1\times(1-r)^3+1.05\times(1-r)^2+1.1\times(1-r)+1.16\}\times r=1.22-0.1 \qquad r=67.4\%$$

r.........Depreciation Rate

Straight-Line Method

Year	Annual Acquisition (1)	Original Cost, After Annual Acquisition (2)	Annual Charge (2)×0.9×0.289 (3)	Depreciation Allowance (4)	Amount Charged against Depreciation Allowance (5)
1	1	1	0.26	0.26	
2	1.05	2.05	0.533	0.793	
3	1.1	3.15	0.818	1.611	
4	1.16	4.31	1.120	2.731	0.9
5	1.22	5.53	1.437	3.268	0.945

Declining-Balance Method

Year	Annual Acquisition (1)	Original Cost, After Annual Acquisition (2)	Annual Charge (2)×0.674 (3)	Book Cost of Retired Asset (4)	Book Cost, at Year-end (5)
1	1	1	0.674		0.326
2	1.05	1.376	0.927		0.449
3	1.1	1.549	1.044		0.505
4	1.16	1.665	1.120	0.1	0.445
5	1.22	1.665	1.120	0.105	0.440

The above rates are not reasonable from the standpoint of the present accounting theory, for they are based on the modified replacement accounting approach. The depreciation procedure, in this case, is made to cover funds for substitutions of existing plants, taking into consideration their expansion or reduction.

If the rate is computed to cover renewal funds in the above meaning, it can also be deducted approximately by using the integral method.

In this case, the difference between the arithmetical method and the integral method would be inevitable. When the rate of growth shows an upward tendency, the original costs, if the integral method is applied, are computed larger than the actual figures, with the result that under the straight-line method, the provision rate is lower than the arithmetical rate. (Under the declining-balance method, the circumstances are complicated because the book cost is used for the factor for computing an annual charge.) When the rate of growth shows a downward tendency, the rate, under the straight-line procedure, is higher than the arithmetical rate.

Straight-Line Method

Assuming that the rate is indicated by r,

$$r\times\frac{(1-e^{-kn})(1-u)}{k}+ue^{-kn}=1$$

Then,

$$r\times\frac{(1-e^{-0.05\times4})(1-0.1)}{0.05}+0.1\times e^{-0.05\times4}=1$$

$$r\times\frac{(1-0.81968)\times0.9}{0.05}+0.1\times0.81968=1$$

$$r=0.283$$

Declining-Balance Method

$$\int_o^n e^{tk}\cdot e^{-rp(n-p)}\cdot dp=\frac{e^{kn}-e^{-rn}}{r+k}\text{ ....Book Cost, in } n\text{th year}$$

$$r\times\frac{e^{kn}-e^{-rn}}{r+k}+u=e^{nk}$$

$$r\times\frac{e^{0.05\times4}-e^{-4r}}{r+0.05}+0.1=e^{0.05\times4}$$

$$r\times\frac{1.22-e^{-4r}}{r+0.05}=1.22-0.1$$

$$r=84.9\%$$

Note:

$$0.849\times\frac{1.22-e^{-4\times0.849}}{0.849+0.05}$$

$$=0.849\times\frac{1.22-0.033784}{0.849+0.05}=1.12014$$

As clarified above, the integral method shows that the depreciation rate is regarded as 28.3% under the straight-line method and as 84.9% under the declining-balance method, respectively.

It is certain that such a rate depends upon not only the life or the salvage value, but also the rate of growth. However, it does not justify that the depreciation procedure should depend upon the rate of growth.

The rate for providing for investments, referred to above, is, strictly speaking, not the depreciation rate, as far as accounting theories are concerned.

(4) Replacement Depreciation

The prevailing entry for providing for maintenance costs may be regarded as one of the replacement cost depreciation procedures. In this respect, two different approaches for absorbing plant cost are used together in present accounting practices. In other words plant accounting policy is not consistent.

If replacement cost depreciation is applied not only to a structural element, subject to separate replacement for maintenance works, but also to the depreciation unit, such a confusion might be eliminated from plant accounting. However, there are some questions about such an overall replacement cost depreciation.

The meaning of replacement cost depreciation is, in this case, that annual depreciation charges are calculated on the basis of estimated replacement cost, in the sense of the cost of the substitute which will be incurred at the time of retirement.

One of the questionable points is the problem of identifying a retired unit from its substitute. To absorb replacement cost in advance, it must be assumed that the substitute will probably be of the same description as the retired unit. If identification is conceived in terms of individual assets, such an assumption may be, in most cases, unreal. For instance, the component of a unit frequently changes. Therefore, there is no alternative but to conceive identification in terms of a comparatively larger unit which is regarded as an integrated group. If the production capacity of a retired group is equivalent to that of its substitute, the description of the latter may be regarded, from such an aspect, as identical with that of the former. Such a group resembles the group of inventory assets to which the retail inventory method is applied. For, if the retail inventory method is applied to margins of assets which are different from each other, identification cannot be conceived in terms of individual assets.

Another question concerns the problem of the probability of acquiring a substitute. Even if identification is conceived in terms of a considerably large unit, there is no reason to assume that it will be replaced by its substitute equivalent in production capacity. Usually, the production capacity of an enterprise fluctuates. To take an extreme example, some electric or railway stations are sometimes abolished without being accompanied by their substitutes. Unless the production capacity of an enterprise is assumed to be maintained eternally and constantly, it is difficult to consider that all the existing units will be replaced by their substitutes equivalent in production capacity.

To justify replacement cost depreciation, it is necessary to make such an assumption.

It is certain that the replacement cost depreciation procedure is the lifo method for fixed assets. In this connection, attention should be paid to the problem of identification of a retired unit with its substitute. Assuming that identification is conceived in terms of an integrated group of dissimilar assets, the lifo method for fixed assets resembles the lifo retail inventory method.

To yield results that are essentially the same as those yielded by the lifo inventory method in plant accounting, the cost of the substitute, that is, the replacement cost, should be written off in advance. If the cost of the substitute is absorbed only when it is acquired, current cost is not always chagred against current revenue in plant accounting. For, a fixed asset is devoting its service to operations over the period covering its life, including different accounting periods. Unless the replacement cost is written off in advance, only a one-sided effect in the lifo inventory method is brought forth by the replacement accounting approach. In other words, the closing balance of inventories is valued at the costs of first-in assets. Insofar as the nature of the lifo method lies in producing such a one-sided effect, the replacement accounting approach might be properly called the lifo method for fixed assets, even if it may be accompanied by the periodic assignment procedure. The adoption of such a lifo method in plant accounting is not so significant from the standpoint of determination of periodic income. This is the reason why replacement cost depreciation is the ultimate object of the lifo method for fixed assets.

However, an assumption, referred to above, is needed for the application of replacement cost depreciation, and it sometimes obstructs the reasonable absorption of plant cost.

(5) Reinvestment Depreciation

In connection with the replacement cost depreciation procedure, we should refer to the term "reinvestment depreciation" briefly.

Reinvestment depreciation is usually thought to be the lifo method for fixed assets,* and therefore, we must discuss it by comparing its effect with that of the lifo inventory method.

According to Mr. Maurice E. Peloubet, reinvestment depreciation is only a step toward replacement cost depreciation. He explains, "those who advocate reinvestment depreciation are fully aware of the theoretical excellence and logical appeal of complete replacement depreciation, and they understand fully that reinvestment depreciation is only a step, although a long one, towards that goal. It is thought that reinvestment depreciation, as it does not require any revaluation of property, any estimate of the future, or any recovery on any particular item of property of more than historical cost, may fit within the present framework of tax theory and philosophy somewhat better than full replacement depreciation."

If "replacement depreciation", referred to in the above quotation means writing off the estimated replacement cost periodically, it is, strictly speaking, not always a reasonable procedure. For, there are some questionable points about the problem of probability on acquiring a substitute for an existing asset and the problem of identification of the description of a retired unit and that of its substitute. The reinvestment depreciation procedure is immune from these questionable points, because the entry for yielding results that are essentially the same as those yielded by replacement cost depreciation is recorded, under reinvestment depreciation, only when the unit has been actually retired.

Under reinvestment depreciation, the difference between the estimated current cost and the recorded actual cost of a retired unit, is absorbed as the extraordinary depreciation charge for its substitute, at the time of replacement. Such a difference means the insufficiency of depreciation which would have been absorbed if the replacement cost depreciation procedure had been previously appplied.

According to the illustration concerning "reinvestment depreciation", the foregoing difference is deducted from the cost of the substitute, but the problem whether it is deducted from the cost of the substitute or charged to the revaluation surplus, is irrelevant directly to the purpose of yielding

* For instance, Maurice E. Peloubet, Insufficient Depreciation and Inflation, The Controller, March 1959, pp. 113-114.

results that are essentially the same as those yielded by replacement cost depreciation. When it is deducted from the cost of the substitute, the plant account is offset by the revaluation surplus account. Theoretically speaking, the retired unit is revalued in advance, and then the surplus resulting from revaluation is offset by the cost of the substitute. The same can be said for replacement cost depreciation and current cost depreciation. We can adopt the reinvestment depreciation procedure without being accompanied by offsetting the revaluation surplus by the plant account. Such a type of reinvestment depreciation may be more advisable, because the plant account is not distorted and, moreover, because we can see more clearly how the revaluation surplus will be dealt with in the future in succeeding entries concerning the substitute for the retired unit.

A misguided procedure for reinvestment depreciation is this; the estimated current cost is found out by multiplying the actual cost of a retired unit by current price index, the price level at the date of its acquisition being 100, and then the foregoing difference is found out by subtracting its actual cost from its estimated current cost. The calculation is as follows;

The estimated current cost of the retired unit =

$$\text{The actual cost of the retired unit} \times \frac{\text{Current price index}}{\text{Price index at the date of the acquisition of the retired unit}}$$

The difference to be absorbed as the extraordinary charge =

The estimated current cost (from which the estimated current cost of salvage, if any, is subtracted)—The actual cost of the retired unit (from which the cost of salvage, if any, is subtracted).

In the above process of calculation, attention should be paid to the denominator of the multiplier. If the denominator of the multiplier is the price index at the date of the acquisition of the retired unit, as shown above, results that are essentially the same as those yielded by the lifo inventory method cannot always be yielded because such an estimated cost means the value of the retired unit at the date it was actually acquired. If the unit has been successively replaced, the cost of the first unit should continue to be recorded in the plant account, as far as results that are essentially the same as those yielded by the lifo inventory method are yielded. In other words, the denominator in the multiplier should not be the index at the date of the acquisition of the retired unit, but the index at the date of the initial installation of the preceding units, if importance is attached to yielding results that are essentially the same as those yielded by the lifo inventory method. In case such an index is selected as the denominator, the multiplicand should be the cost of the initial unit. The date the multiplicand was recorded in the plant account is the same date as the denominator.

Assuming that the cost of the unit which was initially acquired among the successive renewals continues to be recorded in the plant account, the difference between the estimated current cost and the recorded cost of the retired unit is computed as follows;

The estimated current cost of the retired unit =

$$\text{The recorded cost of the retired unit} \times \frac{\text{Current price index}}{\text{Price index at the date of the acquisition of the initial unit}}$$

The difference to be absorbed as the extraordinary charge =

The estimated current cost (from which the estimated current cost of salvage, if any, is subtracted)—The recorded cost of the retired unit (from which the cost of salvage, if any, is subtracted).

To explain the above circumstances mathematically, we quote a simple example in which the production capacity of the retired unit is equivalent to that of the substitute. It can be considered that the equality of production capacity between the retired unit and the substitute is the same case as the opening stock is equivalent in quantity to the closing balance under the lifo inventory method.

Let us assume that a unit, costing 1,000,000 yen, has the life of four years and the salvage value of 10 percent of its cost, and that price indices are regarded as 318, 2,414, and 14,216, respectively, at the end of every four years, price index at the beginning of the first year being 100.

If the denominator in the multiplier for computing the estimated current costs is the index of the initial unit, on condition that the cost of the initial unit continues to be recorded in the plant account, the extraordinary depreciation is shown in column (5) of the following table. The total costs to be absorbed every four years, shown in column (7) of the following table, are equivalent to the total annual depreciation charges of every four years computed, if the replacement cost depreciation procedure had been applied.

Period (1)	Recorded Cost (2)	Actual Replacement Cost (3)	Annual Depreciation Charge (2)×0.9×0.25 (4)	Extra-ordinary Depreciation Charge (5)	Gain Realized by Sale of Salvage (6)	Total Costs to be Absorbed (4)+(5)−(6) (7)
1−4	1,000	3,180	900	2,180	218	2,862
5−8	1,000	24,140	900	23,140	2,314	21,726
9−12	1,000	142,160	900	141,160	14,116	127,944

Unit: 1,000 yen

The computation of extraordinary depreciation charges is;

$$1{,}000\times\frac{318}{100}=3{,}180 \qquad 3{,}180-1{,}000=2{,}180$$

$$1{,}000\times\frac{2{,}414}{100}=24{,}140 \qquad 24{,}140-1{,}000=23{,}140$$

$$1{,}000\times\frac{14{,}216}{100}=142{,}160 \qquad 142{,}160-1{,}000=141{,}160$$

Unit: 1,000 yen

As far as the price index is a correct individual price index, the recorded cost multiplied by the above multiplier, in which the denominator is the index at the date of the acquisition of the initial unit, equals the actual replacement cost on condition that the production capacity of the substitute is always equivalent to that of the retired.

In such a case, the actual replacement cost is treated directly as the estimated current cost of the retired unit. We need not find it out by multiplying the recorded cost by the price index, the price level of the first aquisition being 100. However, such a simple computation for finding out the estimated current cost of the retired unit clarifies what effect is produced if the denominator in the multiplier is the index at the date of the first acquisition.

If the denominator in the multiplier is the index at the date the retired unit is acquired, the extraordinary depreciation charges for the second and third four years are as follows:

The second four years

$3{,}180{,}000 \text{ yen} \times \frac{2{,}414}{318} = 24{,}140{,}000 \text{ yen}$......Estimated current cost

$24{,}140{,}000 \text{ yen} - 3{,}180{,}000 \text{ yen} = 20{,}960{,}000 \text{ yen}$......Extraordinary charge

The third four years

$24{,}140{,}000 \text{ yen} \times \frac{14{,}216}{2{,}416} = 142{,}160{,}000 \text{ yen}$......Estimated current cost

$142{,}160{,}000 \text{ yen} - 24{,}140{,}000 \text{ yen} = 118{,}020{,}000 \text{ yen}$......Extraordinay charge

In case the denominator of the multiplier is the index at the date of the acquisition of the first unit, the extraordinary charge for the second and third four years are regarded as 23,140,000 yen and 141,160,000 yen, respectively. Meanwhile, in case the denominator in the multiplier is the index at the date the retired unit was actually acquired, the extraordinary charges for the second and third four years are regarded as 20,960,000 yen and 118,020,000 yen, respectively.

The insufficiency of extraordinary charges is;

The second four years $23{,}140{,}000 \text{ yen} - 20{,}960{,}000 \text{ yen} = 2{,}180{,}000 \text{ yen}$

The third four years $141{,}160{,}000 \text{ yen} - 118{,}020{,}000 \text{ yen} = 23{,}140{,}000 \text{ yen}$

The above insufficiency amounts to the extraordinary charge which was absorbed when the retired unit was actually acquired.

In this case, effects that are the same as those yielded by the lifo inventory method, which result from absorbing the difference between actual cost and replacement cost as extraordinary charge, become nil at the next time of replacement.

In the above calculation example, the estimated replacement cost is deduced by multiplying the actual cost of a retired unit by the ratio of the current price index to the price index at the date of its acquisition. If the recorded cost is multiplied by this ratio, the date the recorded cost was incurred is not the date of the denominator in this ratio. Such a computation is insignificant. The results are, in most cases, complicated, but they can be clarified to an extent that effects that are the same as those yielded by the lifo inventory method disappear at the next time of replacement. For example, the estimated current cost in the second four years is as follows;

$$1{,}000{,}000 \text{ yen} \times \frac{2{,}414}{318} = 7{,}591{,}195 \text{ yen}$$

Accordingly, the extraordinary charge amounts to 6,591,195 yen (7,591,195 yen-1,000,000 yen). As the correct charge is regarded as 23,140,000 yen, the insufficiency amounts to 16,548,805 yen. This sufficiency is the estimated current cost of the extraordinary charge which was absorbed during the first four years, which is computed as follows;

$$2{,}180{,}000 \text{ yen} \times \frac{2{,}414}{318} = 16{,}548{,}805 \text{ yen}$$

As stated above, the process of computation of the estimated current cost of the retired is closely related to the problem of yielding results that are the same as those yielded by the lifo inventory method.

The method of computing the extraordinary charge by using price index is a device for finding out the estimated cost of the substitute for the retired in case the production capacity of the former is different from that of the latter, assuming that identification is conceived in terms of production capacity.

It is considered, in this case, that to yield results that are the same as those yielded by the lifo inventory method, the cost of the initial unit should continue to be recorded to an extent that its producing capacity is maintained.

The defect in such an ideal reinvestment depreciation procedure lies in that the extraordinary charge threatens to be a heavy burden on the time of replacement. It is not advisable to regard recorded cost from which the revaluation surplus is subtracted as a depreciation base. If replacement cost approach is not acceptable in practice, it is desirable to regard actual cost at least, as a depreciation base as a compromise measure.

If accumulated depreciation charges exceed a plant account, the plant account is shown on the credit side because the revaluation surplus is subtracted from it in the system of reinvestment depreciation.

It is debatable that if the price index at the date of acquisition of a retired unit is used for the denominator in the multiplier for revaluation, the extraordinary charge, which was previously absorbed as expense for the preceding replacement, is indirectly transferred to earnings. For, it may yield results that are the same as those yielded by restating the cost of a retired unit at the price level existing when it was actually acquired.

In case the revaluation surplus is subtracted from the plant account, accountants are liable to pass over the foregoing circumstances. The revaluation surplus means the credit balance which is not reflected in periodic income. Even the revaluation surplus which is subtracted from the plant account, as shown in "reinvestment depreciation", should not be charged to current revenue, as far as results that are the same as those yielded by the lifo inventory method are intended to be yielded.

Reinvestment depreciation means the revaluation of a retired unit on the basis of the cost of its substitute, to an extent that its substitute is of the same description as the retired unit, and then to subtract the surplus resulting from revaluation, from the cost of its substitute. The surplus, in this case, must be regarded as the "neutralized" credit balance.

Under reinvestment depreciation, a unit can be conceived either in terms of individual assets or in terms of comparatively large assets. If a unit is conceived in terms of individual assets, it is easy to identify the description of the retired unit from that of its substitute. Insofar as a unit is conceived in terms of individual assets, it is justifiable to regard reinvestment depreciation as a procedure for absorbing costs in accounting.

If a unit is conceived in terms of individual assets, the price index for computing the estimated current cost of the retired unit should not be the general price index, but the individual price index.

However, if attention is directed to the measuring of periodic income to see the effect of periodic operations at the current price level, it is a fruitless procedure. For, current cost is not charged against current revenue within the limit of an accounting period.

Under the lifo method, current cost is charged against current revenue within an accounting period, assuming that the opening stock equals in quantity the closing stock, or that the opening stock is less in quantity than the closing stock. If the opening stock is more in quantity than the closing stock, the cost of the excess of the opening stock over the closing stock is not absorbed on a current cost basis and as a result, it cannot be mentioned that current cost is charged against current revenue.

Under these circumstances, the effect of the lifo method on the periodic measurement of income concerns the case in which the quantity of the opening stock is equivalent or less than that of the closing stock.

In this connection, it should be noted that there is a hypothesis behind the lifo procedure, that the closing stock consists of goods on hand at the opening date as commonly explained.

This hypothesis means that if an account is closed everytime an individual unit is consumed or delivered, goods are consumed or delivered in reverse order to purchases. However, if an account is closed only at the end of an accounting period, it means that when the opening stock or its part is actually consumed or delivered, it is assumed that its substitute is consumed or delivered. This hypothesis is quite unrealistic.

From the standpoint of absorbing cost for the determination of income, it is more reasonable to consider that a consumed or delivered unit is revalued at the actual cost of its substitute and the credit balance resulting from revaluation is offset by the costs of goods on hand at the closing date so that it may not be treated as profit. The appearance that the closing stock consists of goods on hand at the opening date is nothing but the result of such a policy for "neutralizing" revaluation profit.

Under the lifo method, such a neutralizing policy is applied only to the opening stock or its part. The effect of neutralizing is that current cost is charged to current revenue. It is due to these circumstances that if the quantity of the opening stock is equivalent to or less than that of the closing stock, current costs are charged against revenue in the literal meaning.

Now that the period for closing an inventory account is nothing but an accounting period for measuring periodic income, under the lifo inventory procedure, current cost is charged against current revenue within the limits of an accounting period for measuring periodic income.

It is certain that the reinvestment depreciation procedure is regarded as the lifo method for fixed assets, but if we apply a rigid definition, it is necessary to treat the period covering the life of the unit, including the time of the acquisition of the substitute, as one period for closing an account.

In this case, the opening balance is recorded for the retired unit and the closing balance is recorded for the substitute. Under the lifo method, the opening balance equals the closing balance, assuming that the quantity of the opening stock is equivalent to that of the closing stock. If the production capacity of the retired unit equals that of its substitute, the cost of the substitute is recorded at the same amount as the retired unit. It is not the actual cost of the retired unit, but the actual cost of its substitute, that has been absorbed. As the actual cost of the substitute is nothing but the current cost of the retired unit, current cost is, in this case, charged against current revenue, on condition that the period covering the life of the retired unit, including the time of substitution is regarded as one period for closing an account. As far as one prevailing accounting period is regarded as one period for closing an account, the current cost under the reinvestment depreciation procedure is not charged against revenue. From the standpoint of periodic measurement of income, the adoption of the lifo method for fixed asests seems to be insignificant. Within the limit of the prevailing accounting period, current cost is not charged against current revenue.

From the standpoint of periodic income determination, it is not desirable that the annual depreciation charges are computed on the basis of the cost of the substitute—this is replacement cost depreciation. Considering that there are some questionable points about replacement cost depreciation, current cost depreciation may be rather advisable in practice.

There are two procedures for treating the credit balance or revaluation profit, which results from absorbing cost on a basis other than on an actual cost basis.

One of them is to treat it in the same way as capital surplus or the special account for neutralizing income temporarily.

Another procedure is to subtract it from the plant account.

Before a unit is retired, the credit balance is subtracted from its own plant account. If accumulated current charges exceed the original cost of the unit, the plant account is shown on the credit side, that is, the plant account is shown as negative. When the unit is replaced, total credit balances are sometimes subtracted from the cost of its substitute. Such a treatment yields results that are almost the same as those yielded by the transfer of the credit balance to the capital account. If, in this case, the cost of a retired unit is restated at the same price of its substitute, its substitute appears to be recorded at the old cost of the retired unit. Reinvestment depreciation is included in this category.

If total credit balances are not subtracted from the cost of its substitute, under the latter procedure, credit balances are transferred to earnings. It is neutralized only within the period during which the unit is devoting its service to operations. Such a treatment resembles the transfer of the credit balance to the special account for neutralizing income temporarily.

(6) Principle of Revaluation and Capital Recovery

The cost of the substitute which will be acquired when an existing asset has been retired, that is, future cost for replacement, is not reasonable as a basis for computing annual depreciation charges. Current cost for replacement is often used as a basis for computing annual depreciation charges. It is quite different from the market price of an existing asset, because it means the market price of the substitute.

The market price of an existing asset is measured by taking into consideration the market price of the entire enterprise. The properties of an enterprise are integrated to devote their services to operations. In this respect, the market price of an existing asset means partial value (Teilwert), in which the market value of the entire enterprise is reflected.

Let us then discuss the problem of which is appropriate as the depreciation basis, current replacement cost (the current cost of the substitute) or current value (the market price of an existing asset).

The example for depreciating an obsolete unit clarifies the difference between current replacement cost and current value.

Prof. Paton, who advocates writing off current replacement cost, explains that interest is, in connection with the cost of replacing an obsolete or semiobsolete plant unit, what it would cost to replace the capacity represented in the existing asset with a machine of modern design. In restating costs of assets on a replacement cost basis an obsolete or semiobsolete asset is treated in the same way as other assets operating on the front line.

Meanwhile, Prof. Schmalenbach explains, as regards current value depreciaton (Zeitwertabschreibung), that it is advisable to value an obsolete asset on the basis of selling prices, although an operating-on-the-front asset may be valued, as a practical alternative for the sake of convenience, on the basis of current replacement cost.

In Prof. Schmalenbach's current value depreciation, the use of replacement cost for evaluating assets operating on the front line is a practical alternative for evaluating assets on the basis of current value in which the value of an entire enterprise is reflected. The use of selling price for evaluating an obsolete asset seems to be due to the fact that obsolescence results in the divergence of current value from replacement cost.

In Schmalenbach's current value depreciation, the problem of absorbing cost reasonably seems to be neglected.

Granting that the cost of a plant is restated as a part of the value of an entire enterprise, it is necessary to consider, in the first place, what cost should have been absorbed if capitals had been invested in a plant unit at the current price level, and, in the second place, what section of cost should be urgently absorbed in accordance with the decrease in value of an entire enterprise.

The difference between the replacement cost of an obsolete asset and its selling price is almost equal to the section of cost to be absorbed urgently in accordance with the decrease in value of an entire enterprise. Such a difference must be treated as extraordinary charge.

In case revaluation is made on a selling price basis, it is considered that such an extraordinary charge is offset by the revaluation surplus, resulting from converting an actual cost basis into a replacement cost basis.

Another example for representing the set-off of extraordinary charge against revaluation surplus, is the case in which only annual charges are restated at the current price level.

To solve the problem as to whether the set-off of the extraordinary charge against revaluation surplus is reasonable or not, we should pay attention to the significance of a procedure for absorbing the cost of a property in which capitals are invested, assuming that capitals invested in a property are restated at the current price level.

The cost of a property means capitals invested in a property. If capitals have been recovered, the cost of a property in which they were invested must be absorbed. The extraordinary charge, referred to above, indicates the section of capitals which has been already recovered, although capitals recovered may be less in amount than capitals invested.

In restating costs at the current price level, importance is attached not to what it would cost to acquire a substitute for an existing assets, but to what would have been incurred if capitals had been invested in an existing asset, at the current price level, insofar as the restatement of assets is rigidly defined from the standpoint of absorbing costs in relation to the process of capital recovery.

If current cost for replacement means what it would cost to replace capacity, as Prof. Paton explains, it may be assumed that the fundamental purpose of accounting lies in maintaining the capacity for production. Such an assumption is not realistic, as indicated in regard to replacement cost depreciation.

Meanwhile, there is no reason to assume, as Prof. Schmalenbach explains, that the difference between the market value of an asset and what would have been incurred if capital had been invested in an existing asset, need not be absorbed as extraordinary charge. If rigidly defined, it is not the market price of a property but what would have been incurred if capital had been invested at the current price level that should be absorbed.

The use of current cost for replacement as a basis for depreciation should be regarded as one of practical alternatives for writing off what would be incurred if capital had been invested in an existing asset at the current price level. To avoid misunderstanding, it is advisable to use the term "current cost for an existing asset", instead of the term "current replacement cost." In restating costs, "current cost for an existing asset" should be applied not only to assets on the front, but also to obsolete or semi-obsolete assets. It is reasonable, in this case, to absorb the sections of the restated cost to an extent that such a current cost is cut off below the market price of an existing assets.

Some accountants explain that the difference of original depreciation charges from current depreciation charges in the past need not be absorbed as extraordinary charge, because funds approximately equivalent to it, are retained as a result of the reinvestment of capitals recovered into liquid assets, such as inventories, in which the current price level is reflected.

In this opinion, the purpose of depreciation is to retain the same amount of liquid capitals as fixed capitals, which had been invested, by using the periodic assignment procedure. This purpose is contradictory to the fundamental concept of depreciation.

If liquid capitals recovered are retained long enough to cover the difference of original depreciation charges from current depreciation charges in the past, it might be properly mentioned that there are retained earnings enough to absorb the extraordinary charge, referred to above. This fact does not show that it is not necessary to absorb the above difference as extraordinary charge. It shows that there is no obstacle toward absorbing the above difference as urgent charge.

As regards the reinvestment of capitals recovered into inventories, the question is raised as to what effect is produced if the method for neutralizing revaluation profits, such as the lifo inventory method or some current cost approaches is applied.

Certainly, it might be mentioned that if revaluation profits in inventories in which recovered capitals are reinvested are neutralized, it is not necessary to neutralize revaluation profits resulting from restating past depreciation charges at the current price level.

In this opinion, although revaluation profits resulting from restating past depreciation charges may be neutralized, on one hand, extraordinary charge should be charged against the suspense account for neutralizing revaluation profits in inventories, on the other hand. Such an entry may be not practical.

In this connection, it should be noted that it is advisable to neutralize only revaluation profits in a constant stock, which must be reserved continuously in inventory asset accounting.

As far as capitals are reinvested in the constant stock, in this case, revaluation profits are neutralized twice. However, it is not reasonable that capitals recovered through depreciation charges are reinvested in the constant stock in the above sense, because the reinvestment of capitals is nothing but investing capitals for replacement temporarily into inventory assets.

Even if the lifo inventory method is applied to such assets, neutralized profits, if any, are transferred entirely to earnings if the plant unit is retired and its substitute is acquired.

Therefore, the absorbing of extraordinary charges for current depreciation does not result in double neutralization.

Under current cost depreciation, it is more reasonable to use individual price indices, for restating costs than to use general price indices.

If general price indices are used for restatement, the restated cost does not represent cost incurred if capital had been invested in an existing asset at the current price level. It means the amount of purchasing power committed to an existing asset when it was acquired, but it does not mean the amount of purchasing power committed to it if it had been acquired at the current price level.

Certainly the amount of purchasing power committed to a property is, from the standpoint of absorbing costs to maintain purchasing power, a significant depreciation basis, but it is not a significant depreciation basis from the standpoint of determining income in the real economic circles, whether income may be defined as periodic income or total periodic incomes of the period during which an existing asset is devoting its service to operations.

The multiplier, by which actual cost is multiplied to find out estimated current cost, should be computed from individual indices.

Individual and general price indices, covering the years from 1938 to 1952, in Japan, are shown in Column 3 and Column 4, in the following table.

To compare the individual index basis with the general index basis, let us compute multipliers for restatement in 1952. These multipliers are shown in Columns 1 and 2.

Year	Multiplier		Index	
	From Individual Index	From General Index	Individual Index	General Index
1938	273	263	100	100
1939	230	238	119	110
1940	169	213	162	124
1941	123	199	223	132
1942	86	183	318	144
1943	62	171	441	154
1944	42	151	646	175
1945	23	100	1,189	264
1946	11	22	2,414	1,226
1947	4.9	7.0	5,609	3,629
1948	2.6	2.7	10,627	9,640
1949	1.6	1.7	16,924	15,732
1950	1.9	1.4	14,216	18,599
1951	1.3	1.0	21,121	25,812
1952	1.0	1.0	27,338	26,316

The general index indicates the averaged wholesale price index, published by the Bank of Japan and the individual index indicates the price index for construction costs for buildings, published by the Hypothec Bank of Japan.

The multipliers are computed by dividing the figures of the respective years by the figure of 1952.

(7) Revaluation in Japan

In Japan, fixed assets had been revalued at the current price level three times after the war, that is, in 1950, 1951, and 1953. The revaluations were made, according to the stipulations of the "Assets Revaluation Law".

According to this law, revaluation was left to the option of taxpayers, but afterwards, another law for restating depreciable assets was put into force compulsorily in 1953.

The Assets Revaluation Law was put into force as a result of the "Report on Japanese Taxation", made by the Shoup Mission, in 1949, and therefore, importance is rather attached to the problem of taxation, than to the problem on accounting theories.

According to the law, only fixed assets are revalued on a general price index basis.

Buildings, machines, equipments, mining rights, fishing rights, patents rights, goodwills, land, leaseholds, stocks, or other investments, which circulate over a long period, were revalued. (Stocks and other similar investments were revalued only in 1950.)

Table 7 General Wholesale Index and Multiplier

Year	General Wholesale Index	Multiplier
1938	132.7	229
1939	146.6	207
1940	164.1	185
1941	175.8	173
1942	191.2	159
1943	204.6	148
1944	231.9	131
1945 Jan. — Mar.	256.7	107
Apr. — Jun.	315.3	96
Jul. — Sep.	343.3	88
Oct. — Dec.	485.9	62
1946 Jan. — Feb.	830.6	36
Mar.	1,195.1	25
Apr. — Jun.	1,574.2	19
Jul. — Sep.	1,846.1	16
Oct. — Dec.	2,135.9	14
1947 Jan. — Mar.	2,370.1	12
Apr. — Jun.	3,169.1	9.6
Jul. — Sep.	5,806.9	5.2
Oct. — Dec.	7,914.4	3.8
1948 Jan. — Mar.	8,591.2	3.5
Apr. — Jun.	8,962.6	3.3
Jul. — Sep.	15,413.2	1.9
Oct. — Dec.	18,203.2	1.6
1949 Jan. — Mar.	19,436.6	1.5

(continue)

Year	General Wholesale Index	Multiplier
1949 Apr. — Jun.	20,848.7	1.4
Jul. — Sep.	21,319.4	1.4
Oct. — Dec.	21,900.6	1.3
1950 Jan. — Mar.	22,745.5	1.3
Apr. — Jun.	22,907.2	1.3
Jul. — Sep.	25,300.2	1.2
Oct. — Dec.	27,769.9	1.0
1951 Jan. — Mar.	31,733.8	1.0
Apr. — Jun.	34,775.2	1.0
Jul. — Sep.	34,699.6	1.0
Oct. — Dec.	35,802.6	1.0
1952 Jan.	35,751.6	1.0

Note: The general wholesale indices are computed with the 1934—1936 average being 100.

It is certainly reasonable to restate all sorts of assets by using the current unit for measuring purchasing power. In view of the fact that inflation is keenly reflected in fixed assets, however, the restating of only fixed assets might be mentioned as a significant practical alternative for the sake of convenience.

In calculating the multipliers for revaluation, general wholesale indices are used for depreciable assets and consumer's indices used for land, leaseholds, stocks, and other similar investments.

To illustrate the multipliers for restating depreciable assets in 1953, let us compare these multipliers with general wholesale indices published by the Bank of Japan as above (Table 7).

Although the process for computing the multipliers are not published clearly, it can be concluded that the multipliers are computed on the basis of the general wholesale indices, shown above. These multipliers are found out by dividing 30,388 by these indices, except for the period covering January to March in 1945.

According to the stipulations of the law, the new cost is deducted by multiplying the actual cost by the above multiplier. In the case of depreciable assets, the accumulated depreciation charges, computed by the declining-balance method, should be subtracted from the new cost, referred to above, to find out the new book cost. In some special cases for the mining industry, the accumulated depreciation charges are computed by the unit-of-production method.

The Shoup report explains, "it would be preferable on theoretical grounds to use a general index. For, we are not trying to exempt from tax all gains, but only those gains that do not represent a real increase in purchasing power. If the price of a particular type of asset has gone up 200 times while the general price level has gone up only 100 times, the owner of such assets is better off than the owner of assets that have gone up only in proportion to the general increase in prices. He is accordingly well able to bear the additional tax that will be imposed if he is allowed to revalue only to the extent of 100 times. On the other hand the owner of assets that have risen only 50 times in value has suffered a real loss in purchasing power, that is, in the amount of general goods and services that he can buy with what his assets will bring on the market. It is in theory at least quite in order to permit him to revalue up to 100 times, and to eventually have the benefit of deducting this real loss."

As far as importance is attached to the problem of taxation, it is not objectionable to use the general price index in computing the multipliers for revaluation. From the standpoint of taxation, it is desirable to revalue assets on the basis of the current unit for measuring purchasing power. The concept of fair taxation means nothing but to levy fair taxes on purchasing powers of individuals.

According to the Shoup report, the purpose of revaluation is to modify or eliminate, during the inflationary period, income taxation on nominal profits, which results in imposing a drastic capital levy.

The concept of nominal profit means, according to the Shoup report, the difference between actual cost and cost restated in the current monetary unit.

Assuming that cost means the amount of purchasing power committed to a property, nominal profit means the difference resulting from the change in the measuring unit for purchasing power. Meanwhile, the concept of real profit means the increment of purchasing power, on condition that the measuring unit is not changed.

If the concept of purchasing power is defined as the capacity of purchasing "general goods and services," as suggested in the Shoup report, it is thought that the term "goods and services" represent materials for living in an individual consumer and materials for operations in an enterprise.

It should be noted, in this connection, that it is difficult, generally speaking, to generalize materials for operations between different enterprises, although it is possible, to some extent, to generalize materials for living between different individual consumers.

In determining taxable income, importance might be attached to the fact that the net income of an enterprise belongs, in the long run, to individual consumers, who are the owners of an enterprise, and as a natural result, it will be used for materials for living, sooner or later. To levy fair taxes on individual consumers, attention should be directed to this fact. As far as tax accounting is concerned, there is no reason to condemn that general price index is used for restatement. In this case, general price index means, if rigidly defined, general consumers' price index.

However, assuming that an enterprise is an entity which operates continuously, separate from individuals, importance must be attached to the fact that capitals recovered will be again invested in materials for operations. The aim of restatement lies in eliminating the influence of the change in price level on continuous operations. Nominal profit is not always eliminated from income eternally. In case the substitute is not sure to be acquired, or in case an enterprise is dissolved, it is transferred to earnings. If rigidly defined, nominal profit is nothing but profit which is eliminated from income temporarily, for continuous operations.

Granting that materials for operations can be generalized between different enterprises, general wholesale index is applicable to restatement.

In most cases, it is difficult to generalize materials for operations between different enterprises. Therefore, individual price index is more reasonable than general price index.

One of the defects in revaluation in Japan lies in the use of general index for revaluation.

Another defect lies in neglecting the problem of absorbing the deficiency of depreciation, which would have been made if current cost approach had been adopted before revaluation.

For example, let us assume that a plant unit which was accquired in 1943 is restated in 1953. According to the foregoing table of the multipliers, the multiplier for restating the unit is regarded as 148. Assuming that the actual cost, the life and the salvage value of the unit, are regarded as 1,000,000 yen, 30 years,and 10% of the actual cost, respectively, the new cost amounts to 148,000,000 yen (1,000,000 × 148) and as a result, the new book cost from which the depreciation allowance is subtracted, amounts to 69,000,000 yen, as follows;

$$148,000,000 \times (1-0.074)^{10} = 69,000,000$$

$$10-\sqrt[30]{\frac{1}{10}}=0.074$$

Considering that the depreciation allowance, recorded before the time of restatement, amounts to 536,470 yen [1,000,000–1,000,000 × $(1-0.074)^{10}$], the entries for restatement are as follows, according to the stipulation of the law;

Building	69,000,000	Building	1,000,000
Depreciation Allowance	536,470	Appraisal Surplus	68,536,470

To clarify the accounting effect of these entries, it is advisable to divide this transaction for restatement into the following two transactions; one is correcting the plant account and the other is correcting the accumulated depreciation charges.

1. The entry for correcting the plant account

Building	147,000,000	Appraisal Surplus	147,000,000

(As a result of the above entry, the plant account amounts to 148,000, 000 yen, that is, the new cost.)

2. The entry for correcting the accumulated depreciation charges

Appraisal Surplus	78,463,530	Depreciation Allowance	78,463,530

[As a result of the above entry, the depreciation allowance amounts to 79,000,000 yen. The new book cost amounts to 69,000,000 yen (148,000,000 — 79,000,000)]

As clarified above, the new book cost shows the current cost of an existing asset, assuming that the using of the general index for computing the multiplier for restatement, is set aside from the question.

In this case, what would have been incurred if the unit had been acquired on the price level in 1953 is regarded as 148,000,000 yen. This amount of cost should have been entirely absorbed over the period covering the life of the unit. The concept of absorbing means charging cost against revenue.

The depreciation allowance, amounting to 78,463,530 yen in the second entry, means the difference between the current accumulated charges, amounting to 79,000,000 yen, and the original accumulated charges, amounting to 536,470 yen. The difference should be absorbed as extraordinary charge at the time of restatement. (It may be allowed, in practice, to postpone absorbing the extraordinary charge if it is too heavy a burden during the current accounting period.)

Although the extraordinary charge, amounting to 78,463,530 yen, should be charged against revenue, from the standpoint of current cost depreciation, it is, in the case of the second entry, as shown above, charged against the appraisal surplus. It may be properly mentioned that the extraordinary charge is offset by the appraisal surplus.

The above circumstances show that the revaluation in Japan is defective in neglecting the problem of absorbing the past depreciation charges at the current price level.

The example for indicating the same defect concerning the problem of absorbing the past charges on a current cost basis is the case of restating an obsolete asset.

According to the stipulation of the law (Assets Revaluation Law, Article 35, Assets Revaluation Order, Article 6), an obsolete asset should be restated within the limit of the current selling price. This treatment has almost the same nature as that which Prof. Schmalenbach explains in regard to depreciating an obsolete asset under current value depreciation (Zeitwertabschreibung). Certainly, the current value of an obsolete asset is much lower than what would have been incurred if an asset had been acquired at the current price level. The difference between the former and the latter means the extraordinary charge which must be absorbed at the time of restatement.

In Japanese financial circles, importance was attached to the effect of the revaluation on making good the damages or retrogression resulting from the war and modernizing existing plants. From this point of view, the treatment of an obsolete asset was not commendable. The special deprcciation system is significant in that it is a remedy for covering the insufficiency of cost absorption. If an obsolete asset had been reasonably restated, accounting practices would not have been confused so much by such an unreasonable depreciation procedure.

Even if it is assumed that nominal profits mean the difference resulting from the change in the measuring unit, as the Shoup report explains, the treatment of neglecting the absorption of past depreciation charges at the current price level is contradictory to the fundamental concept of restatement. The difference of past depreciation charges between current cost level and original cost level means the difference resulting from the change in the measuring unit, that is, nominal profit. The difference between the current cost of an obsolete asset and its selling price is almost equivalent to the estimated retirement loss which would have been discovered if the section of cost, subject to absorption as a result of obsolescence, had been restated at the current price level.

Such a difference is also the difference resulting from the change in the measuring unit for purchasing power, according to the definition in the Shoup report.

(8) Composite Procedures for Maintenance Costs

There are two classes of expenditures for maintaining a plant; one is that which is incurred almost regularly every year, such as the expenditure for cleaning, adjusting, aligning, or sharpening, and the other is that which is not always incurred regularly every year and usually contains the replacement of a structural element, such as the expenditure for overhauling or other preventive maintenance works.

The former class of cost benefits the period during which it is incurred, and, therefore, current revenue, resulting partly from its benefit, can make easily amends for it. The latter class of cost benefits not only the period which it is incurred, but also the future periods during which a structural element, acquired as a result of maintenance or repair works, is devoting its service to operations. Therefore, there is no reason to assume that it is covered by current revenue produced during the period in which it is incurred.

From the standpoint of absorbing cost reasonably, it is more important to consider how to deal with the latter class of cost, than to consider how to deal with the former class of cost.

Maintenance or repair cost increases, as a rule, not only in proportion to operation, but in proportion to age, and, exceptionally, it occurs, due to extraordinary causes, such as accidents or disasters. In case the latter class of maintenance or repair cost occurs in proportion to operation or age, its cause arises during the past periods over which the structural elements, retired as a result of maintenance or repair works, had been devoting their services to operations; while extraordinary causes, such as accidents or disasters, arise at the same time as their costs are incurred. If a substantial amount of loss is estimated to occur as a result of probable accidents or disasters, it should be remedied by insurance.

Maintenance or repair costs which are incurred ordinarily should not be covered by insurance. If the costs cannot be covered by current revenue produced during the period it is incurred, there is no alternative but to charge them to the plant account or provide for them in the maintenance reserve, so that they may be easily charged against revenue.

The procedure for providing for estimated maintenance or repair costs is usually regarded as a procedure for absorbing the sections of replacement cost which will be incurred in future, and it belongs to replacement accounting approach. The replacement cost means the cost of the substitute which will be acquired for an existing structural element, subject to replacement. The service of the substitute benefits the future period during which it will be devoting its service to operations. Considering that cost should be absorbed during the period over which its effect is produced, as stated in modern accounting, such a procedure is not reasonable.

Assuming that cost is absorbed for determining periodic income, during the period in which its cause arises, such a procedure might be justified, insofar as its assignment is computed only in proportion to operations or age, which are regarded as its cause. In this case, maintenance or repair cost is not prepaid expense but deferred expense.

However, assuming that cost, meaning effort, is matched with revenue, meaning its accomplishment, in modern income accounting, importance is attached rather to the reason for effort. The reason for effort lies in the transfer of goods or services brought forth by expenditures to customers.

Cost is not incurred only because its cause arises. Although its cause lies in damaged properties requiring expenditures, in the case of maintenance or repair, it is not incurred actually until an enterprise makes an effort to produce goods or services by recovering a damaged property. If importance is attached to the reason for effort, cost is absorbed over the period during which it is effective to operations.

From this point of view, maintenance or repair cost, which benefits the future periods, is regarded as prepaid expense.

Under these circumstances, maintenance or repair cost, which benefits the future periods, is charged to the plant account and absorbed by the depreciation procedure.

In this connection, the important question is how to write off additionally the costs of structural elements, subject to replacements for maintenance or repair works. This sort of depreciation procedure has the nature of composite depreciation. Paton's allowance for depreciation and maintenance or Schmalenbach's proposal for charging maintenance or repair costs to the plant account and writing them off by applying a higher rate than normal (although it is defective in regarding them as deferred expenses) belongs to this category of composite depreciation.

To clarify the composite procedure for absorbing maintenance costs in the case of the straight-line method, let us quote a simple example. Assuming that a unit, life and salvage value of which are regarded as 10 years and $1,000, respectively, is purchased at a price of $10,000, and that it includes a structural element, costing $1,200, which is replaced every 3⅓ years, Paton's composite rate is computed as follows;

	Depreciable Cost	Annual Charge
Initial Cost of Unit	$ 10,000	
Estimated Net Salvage	1,000	
Initial Depreciable Cost	9,000	

Portion, Depreciable at 30%	$ 1,200	$ 360
Balance, Depreciable at 10%	7,800	780
	9,000	
Estimated Maintenance Cost	2,400	
Total	$ 11,400	$ 1,140

Rate, Applicable to Depreciable Cost of Unit and Its Maintenance Costs

$ 1,140÷$ 11,400=10%

If, in this case, the rate is applied to the depreciable cost of a unit, excluding the estimated future maintenance costs, it is:

$ 1,140÷$ 9,000=12.6%

If, in this case, the rate is applied to the original cost, excluding the estimated future maintenance costs, it is:

$ 1,140÷$10,000=11.4%

In the above example, the life of the last structural element expires at the same time as the life of a unit expires. Therefore, the costs of the substitutes for the structural element, subject to replacement, which will be acquired in future, are not reflected in an annual charge, amounting to $1,140.

However, the life of the last structural element, subject to replacement, does not always expire at the same time as the life of a unit expires. For instance, let us assume, in the above example, that the structural element, subject to replacement, is replaced every 4 years, instead of 3⅓ years, the other conditions being the same.

In this case, to absorb both the cost of a unit and maintenance costs within the period covering the life of a unit, under the straight-line method, the composite rate may be computed as follows;

	Depreciable Cost	Annual Charge
Initial Cost of Unit	$ 10,000	
Estimated Net Salvage	1,000	
Initial Depreciable Cost	9,000	
Portion, Depreciable at 25%	1,200	$ 300
Balance, Depreciable at 10%	7,800	780
	9,000	
Estimated Maintenance Cost		
Depreciable at 25%	1,200	
Depreciable at 50%	1,200	60 (Additional Charge)
	$ 11,400	$ 1,140

Rate, Applicable to Depreciable Cost of Unit and Its Maintenance Costs

$ 1,140÷$ 11,400=10%

Rate, Applicable to Depreciable Cost of Unit

$ 1,140÷$ 9,000=12.6%

The above composite rate indicates the rate for writing off both the cost of a unit and its maintenance costs within the period covering the life of a unit.

If a unit is conceived in terms of a structural element, subject to replacement, it is not commendable that the estimated cost of an asset, which will be acquired in figure, is absorbed before acquisition; this is a sort of replacement accounting approach.

To be immune from the foregoing defect, the costs of the first and the second structural element, subject to replacement, must be written off over four years and the cost of the last structural element, subject to replacement, be written off over two years.

The composite rate is regarded as 12% for the first eight years and regarded as 15.7% for the residual years.

The composite rate for the first eight years

Element	Depreciable Cost	Life	Annual Rate	Annnal Charge
Structural Element				
Subject to Replacement	$ 1,200	4	25%	$ 300
Balance	7,800	10	10	780
	9,000			1,080

$ 1,080 ÷ $ 9,000 = 12%

The composite rate for the residual years

Element	Depreciable Cost	Life	Annual Rate	Annual Charge
Structural Element				
Subject to Replacement	$ 1,200	2	50%	$ 600
Balance	7,800	10	10	780
	9,000			1,380

$ 1,380 ÷ $ 9,000 = 15.7%

To clarify the composite procedure for absorbing maintenance costs in the case of the declining-balance method, let us assume that a plant unit, costing $6,000,000, has a life of 11 years, its salvage value being 10 percent of the original cost. If maintenance costs for the structural elements, A and B, amounting to $2,700 and $1,800, respectively, are incurred every three and four years, respectively, the composite rate is regarded as 0.598. The reason is as follows;

	Original Cost or Maintenance Costs	Book Cost, at End of Period Covering Life of Unit
Entire Unit	6,000	$6{,}000(1-r)^{11}$
First Maintenance for A	2,700	$2{,}700(1-r)^{11-3}$
Second Maintenance for A	2,700	$2{,}700(1-r)^{11-6}$
Third Maintenance for A	2,700	$2{,}700(1-r)^{11-9}$
First Maintenance for B	1,800	$1{,}800(1-r)^{11-4}$
Second Maintenance for B	1,800	$1{,}800(1-r)^{11-8}$
Total		$6{,}000(1-r)^{11}+2{,}700(1-r)^{8}$ $+1{,}800(1-r)^{7}+2{,}700(1-r)^{5}$ $+1{,}800(1-r)^{3}+2{,}700(1-r)^{2}$

r.........Composite Rate

Total book costs equal the salvage value of a unit, amounting to $600. Then,

$$6{,}000(1-r)^{11}+2{,}700(1-r)^{8}+1{,}800(1-r)^{7}+2{,}700(1-r)^{5}+1{,}800(1-r)^{3}$$
$$+2{,}700(1-r)^{2}=600$$

Solving this equation,

$$1-r=0.406$$
$$r=0.594$$

The generalized equation is;

Assuming that for a unit, the cost, salvage value, and life of a unit are indicated by C, s, and n, respectively, and that maintenance costs containing the replacement costs of structural elements, which are indicated by C_1, C_2, ..., C_N, are incurred at intervals of n_1, n_2,..., n_N, the equation is as follows;

$$C(1-r)^{n}$$
$$+C_1(1-r)^{n-n_1}+C_1(1-r)^{n-2n_1}+C_1(1-r)^{n-3n_1}+\dots\dots\dots$$
$$+C_2(1-r)^{n-n_2}+C_2(1-r)^{n-2n_2}+C_2(1-r)^{n-3n_2}+\dots\dots\dots$$
$$\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots$$
$$+C_N(1-r)^{n-n_N}+C_N(1-r)^{n-2n_N}+C_N(1-r)^{n-3n_2}\ \dots\dots$$
$$=s$$

Under the declining-balance method, an annual charge in the composite procedure is not equivalent to total annual charges computed by the unit procedure, under which each structural element, subject to replacement for maintenance or repair, is also regarded as a unit.

Therefore, there is a good reason, in regard to individual structural elements, to assume that the cost of an asset which will be acquired in future is reflected in an annual charge; this is a sort of replacement accounting approach.

Generally speaking, the composite procedure for absorbing additionally maintenance costs has almost the same appearance as the replacement accounting approach, insofar as each structural element, subject to replacement for maintenance, is regarded as a unit. Even if the straight-line method may be in effect, maintenance costs which will be incurred in future are sometimes reflected in the current depreciation charge. The life of a unit is not always the common multiple of lives of structural elements, subject to retirement for maintenance (in this case the life of a structural element means the period during which each maintenance cost is effective to operations). Especially, maintenance costs, containing the replacement of a structural element, have a remarkable tendency to increase in proportion to age.

There is no alternative but to adopt the pool concept to intermingle the costs of a unit and its structural elements, emphasizing that they are regarded as an integrated group.

(9) Defects in Prevailing Entries for Maintenance Costs

The criterion for discriminating capital expenditure from revenue expenditure is, in practice, obscure. In the present accounting system, capital expenditure means the expenditure which is charged to the plant account and revenue expenditure means the expenditure which is charged to expense. In determining periodic income, capital expenditure is defined as the expenditure which benefits the future periods, while revenue expenditure is defined as the expenditure which benefits the current period.

In accounting for income taxation, in Japan, maintenance or repair costs must be charged to the plant account, insofar as it extends the life or increases the value of a plant unit.

The extension of life has an effect of increasing services produced by a plant unit. The most reasonable solution for it is to correct the depreciation allowance. The procedure of charging maintenance costs, having the effect of extending the life, to the plant account, may be a practical alternative for the sake of convenience.

If the increase in value means to increase the capacity for producing services, or to make services more efficient or more economical than original, it requires an entry for revising the original cost of a plant unit. One solution for it is to charge maintenance costs, having an effect of increasing the value, to the plant account.

One of the defects in the tax treatment is that the danger of conceiving each structural element, subject to replacement, as a unit, is often demonstrated by the tax authorities. Sometimes, maintenance or repair costs are regarded as capital expenditures, only because they have a nature of the replacement of an asset.

Another defect results from the fact that the life of the depreciation procedure is compulsorily provided by the order of the tax authorities, except in special cases.

The estimate of the life of the depreciation procedure is, in principle, made on an ordinary level. If it is compulsorily provided by the tax authorities, it is advisable to publish what kinds of maintenance or repair costs are regarded as ordinary incidental costs in estimating the life for the depreciation procedure. If the publication of such maintenance or repair costs is technically difficult, it is desirable to allow that the estimate of the life is made optionally by each taxpayer on condition that the burden of proof concerning the evidences for the estimate of the life is imposed upon each taxpayer.

Under these circumstances, the confused criterion for discriminating capital expenditure from revenue expenditure is due to the obscure meaning of "ordinary incidental maintenance or repair costs and replacement".

This defect is almost the same as that which is indicated in the tax treatment for maintenance or repair costs in the United States. The reason may be that the treatment for the Federal Income Tax Regulation is keenly reflected in the tax treatment in Japan, as a result of the recommendation of the Shoup mission.

In the treatment for the income taxation in the United States, there are some questions about the meaning of ordinary incidental cost and replacement.

According to the Federal Income Tax Regulation, "the cost of incidental repairs which neither materially add to the value of the property nor appreciably prolong its life, but keep it in an ordinarily efficient operating condition, may be deducted as an expense," and "repairs in the nature of replacements, to the extent that they arrest deterioration and appreciably prolong the life of the property shall either be capitalized and depreciated" or "charged against the depreciation reserve if such an account is kept."

In the above stipulation, importance is attached to the extention of life and the increase in value, in discriminating capital expenditure from revenue expenditure, similar to the treatment in Japan.

Usually the concept of "incidental repairs referred to above, is apt to be connected with the concept of ordinary expense, which is stipulated to be deducted from income according to the Internal Revenue Code. According to the court authorities' opinion, in the case of Welch v. Helvering, the expense is regarded as an ordinary one because payments are the common and accepted means of defense against attack. Ordinary expenses do not mean habitual expenses in the case of each enterprise. They mean common expenses, which are made objective by norms of conduct in the community.

However, the estimate of life should be made, strictly speaking, on condition that maintenance or repair costs will be incurred on a habitual level, rather than on a common level, under individual circumstances of operations. Otherwise, the cost of a unit cannot be absorbed entirely. Granting that the estimate of life is made, in determining taxable income, on condition that maintenance or repair costs will be incurred on a common level, it might be commendable that the concept of incidental repairs, referred to above, should mean common repairs; although such life is not advisable from the standpoint of absorbing costs reasonably.

In this connection, attention should be directed to the fact that any maintenance or repair cost is deducted from income, in the long run, whether it may be charged to the plant account or to expense, or whether it may be regarded as ordinary expense or habitual expense. In defining the term "incidental repairs", the crux does not lie in the problem as to whether they should be allowed as a deduction or not, but in the problem as to when they are allowed as a deduction.

Another question concerns the difficulty of discriminating the concept of incidental repairs from the concept of repairs in the nature of replacements.

Maintenance or repair costs for keeping a plant unit in an ordinarily efficient operating condition contain often the replacement of a structural element, whether it may be common costs or habitual costs. In this case, costs are incidental and at the same time, regarded as repairs in the nature of replacements.

As regards the stipulation for maintenance or repair costs in the Federal Income Tax Regulation, referred to above, the court explains, concerning the case of the Illinois Merchants Trust Co., that the first sentence of the article relates to repairs and the second sentence of the article deals with replacements.

Generally speaking, this definition seems to be unreasonable, assuming that any structural element, subject to replacement, is regarded as a unit, the cost of which is absorbed by the depreciation procedure.

In this connection, it should be noted that "repairs in the nature of replacements" are charged to the plant account, only because they benefit the future period during which they are effective to operations.

An ideal procedure for absorbing their costs is, therefore, the composite procedure.

To apply this procedure reasonably, a composite rate for absorbing maintenance costs additionally must be computed reasonably.

This procedure is devised, assuming that a structural element, subject to replacement, must be conceived as a unit, and that the cost of the structural element must be absorbed during the period over which it is effective to operation. However, the estimated maintenance cost, which will be incurred in future, is sometimes partly reflected in the current charge, in the case of such a composite procedure, as stated in the previous paragraph.

Mr. Irving D. Dawes, vice-president and treasurer, Virginia-Carolina Chemical Corporation, explains that the difficulty of this method is to obtain the approval of the government to a rate sufficiently high to cover all the costs of structural elements, subject to replacement, over the period covering the life of a unit. This explanation clarifies that a reasonable composite life is liable to be neglected in practice.

The trend of maintenance costs in electric power plants in Japan indicates clearly these circumstances.

(10) Statistical Analysis of Maintenance Costs

It is generally understood that maintenance or repair costs increase in proportion not only to operations, but also to age.

This characteristic of maintenance or repair costs is important from the standpoint of absorbing costs reasonably.

In the first place, the relation between maintenance or repair costs and age is closely related to the problem of the estimate of life.

In the second place, it is also related to the problem of how to establish a composite rate.

J. Maurice Clark, author of "Studies in the Economics of Overhead Costs", mentions that there are two kinds of costs; urgent costs and postponable costs. Urgent costs are costs which are incurred before the materials are manufactured into finished products, such as material or labor. Postponable costs are, meanwhile, costs which are incurred when the management pleases; that is, costs which can be postponed after the time of production.

However, strictly speaking, it is not the cost but the making of it good, that is really postponable, as Clark mentions.

In analysing the relation between maintenance costs and age by the statistical method, it is often distorted by the fact that maintenance cost has the nature of postponable cost. Maintenance is made sometimes when the management has enough funds for it or can make amends for its costs, and, in most cases, it is very difficult to eliminate such influences from statistical data.

One of the possible statistical methods is to analyse the correlation between maintenance costs and operation at the same time. If the data is little influenced by the correlation between maintenance costs and age, it is suitable to clarify the relation between maintenance costs and age.

The correlation between maintenance costs and operations indicates, to some extent, the influence of postponed maintenance upon the trend of maintenance costs. If it is considered that current revenue cannot cover maintenance costs, some maintenance may be postponed to the future period during which they will be able to be made good. This indicates that as a result of the postponement of maintenance the correlation between maintenance costs and operations shows a comparatively higher rate.

We would now like to quote an example, in which the correlation between maintenance cost and age is not so distorted by the correlation between maintenance cost and operation.

The data are collected from the reports of the 17 pulverizer-type steam power stations, which pulverize coals for consumption. The reports cover the years from 1951 to 1956.

This type of station is a modern and prevailing station. In this analysis, maintenance costs mean annual costs for maintaining electric and steam generators, per kilo-watt. The operating ratio is computed by using the following formula;

$$\text{Operating Ratio} = \frac{\text{Yearly Production Capacity of Electric Powers}}{\text{Yearly Production of Electric Powers}}$$

Unit: kilo-watt hour

In this example, the correlation coefficient between maintenance cost and operation is only 10.9%, and the correlation coefficient between operating ratio and age is −24.3%.

Under these circumstances, it is clearly shown that maintenance cost is closely correlated with age, with the result that the regression line between maintenance cost and age can be appropriately plotted. The correlation coefficient between maintenance cost and age is 55.0%. Testing the significance of this coefficient by "T test", it is regarded as significant. Moreover, the correlation ratio between maintenance cost and age is 55.1%. Testing the significance of this ratio by "F test", it is also regarded as significant [See Table 8 (a) (b) (c)].

Table 8 Correlation Analysis in Cases of Pulverizer-type Steam Power Stations

(a) Table of Correlation between Maintenance Cost (incl. Preventive Maintenance Cost) and Age

x'	y'	−1	0	1	f_y	$\Sigma f_{xy}x'$	$y'\Sigma f_{xy}x'$	$f_y y'$	$f_y(y')^2$
	y \ x	0—9	10—19	20—29					
−2	yen 0 — yen 449	17			17	−17	34	−34	68
−1	500—999	7	7	2	16	−5	5	−16	16
0	1,000—1,499	6	10	5	21	−1	0	0	0
1	1,500—1,999	6	3	3	12	−3	−3	12	12
2	2,000—2,499			5	5	5	10	10	20
	f_x	36	20	15	71	−21	46	−28	116
	$\Sigma f_{xy}y'$	−35	−4	11	−28				
	$x'\Sigma f_{xy}y'$	35	0	11	46				
	$f_x x'$	−36	0	15	−21				
	$f_x(x')^2$	36	0	15	51				

x............Age
y............Maintenance Cost per kilo-watt

1) Correlation Coefficient $r=0.550$
Significance Test $t=5.504>t_{60}(0.001)=3.46$
Confidence Interval
(at 5 percent level) $0.363\leqq\rho\leqq0.696$
ρ............True Value of r

2) Correlation Ratio $\eta_{yx}=0.551$
Significance Test $F=14.824>F^{2}_{65}(0.01)=4.95$

(b) Table of Correlation between Maintenance Cost (incl. Preventive Maintenance Cost) and Operating Ratio

y'	x'	−4	−3	−2	−1	0	1	2	3	f_y	$\Sigma f_{xy}x'$	$y'\Sigma f_{xy}x'$	$f_y y'$	$f_y(y')^2$
	y \ x	% 0—9	% 10—19	% 20—29	% 30—39	% 40—49	% 50—59	% 60—69	% 70—79					
−2	yen 0 — yen 499	1	3	4	3	4	1	1		17	−21	42	−34	68
−1	500—999		1	3	3	5	3	1		16	− 7	7	−16	16
0	1,000—1,499			6	4	7	3	1		21	−11	0	0	0
1	1,500—1,999			2	2	7			1	12	− 3	− 3	12	12
2	2,000—2,499			2	3					5	− 7	−14	10	20
	f_x	1	4	17	15	23	7	3	1	71	−49	32	−28	116
	$\Sigma f_{xy}y'$	−2	− 7	− 5	− 1	−6	−5	−3	1	−28				
	$x'\Sigma f_{xy}y'$	8	21	10	1	0	−5	−6	3	32				
	$f_x x'$	−4	−12	−34	−15	0	7	6	3	−49				
	$f_x(x')^2$	16	36	68	15	0	7	12	9	163				

x.........Operating Ratio
y.........Maintenance Cost per kilo-watt

1) Correlation Coefficient $r=0.109$
Significance Test $t==0.911$
$t_{60}(0.50)=0.679<t<t_{60}(0.25)=1.16$

(c) Table of Correlation between Operating Ratio and Age

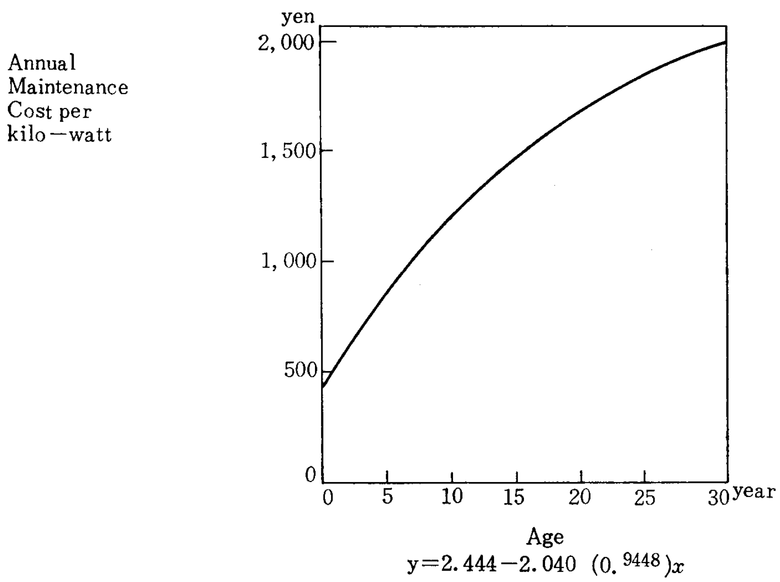
y'	x' / y \ x	−1 (0—9)	0 (10—19)	1 (20—29)	f_y	$\Sigma f_{xy}x'$	$y'\Sigma f_{xy}x'$	$f_y y'$	$f_y(y')^2$
−4	% 0—19	1			1	− 1	4	− 4	16
−3	10—19	4			4	− 4	12	−12	86
−2	20—29	4	6	7	17	3	−6	−34	68
−1	30—39	5	5	5	15	0	0	−15	15
0	40—49	13	7	3	23	−10	0	0	0
1	50—59	5	2		7	− 5	−5	7	7
2	60—69	3			3	− 3	−6	6	12
3	70—79	1			1	− 1	−3	8	9
	f_x	36	20	15	71	−21	−4	−49	163
	$\Sigma f_{xy}y'$	−15	−15	−19	−49				
	$y'\Sigma f_{xy}y'$	15	0	−19	− 4	x............Age			
	$f_x x'$	−86	0	15	−21	y............Operating Ratio			
	$f_x(x')^2$	86	0	15	51				

1) Correlation Coefficient $r=-0.243$
   Significance Test $t=-2.347$ $|t|>t_{60}(0.025)=2.30$
   Confidence Interval $-0.454\leqq\rho\leqq-0.01$
   (at 5 percent level)
   ρ............True Value of r

2) Partial Correlation Coefficient between Maintenance Cost and Age
   $r=0.598$
   Significance Test $t=6.156>t_{60}(0.001)=3.46$

In this example, the regression curve is shown by Chart 4.

Chart 4 Regression Curve of Pulverizer-type Steam Power Stations between Maintenance Cost and Age ... in case overhauling and prevention against accidents or the decrease of efficiency are included.



$y=2.444-2.040\ (0.9448)^x$

Chart 5 Regression Curve of Pulverizer-type Steam Power Station between Maintenance Cost and Age ... in case overhauling and prevention against accidents or the decrease of efficiency are excluded.

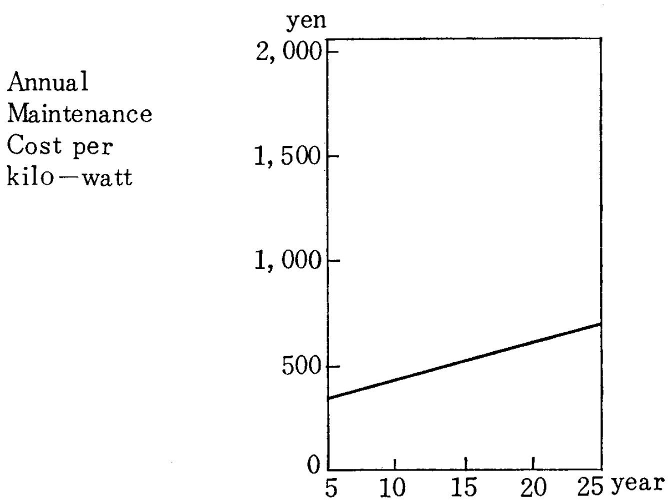


Table 8 (continue)

(d) Table of Correlation between Maintenance Cost and Age ... in case overhauling and prevention against accidents or the decrease of efficiency are excluded.

y'	x' / x \ y	−1 0—9	0 10—19	1 20—29	f_y	$\Sigma f_{xy}x'$	$y'\Sigma f_{xy}x'$	$f_y y$	$f_y(y')^2$
−1	yen yen 0 —199	14	1		15	−14	14	−15	15
0	200—399	8	13	5	26	− 3	0	0	0
1	400—599	7	5	4	16	− 3	−3	16	16
2	600—799	5	1	3	9	− 2	−4	18	36
8	800—999	1		2	3	1	3	9	27
4	1,000—1,999	1		1	2	0	0	8	32
	f_x	36	20	15	71	−21	10	36	126
	$\Sigma f_{xy}y'$	10	6	20	36				
	$x'\Sigma f_{xy}y'$	−10	0	20	10				
	$f_x x'$	−36	0	15	−21				
	$f_x(x')^2$	36	0	15	51				

x.........Age
y............Maintenance Cost per kilo-watt

1) Correlation Coefficient $r=0.297$
Significance Test $t=2.586>t_{60}(0.025)=2.30$

2) Correlation Ratio $\eta_{yx}=0.348$
Significance Test $F=4.684>F^{2}_{65}(0.05)=3.14$

As regards the regression curve, it should be noted that the angle or the inflexion of the curve, is closely related to the problem whether costs for renewals are included in maintenance costs or not. The foregoing analysis

Chart 6 Regression Curves of Pulverizer-type Steam Power Stations between Maintenance Cost and Age... in the case of preventive maintenance cost

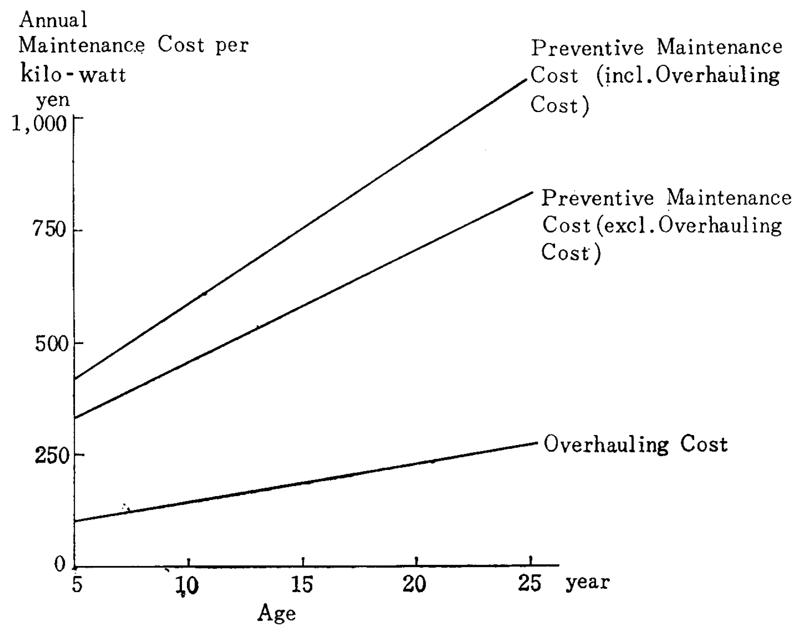


Table 8 continue)

(e) Table of Correlation between Preventive Maintenance Cost (incl. Overhauling Cost) and Age

y'	x' / y \ x	−1 (0—9)	0 (10—19)	1 (20—29)	f_y	$\Sigma f_{xy}x'$	$y'\Sigma f_{xy}x'$	$f_y y'$	$f_y(y')^2$
−1	yen 0 — yen 499	22	3	3	38	−19	19	−28	28
0	500—999	12	13	4	29	− 8	0	0	0
1	1,000—1,499	2	4	5	11	3	3	11	11
2	1,500—1,999			2	2	2	4	4	8
3	2,000—2,499			1	1	1	3	3	9
	f_x	36	20	15	71	−21	29	−10	56
	$\Sigma f_{xy}y'$	−20	1	9	−10				
	$x'\Sigma f_{xy}y'$	20	0	9	29				
	$f_x x'$	−36	0	15	−21				
	$f_x(x')^2$	26	0	15	51				

x............Age
y............Maintenance Cost per kilo-watt

1) Correlation Coefficient $r=0.527$
Significance Test $t=5.156>t_{60}(0.001)=3.46$

2) Correlation Ratio $\eta_{yx}=0.528$
Significance Test $F=13.143>F^{1}_{65}(0.01)=4.95$

(f) Table of Correlation between Preventive Maintenance Cost (excl. Overhauling Cost) and Age

y'	x'	-1	0	1	f_y	$\Sigma f_{xy}x'$	$y'\Sigma f_{xy}x'$	$f_y y'$	$f_y(y')^2$
	y \ x	0—9	10—19	20—29					
−1	yen 0 — yen 499	26	6	5	37	−21	21	−37	37
0	500—999	9	11	6	26	− 3	0	0	0
1	1,000—1,499	1	3	2	6	1	1	6	6
2	1,500—1,999			2	2	2	4	4	8
	f_x	36	20	15	71	−21	26	−27	51
	$\Sigma f_{xy}y'$	−25	−3	1	−27				
	$x'\Sigma f_{xy}y'$	25	0	1	26				
	$f_x x'$	−36	0	15	−21				
	$f_x(x')^2$	36	0	15	51				

x............Age
y............Maintenance Cost per kilo-watt

1) Correlation Coefficient $r=0.442$
   Significance Test $t=3.869>t_{60}(0.001)=3.46$
2) Correlation Ratio $\eta_{xy}=0.432$
   Significance Test $F=7.801<F^{2}_{65}(0.01)=4.95$

(g) Table of Correlation between Overhauling Cost and Age

y'	x'	-1	0	1	f_y	$\Sigma f_y x'$	$y'\Sigma f_{xy}x'$	$f_y y'$	$f_y(y')^2$
	y \ x	0—9	10—19	20—29					
−1	yen 0 — yen 99	20	9	2	31	−18	18	−31	31
0	100—199	11	11	6	28	− 5	0	0	0
1	200—299	3		1	4	− 2	−2	4	4
2	300—399	2		1	3	− 1	−2	6	12
3	400—499			2	2	2	6	6	18
4	500—599			2	2	2	8	8	32
5	600—699			1	1	1	5	5	25
	f_x	36	20	15	71	−21	33	−2	122
	$\Sigma f_{xy}y'$	−13	−9	20	− 2				
	$x'\Sigma f_{xy}y'$	13	0	20	33				
	$f_x x'$	−36	0	15	−21				
	$fx(x')^2$	36	0	15	51				

x............Age
y............Maintenance Cost per kilo-watt

1) Correlation Coefficient $r=0.438$
   Significance Test $t=4.051>t_{60}(0.001)=3.46$
2) Correlation Ratio $\eta_{yx}=0.542$
   Significance Test $F=14.143>F^{2}_{65}(0.01)=4.95$

shows the trend of maintenance costs in which costs for renewals are included.

If costs for overhauling and prevention against accident or the decrease of efficiency are disregarded in the foregoing analysis, the regression curve between maintenance cost and age is shown by Chart 5 [See Table 8(d)].

If costs for overhauling and prevention against accident or the decrease of efficiency are spotted respectively, the regression curves between maintenance cost and age are shown by Chart 6 [See Table 8 (e) (f) (g)].

The upward tendency of maintenance costs, resulting from the lapse of time, is mainly due to the costs of replacing structural elements for arresting decreasing efficiency or accidents. According to the correlation between maintenance costs and age, computed from the data of 155 hydraulic stations covering the years from 1951 to 1955, the above circumstances are clarified by Table 9.

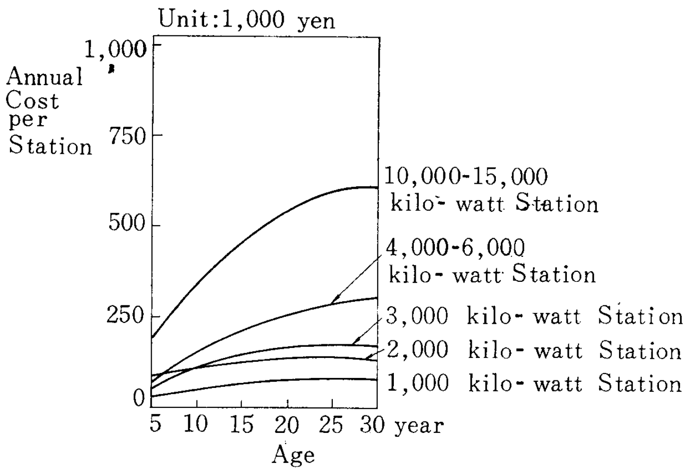
Table 9 Correlation between Maintenance Cost and Age
... in the case of hydraulic stations

Cause	Less than 5 (years)	5—19 (years)	20—29 (years)	30—39 (years)	More than 40 (years)
Overhauling	100	195	246	249	196
Prevention against Accidents	100	163	257	340	297
Prevention against Decrease of Efficiency	100	497	999	598	900
Others	100	234	323	338	188

The maintenance cost means annual average cost per station.

The costs of replacing structural elements for arresting decreasing ef-

Chart 7 Correlation Curve Between Maintenance Cost and Age
... in the case of buildings in hydraulic stations



ficiency or accidents, and the costs for overhauling, are incurred mainly for machines and structures (excluding buildings). These circumstances are shown in their correlation curves (See Chart 7–9).

Chart 8 Correlation Curve Between Maintenance Cost and Age
... in the case of machines in hydraulic stations

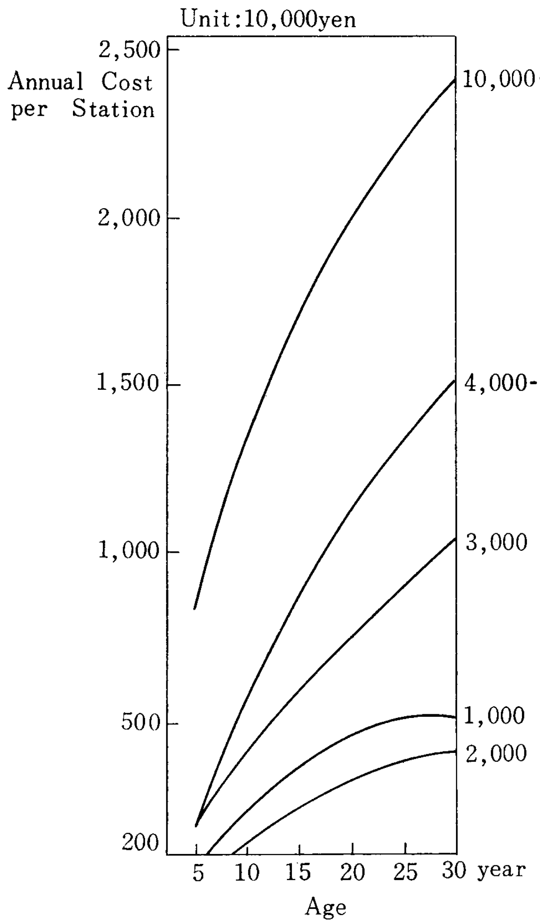


Chart 9 Correlation Curve Between Maintenance Cost and Age ... in the case of structures (excluding buildings) in hydraulic stations

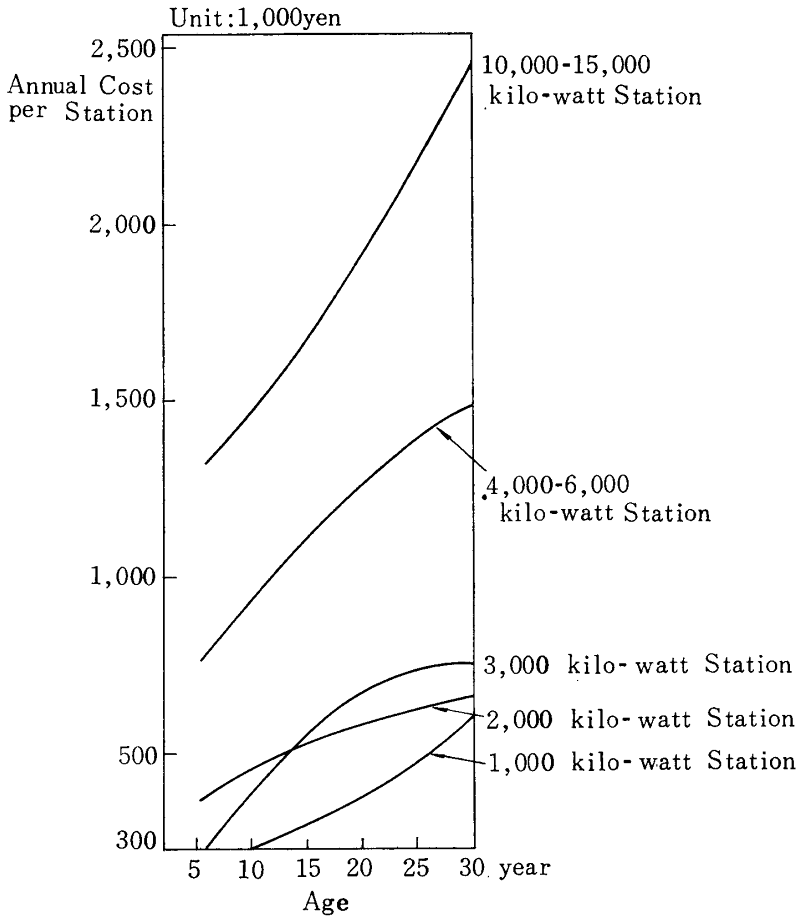


Table 10 Correlation Ratios for Curves in Charts 7-9

Capacity	Machine	Structure (excl. buildings)	Building
1,000 kilo-watt	97.2%	82.2%	96.4%
2,000 kilo-watt	97.5	61.1	89.4
3,000 kilo-watt	44.7	79.5	94.6
4,000—6,000 kilo-watt	97.7	51.2	94.7
10,000—15,000 kilo-watt	99.1	82.2	95.1

(11) Problem Points in Group or Composite Depreciation

If we intend to absorb the cost of a group reasonably, attention should be directed to what life (or depreciation rate) is most suitable for absorbing entirely the cost of a group under a given depreciation method.

In case a group does not contain substitutes for existing structural elements, the cost of a group must have been already written off entirely before a structural element having the longest life among these elements is retired.

In case a group includes substitutes for existing structural elements, its cost must have been entirely written off during the period covering the least common multiple of lives of existing structural elements, assuming that any element is always replaced by its substitute equivalent in cost and life.

From this standpoint, the weighted arithmetical mean is suitable for the life of a group excluding substitutes for existing structural elements, while the weighted harmonical mean is suitable for the life of a group including substitutes for existing structural elements, assuming that the straight-line method is in effect.

In case a group consists of dissimilar assets having different lives from each other, there is no alternative but to include the substitutes for existing structural elements in a group, because, if the substitutes for existing structural elements are excluded from a group, the group or composite procedure will be changed, in the long run, into the unit procedure, as a natural result of the fact that the costs of substitutes, which are acquired one after another, are respectively written off by the unit procedure.

Therefore, the composite life for a group consisting of dissimilar assets should be the weighted harmonical mean of lives of existing structural elements, assuming that the straight-line method is in effect.

As regards the composite life for a group consisting of dissimilar assets, Mr. Grant and Mr. Norton quote the following example;

Class of Assets	Investment (1)	Estimated Life (in years) (2)	Investment × Life (in dollar years) (3)
Addressing machine	$ 300	15	$ 4,500
Bookcases	400	20	8,000
Calculating machines	1,100	10	11,000
Chairs	250	16	4,000
Clock	50	20	1,000
Desks	400	20	8,000
Dictation machine	600	6	3,600
Duplicating machine	250	10	2,500
Lamps	150	10	1,500
Tables	300	15	4,500
Typewriters	450	5	2,250
Wardrobes	50	20	1,000
Total	$ 4,300		$ 51,850

Composite Average Service Life

$$=\frac{\$\,51{,}850}{\$\,4{,}300}=12.06 \text{ (years)}$$

(Eugene L. Grant & Paul T. Norton, jr., Depreciation, p. 145)

The above example seems to be liable to cause misleading notions about the method for computing a composite life for a group of dissimilar assets.

The above composite life, amounting to 12.06 years, appears to have been deducted by computing the weighted arithmetical mean of lives of existing assets. Assuming, in the above computation, that the investments do not include substitutes for existing assets, the composite life, referred to above, means the weighted arithmetical mean of lives of existing assets. Considering that we cannot but treat this group as an open group, such a composite life is not a reasonable life.

To regard this composite life as the life for an open group, it is necessary to assume that the substitutes for existing assets are contained in the investments in Column 1 of the foregoing example.

For instance, the following computations must be made to find out a composite life amounting to 12.06 years;

Class of Assets	Investments during 240 Years (1)	Number of Renewal Times during 240 Years (2)	Existing Assets (1) ÷ (2) (3)	Life (4)	Annual Charge (5)
Addressing machine	$ 300	16	$ 18.75	15	1.25
Bookcases	400	12	33.33	20	1.66
Calculating machine	1,100	24	45.83	10	4.58
Chairs	250	15	16.67	16	1.04
Clock	50	12	4.16	20	0.21
Desk	400	12	33.33	20	1.67
Dictation machine	600	40	15.00	6	2.50
Duplicating machine	250	24	10.42	10	1.04
Lamps	150	24	6.25	10	0.63
Tables	300	16	18.75	15	1.25
Typewriters	450	48	9.38	5	1.88
Wardrobes	50	12	4.16	20	0.21
Total			216.03		17.92

Weighted Harmonical Mean $\frac{216.03}{17.92}=12.03$

Such a weighted harmonical mean should be used as a composite life to write off the cost of an open group under the straight-line method.

However, it should be noted that if such a life is applied under the declining-balance method, the cost of a group has not been entirely absorbed during the period covering the least common multiple of lives of existing assets, even though it may be assumed that any asset may be always replaced by its substitute equivalent in cost and life.

Prof. Paton shows that a composite rate is computed as follows;

Unit	Depreciation Base (1)	Annual Rate (2)	Annual Charge (3)	Service Life (4) *
1	$ 10,000	20%	$ 2,000	5 years
2	5,000	50	2,500	2
3	20,000	25	5,000	4
4	15,000	$3\frac{1}{3}$	500	30
Total	$ 50,000		$ 10,000	

*Column 3 is supplemented for reference.

$$\text{Composite Rate} = \frac{10,000}{50,000} = 20\%$$

$$\text{Composite Life} = \frac{50,000}{10,000} = 5 \text{ years}$$

$$= \frac{1}{\frac{1}{50,000}\left(\frac{10,000}{5} + \frac{5,000}{2} + \frac{20,000}{4} + \frac{15,000}{30}\right)}$$

The above composite life means clearly the weighted harmonical mean of lives of structural elements.

According to the stipulation of the Federal Income Tax Regulation, the composite rate is also computed as follows;

	Costs or Other Basis	Estimated Useful Life	Annual Depreciation Charge
	$ 10,000	5	$ 2,000
	10,000	15	667
Total	20,000		2,667

Average Rate $ 2,667 ÷ $ 20,000 = 13.33%

Assuming that estimated salvage value is 10 percent of original cost, the rate adjusted for salvage is as follows;

Adjusted Average Rate $13.33\% - 13.33 \times 10\% = 12\%$

The above average rate applicable to the depreciable cost is also computed as follows;

Cost or Other Basis	Estimated Salvage Value	Depreciable Cost	Estimated Useful Life	Annual Depreciation Charge
$ 10,000	$ 1,000	$ 9,000	5	$ 1,800
10,000	1,000	9,000	15	600
Total		18,000		2,400

$$\text{Average Rate} \quad \frac{\$\,2,400}{\$\,18,000} = 13.33\%$$

Average Life $\frac{\$18{,}000}{\$2{,}400}=7.5$ (years)

〔1.167 (b) −1, Example (2,T.D., 6182)〕

The foregoing composite life is also the weighted harmonical mean of lives of structural elements of a group.

Also in income taxation in Japan, the composite life, as a rule, is computed in the same way as above, and therefore, it means the weighted harmonical mean of lives of structural elements of a group. For instance, the composite rate for a certain airplane is computed as follows;

Unit	Cost	Life	Annual Depreciation Charge
Body	$ 993,600	10	$ 99,360
Motors	304,000	6	50,667
Propellers	72,800	3.3	22,061
Total	$ 1,370,400		$ 172,088

Composite Life $\frac{\$1{,}370{,}400}{\$172{,}088}=7.9$ (years)

As stated above, the prevailing method for computing a composite life is to find it out by dividing total annual charges, which are computed under the unit procedure, by total depreciable costs. Most accountants are apt to think that it is always applicable, no matter whether it may be used under the straight-line method or used under the declining-balance method. However, the weighted harmonical mean can be used only to write off the cost of an open group under the straight-line method.

Another question concerning the prevailing method for computing a composite life is to neglect that an entire group, regarded as an integrated group, is sometimes retired, as a result of obsolescence, although no structural element had been damaged. As far as physical life is concerned, the life of a group might be regarded as an eternal one, now that its damaged structural elements are always replaced by their substitutes. But its service is not eternally effective to operations from an economical viewpoint.

If a group is retired as a result of obsolescence, the costs of structural elements and their substitutes, acquired before its retirement date, must have been absorbed entirely over the period ending at that date; instead of the period covering the least common multiple of lives of structural elements.

For instance, an airplane is sometimes retired, due to functional causes. Even if any damaged element, such as a motor, a propeller, or a body, may be replaced by a new one, the plane is not eternally serviceable. In such a case, an airplane cannot be regarded as an eternally existing unit, if rigidly defined. It is not advisable to assume that the costs of structural elements

Note: In this study, an open group means a group in which the substitutes for existing structural elements are included, while a closed group means a group from which they are excluded.

and their substitutes should be entirely absorbed over the period covering the least common multiple for lives of existing structural elements. In this case, the composite procedure for maintenance, referred to in Paragraph 8, serves as a good guide.

In prevailing accounting practice, accountants are liable to ignore what group or composite rate is suitable in the case of the declining-balance method.

Also in Japan, the life for the declining-balance method is not discriminated from the life for the straight-line method. Either in the case of the unit procedure or in the case of the group or composite procedure, the depreciation rate for the straight-line method is the reciprocal of the life and the depreciation rate for the declining-balance method is computed as follows;

$$1-\sqrt[n]{\frac{\text{Salvage Value}}{\text{Original Cost}}}$$

n..............Life

According to the stipulation in the Federal Income Taxation system, the composite rate for the declining-balance method is limited to twice the composite rate for the straight-line method. [Internal Revenue Code, S E C 167 (b)(2)]

This treatment seems to be clearly related to the fact that the rate for the declining-balance method under the unit procedure, is limited in the same way as above. Such a treatment for a composite rate concerning the declining-balance method is reflected in the theoretical analysis for the composite rate, made by Mr. Grant and Mr. Norton, in the "Depreciation", pp. 410–415; in which the composite rate is assumed to be two and a half times as much as the straight-line rate.

However, the concept of the composite life must be discriminated from the concept of the life for the unit procedure.

The composite life means the artificial life for writing off the cost of a group entirely during a given period, rather than the most probable actual life for its structural elements. Only in the case of a group, consisting of homogeneous assets, it equals the most probable actual life for its structural elements, assuming that the straight-line method is in effect, and that a group consists of a number of assets. The weighted-by-quantities arithmetical mean of lives of structural elements is regarded as the reasonable life for such a group. In this case, the weighted arithmetical mean is nothing but the mathematical expectation for estimated actual lives of its structural elements. However, even in the case of a group consisting of homogeneous assets, the most reasonable life for the declining-balance method is not such a weighted arithmetical mean of estimated actual lives of its structural elements. The most reasonable life for the declining-balance method must be the reciprocal of the rate which is found out by applying experimental lives, obtained by observations, to the formula for computing the composite life, assuming that any structural elements are uniformly priced per unit.

If a group consists of dissimilar assets, the composite life is the reciprocal of the rate which is found out by applying the estimated lives of components to the same formula as above, assuming that all the costs of components containing their substitutes have been entirely absorbed during the period covering the least common multiple of lives of existing components of a group; it is not the weighted harmonical mean of lives of existing components.

The rate for writing off the cost of a group consisting of homogeneous asset is deducted by using the same formula as the rate for writing off the cost of a group consisting of dissimilar assets, on condition that any component is uniformly priced per unit.

To find out the formula for computing the declining-balance composite rate, it is advisable to pay attention to the formula for computing the rate for unit depreciation under the declining-balance method.

This formula is based upon the fact that the salvage value of an asset is equivalent to its book cost (which is found out by subtracting accumulated depreciation charges from original cost) at the end of the period covering its life. The book cost is represented by $V(1-r)^n$, assuming that original cost, salvage value, life, and rate, are indicated by V, s, n, and r, respectively.

The above book cost being equivalent to the salvage value s,

$$V(1-r)^n=s$$

$$1-r=\sqrt[n]{\frac{s}{V}}$$

$$r=1-\sqrt[n]{\frac{s}{V}}$$

Also, in case the composite procedure is applied, attention is paid to the fact that book cost, represented by using original cost V, life n, and, rate r, equals salvage value s.

In case a group is substituted for an individual asset in the above equation, the salvage value s, means the salvage value of the structural element having the longest life among the structural elements of a group, assuming that the substitutes of existing elements are not included in a group. To find out the book cost at the date of retirement of a structural element having the longest life, the book costs of salvages of other structural elements, which have been retired before that date, must be subtracted from the book cost of a group shown if other structural elements had not been retired before that date.

Assuming that the lives and salvages of structural elements, which are acquired simultaneously, are indicated by $n_1, n_2, \ldots\ldots, n_N$ $(n_1<n_2<\ldots\ldots, <n_N)$, and $s_1, s_2, \ldots\ldots, s_N$, respectively, the book cost of a salvage of a structural element, having the life of n_1 and the salvage value of s_1, is represented by $s_1(1-r)^{n_N-n_1}$, and, then $V(1-r)^n$ in the foregoing equation is changed into the following items;

	Book Cost, at Date of Retirement of Component Having Longest Life
Total Original Costs of Structural Elements	$V(1-r)^{n_N}$
Salvage Value of Component, Having Life of n_1 Years	$-s_1(1-r)^{n_N-n_1}$
Salvage Value of Component, Having Life of n_2 Years	$-s_2(1-r)^{n_N-n_2}$
Salvage Value of Component, Having Life of n_3 Years	$-s_3(1-r)^{n_N-n_3}$
....	....

Total above items are equivalent to the salvage of a component having the longest life amounting to s_N, and the equation is shown as follows;

$$V(1-r)^{n_N}-s_1(1-r)^{n_N-n_1}-s_2(1-r)^{n_N-n_2}-s_3(1-r)^{n_N-n_3} \\ \cdots\cdots=s_N$$

In the case of an open group, there is no alternative but to write off the costs of structural elements, including their substitutes, entirely over the period covering the least common multiple of lives of existing structural elements.

In this case, therefore, the salvage at the end of the period, amounting to s, on the right side in the foregoing equation, consists of the salvages of structural elements which are actually retired at the end of the period.

The least common multiple of lives of structural elements is substituted for the longest life n_N in the above equation. Salvage value s, on the right side in the foregoing equation, is changed into the series of $s_1, s_2, \ldots\ldots, s_N$.

Assuming that the costs, lives, and salvages of existing structural elements, which are acquired simultaneously, are indicated by $C_1, C_2, \ldots\ldots, C_N$, and, $n_1, n_2, \ldots\ldots, n_N$, and, moreover, $s_1, s_2, \ldots\ldots, s_N$, respectively, the equation for computing a composite life, referred to above, is changed into the following equation, if the period covering the least common multiple of their lives, $n_1, n_2, \ldots\ldots, n_N$, is indicated by m;

$$\{C_1(1-r)^m+C_1(1-r)^{m-n_1}+C_1(1-r)^{m-2n_1}+\cdots\cdots+C_1(1-r)^{n_1}\}$$
$$+\{C_2(1-r)^m+C_2(1-r)^{m-n_2}+C_2(1-r)^{m-2n_2}+\cdots\cdots+C_2(1-r)^{n_2}\}$$
$$+\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots$$
$$+\{C_N(1-r)^m+C_N(1-r)^{m-n_N}+C_N(1-r)^{m-2n_N}+\cdots\cdots+C_N(1-r)^{n_N}\}$$

(Depreciated Original Cost, at m th Year-end)

$$-\{s_1(1-r)^{m-n_1}+s_1(1-r)^{m-2n_1}+\cdots\cdots+s_1(1-r)^{n_1}\}$$
$$-\{s_2(1-r)^{m-n_2}+s_2(1-r)^{m-2n_2}+\cdots\cdots+s_2(1-r)^{n_2}\}$$
$$-\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots$$
$$-\{s_N(1-r)^{m-n_N}+s_N(1-r)^{m-2n_N}+\cdots\cdots+s_N(1-r)^{n_N}\}$$

(Depreciated Salvage Value, at m th Year-end)

$$=s_1+s_2+\cdots\cdots+s_N$$

(Salvage Value of Components, Actually Retired at m th Year-end)

Then,

$$\frac{C_1(1-r)^{n_1}-s_1}{1-(1-r)^{n_1}}+\frac{C_2(1-r)^{n_2}-s_2}{1-(1-r)^{n_2}}$$

$$+\dots\dots\dots+\frac{C_N(1-r)^{n_N}-s_N}{1-(1-r)^{n_N}}=0$$

$$\sum_{j=1}^{N}\frac{C_j(1-r)^{n_j}-s_j}{1-(1-r)^{n_j}}=0 \; *$$

In this formula, it is not necessary, in computing a composite life, to find out the least common multiple for lives of components. It is quite convenient in practice. However, attention should be directed to the fact that there is a fundamental idea behind this computation that the costs of structural elements containing their substitutes must be entirely written off during the period covering the least common multiple of lives of components.

In this respect, this formula has the common character with that which is given for computing the weighted harmonical mean under the straight-line method. The weighted harmonical mean can be also found out without regard to the period covering the least common multiple of lives of structural elements, although the aim of its adoption is to write off the entire costs of structural elements and their substitutes over this period.

(12) Defects in Prevailing Retirement Adjustments

There is a divergence in views on whether insufficient depreciation should be absorbed as loss or not under the group or composite procedure. Moreover, granting that insufficient depreciation is absorbed as loss, opinion is divided on the problem whether it should be conceived in terms of individual structural elements or in terms of an entire group.

Such a divergence in views is mainly due to the fact that the concept of the group or composite procedure is not uniformly defined.

According to some opinion, the weighted arithmetical mean of lives of existing structural elements is used as a composite life. In this case, the group or composite depreciation procedure is to write off the cost of a closed group under the straight-line method. Otherwise, the costs of structural elements are not absorbed reasonably. One of the dangers is that the principle for writing off the cost of a group which consists of a number of homogeneous assets is liable to be misapplied to a group of dissimilar assets or to an open group of similar or dissimilar assets. If a group consists of a number of homogeneous assets, "mathematical expectation", which means the weighted arithmetical mean of empirical lives, is used for an average life.

Empirical lives include not only normal lives, but also abnormal lives in which contingent accidents or obsolescence is reflected. Therefore, insufficiency of depreciation is not produced by abnormal retirement, and as a

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* This is the same equation as the one deducted by Prof. S. Sato, Yokohama University.

result, it is not necessary to measure insufficiency of depreciation even if a structural element may be abnormally retired, assuming that a group has "a normal frequency distribution."

Grant and Norton's opinion on the group or composite depreciation procedure belongs to this category.

According to Grant and Norton, the entry for retirement is as follows, assuming that assets costing $5,000 are retired with a net cash salvage of $300;

Depreciation Allowance	$ 4,700	Asset Account	$ 5,000
Cash (or equivalent)	300		

(Besides the above entry, an annual depreciation charge is recorded.)

(Grant and Norton, Depreciation, p. 120)

The above entry is usually made, independent of the age of an asset retired.

Such a treatment is reasonable only on condition that insufficient depreciation of assets having longer lives is offset by excessive depreciation of assets having shorter lives. This condition is satisfied only in case the correct arithmetical mean of lives of structural elements is used as the composite life.

As regards the above entry for retirement, there are two exceptional cases. One is the transfer from one group to another group and the other is the disposal of a structural element at a price substantially higher than that anticipated in establishing a composite rate.

Assuming that a machine, cost and salvage of which are regarded as $10,000 and $400, respectively, is transferred from one group A to another group B, at the end of the 20th year, the entry for retirement is as follows, on condition that its probable life is regarded as 32 years;

Section of Depreciation Allowance, Applicable to Asset Retired............ $\frac{20}{32}$($ 10,000 − $ 400) = $ 6,000

Asset Account—Plant B	$ 10,000	Asset Account—Plant A	$ 10,000
Depreciation Allowance—Plant A..........................	$ 6,000	Depreciation Allowance—Plant B	$ 6,000

If the above element is sold at a price of $13,000, the entry for retirement is as follows;

Cash (or equivalent)	$ 13,000	Asset Account—Plant A	$ 10,000
Depreciation Allowance —Plant A	6,000	Gain on Disposal	9,000

The first exceptional case, concerning the transfer of a structural element from one group to another group, seems to be due to the fact that a group does not always consist of a number of homogeneous elements enough to regard the weighted arithmetical mean of lives as its "mathematical expectation", or otherwise, to the fact that the principle for writing off the cost of a homogeneous group is misapplied to a group of dissimilar elements.

The second exceptional case, concerning the disposal of a structural element at a price substantially higher than that anticipated in establishing a composite rate, is due to the fact that net cash salvage is excluded from cost chargeable to the depreciation allowance, in the fundamental entry for retirement.

Assuming that a group consists of dissimilar assets, there are some questions about the entry for adjustment.

In Grant and Norton's theory, the rate is revised whenever there is good evidence that estimated average lives or salvage values are incorrect. (Eugene L. Grant & Paul T. Norton, jr., Depreciation, p. 122)

Also in such a case, the entry for adjustment must be made on condition that the depreciation allowance is conceived in terms of an entire group.

To clarify these circumstances, let us quote the simple example, in which the structural elements, A, B and C, costing \$1,000, \$3,000, and \$2,000, respectively, are estimated to have the lives of 2 years, 3 years, and 4 years, respectively, salvage value being 10% of original cost.

In this case, the weighted arithmetical mean of lives of structural elements is 3.16 years, and as a result the composite rate is 0.31579.

If, in the above example, the structural element C, life of which is regarded as 4 years, is actually retired at the end of the second year, insufficiency of depreciation, amounting to \$1,137 is shown at the end of the third year, assuming that the original composite rate of 0.31579 is applied continuously;

Year	Original Cost	Annual Charge	Depreciation Allowance	Cost of Retired Unit	Cost Charged against Depreciation Allowance	Depreciation Allowance after Retirement
1	6,000	1,705	1,705	—	—	1,705
2	6,000	1,705	3,410	3,000 AC	2,700	710
3	3,000	853	1,563	3,000 B	2,700	−1,137

Unit: \$

The above insufficiency of depreciation amounting to \$1,137, means total annual charges, computed if the structural element C had been retired, as estimated originally at the end of the fourth year.

Depreciation Charge in Third Year $(2{,}000-200)\times 0.31579=568.42$

Depreciation Charge in Fourth Year $(2{,}000-200)\times 0.31579=568.42$

Total 1,137
(counted as one fractions more than 0.5)

If the structural element C is retired normally at the end of the second period, the original composite rate must be revised at the end of the second year. Since the end of the second year, only the structural element B exists, and the correct composite life equals the life of C (that is, 3 years); the composite rate is regarded as 0.3.

As a result of the retirements of A and C, the original cost of a group amounts to \$3,000 at the end of the second year. Subtracting the salvage value from this, the depreciable cost of a group amounts to $2,700. The annual charge in the third year amounts to $900 ($2,700 × 0.3). Subtracting the annual charge in the third year amounting to $900 from the depreciable cost amounting to $2,700, the correct depreciation allowance to be recorded at the end of the second year is regarded as $1,800.

In the above table, the depreciation allowance is recorded as $710 at the end of the second year, and therefore insufficient depreciation is regarded as $1,090 as follows;

Correct Depreciation Allowance .... $ 1,800
Recorded Depreciation Allowance .... $ 710
Insufficient Depreciation .... $ 1,090

If the structural element C is retired abnormally at the end of the second year, the original rate need not be corrected. The annual charge of the third year is then regarded as $853 (2,700 × 0.31579). Subtracting this from the depreciable cost of a group, amounting to $2,700, referred to above, the correct depreciation allowance is regarded as $1,847.

Then, insufficient depreciation is,

Correct Depreciation Allowance .... $ 1,847
Recorded Depreciation Allowance .... $ 710
Insufficient Depreciation .... $ 1,137

In both cases, referred to above, insufficient depreciation should be absorbed as retirement loss.

Meanwhile, according to Grant and Norton, the entry for correcting the depreciation allowance is not, as a rule, made under the group or composite procedure, except in special cases. Granting that the entry for correcting the depreciation allowance may be made, it is not satisfactory, insofar as insufficient depreciation is computed according to the illustration of Grant and Norton, as follows;

Section of Depreciation Allowance, Applicable to Structural Element, C, at End of Second Year

$$\frac{2}{4}\times(2{,}000-200)=900$$

Probable Life of C .... 4 years
Years Elapsed before Retirement of C .... 2 years
Original Cost of C .... $ 2,000
Salvage Value of C .... $ 200

Year	Original Cost	Annual Cost	Deprecia-tion Allowance	Cost of Retired Unit	Cost Charged against Depreciation Allowance	Depreciation Allowance before Retirement
1	6,000	1,705	1,705	—	—	1,705
2	6,000	1,705	3,410	3,000 (A 1,000) (C 2,000)	1,800 (A 900) (C 900)	1,610
3	3,000	853	2,465	3,000 B	2,700 B	−237

In this case, insufficiency of depreciation amounting to $237 is carried forward to the end of the third year. The reason is that the section of cost of C, amounting to $900, is thought to have already been written off at the end of the second year and as a result, insufficient depreciation is regarded as $900 (1,800 — 900).

Depreciable Cost of C — Accumulated Depreciation Charges

However, now that correct insufficient depreciation at the second year-end amounts to $1,137, if the retirement of C is due to an abnormal cause as stated above, insufficiency of depreciation amounting to $237 ($1,137--900) is carried forward to the end of the third year in this entry.

According to another opinion, the weighted harmonical mean of lives of structural elements is used as a composite life, under the composite depreciation procedure. In this case, composite depreciation is to write off the cost of an open group under the straight-line procedure. In writing off the cost of an open group, it cannot but be assumed that the costs of structural elements containing their substitutes should be entirely written off during the period covering the least common multiple of lives of existing elements, on condition that any element will be replaced by its substitute equivalent in life and cost.

Usually, the weighted harmonical mean is used as a composite life of a group consisting of dissimilar assets. It is computed by using the individual lives of dissimilar elements which are estimated on a normal level. Contingent accident or obsolescence is neglected in the estimates of individual lives of dissimilar elements.

Such being the case, if a structural element is abnormally retired insufficient depreciation should be absorbed as loss, in addition to annual ordinary charges.

Besides, now that the weighted harmonical mean is justified on condition that any structural element is always replaced by its substitute equivalent in cost and life, it is necessary to revise the composite life or the depreciation allowance in accordance with the changes in costs or lives of structural elements; which may be, in practice, neglected if the changes are trifling.

One of the dangers is that the principle for writing off the cost of a group under the straight-line method is liable to be misapplied to a group for which the declining-balance method is used.

If the weighted harmonical mean of lives of structural elements is used as a composite life under the declining-balance method, the costs of structural elements cannot be absorbed reasonably. Especially, in view of the fact that the problem of writing off the cost of an asset reasonably is apt to be neglected in the case of the declining-balance method in the practical field, attention should be directed to this danger.

The prevailing practice for retirement, which is enforced by the stipulation of the income taxation system in the United States or in Japan, belongs to the second category.

The third opinion concerns the retirement entry for the declining-balance method. Under the declining-balance method, insufficient or excessive depreciation, if any, is corrected in the long run. Let us assume that insufficiency of depreciation amounting to E, which is now included in the plant account, the composite rate being indicated by r. If n years have elapsed, the accumulated annual charges for E, which are added to annual ordinary charges, amount to $E-E\ (1-r)^n$, as follows;

Year	Annual Charge of Insufficiency	Residual Insufficiency (after Depreciation)
1	Er	$E(1-r)$
2	$E(1-r)r$	$E(1-r)^2$
3	$E(1-r)^2r$	$E(1-r)^3$
⋮		
n	$E(1-r)^{n-1}r$	$E(1-r)^n$
Total	$E-E(1-r)^n$	

As r indicates the depreciation rate, it is a positive quantity less than 1.

In this case, $1>(1-r)>0$

$$(1-r)>(1-r)^2>(1-r)^3>\ldots\ldots>(1-r)^n$$

Then, the accumulated annual charges for insufficient or excessive depreciation come near E, with the lapse of time.

The above consideration indicates that the insufficiency of depreciation will be absorbed in the long run under the declining-balance method.

Assuming that the book cost is multiplied by the composite rate, even if it may be a negative quantity, excess of depreciation will be also corrected in the same way as above.

According to this opinion, the entry for correcting insufficiency or excess of depreciation is not needed, whether a structural element may be retired normally or abnormally.

One of the defects is that, if insufficient depreciation amounts to a considerably large quantity as a result of abnormal retirements, a comparatively long period must elapse until it comes to a negligible quantity.

Another defect is that the unfavourable influence of the erroneous rates upon the recovery of capital is apt to be neglected.

Certainly, insufficient or excessive depreciation resulting from the application of an erroneous rate will be corrected in the long run. But assuming that an erroneous rate will be applied continuously in future, the effect of correcting the old insufficiency or excess of depreciation is offset by the occurrence of the new insufficiency or excess of depreciation.

Let us assume that an open group consists of the structural elements, A and B, lives of which are estimated to be 6 years and 3 years, respectively.

In this case, the correct rate must be computed so that the costs of A and B, containing their substitutes, may be written off during six years.

Under the declining-balance method, the error, contained in an annual charge, decreases gradually. The errors in each six years are as follows, assuming that the error in the first six years is indicated by E.

$$E>E(1-e)^6>E(1-e)^{12}>E(1-e)^{18}>\dots\dots>E(1-e)^{6(n-1)}$$

First six years	Second six years	Third six years	Fourth six years		n th six years

e.................... Erroneous Composite Rate

These circumstances are shown by the following illustration.

If the erroneous composite rate is indicated by e, and insufficiency of depreciation, amounting to E, is accumulated newly during each six years, net insufficiency of depreciation is deducted by subtracting additional charge for correcting old insufficiency of depreciation from the new insufficiency of depreciation, as follows;

New Insufficiency	Additional Charge for Correcting Old Insufficiency	Net Insufficiency
First six years E		E
Second six years E	$E-E(1-e)^6$	$E(1-e)^6$
Third six years E	$E-E(1-e)^{12}$	$E(1-e)^{12}$
....	....	....
....	....	....
n th six years E	$E-E(1-e)^{6(n-1)}$	$E(1-e)^{6(n-1)}$

As a result of the accumulation of net insufficiency of depreciation, insufficiency of depreciation included in the book cost, increases and reaches the following quantity, at the end of the nth six years; although net insufficiency of depreciation included in an annual charge may decrease.

$$E+E(1-e)^6+E(1-e)^{12}+\dots\dots+E(1-e)^{6(n-1)}$$

As clarified above, insufficiency of depreciation is gradually accumulated in the book cost with the lapse of time if the erroneous rate is used continuously in case the declining-balance method is applied to an open group.

Certainly, even if a composite rate may not be reasonable, an annual charge comes near correct annual charge with the lapse of time. As far as periodic income measurement is concerned, the declining-balance method eliminates the unfavourable influence of an erroneous rate upon income determination.

Schmalenbach's concept of automatic adjustment ("Automatischer Ausgleichung") means the foregoing effect of the declining-balance method. This adjustment is emphasised to eliminate the undesirable influence of an unreasonable composite rate, which is used for the procedure of charging maintenance or repair costs to the plant account. (Eugen Schmalenbach, Dynamische Bilanz, 12 Auflage, S. 118.) In this case, the accumulated insufficiency or excess of depreciation, included in the plant account, is absorbed when a plant unit is entirely retired. In this respect, there is a complementary entry for correcting unreasonable cost absorption, although the cost of a plant or its part may be unreasonably absorbed before a plant unit is entirely retired.

In case the composite depreciation is applied to an open group, there is no remedy for correcting unreasonable cost absorption, now that the least common multiple of lives of structural elements is nothing but a hypothesis for computing a composite rate.

There is no reason to assume that the entry for correcting insufficient or excessive depreciation is not needed in the case of the declining-balance method.

(13) Reasonable Retirement Entries in Group or Composite Depreciation

Attention should be directed to the fact that insufficient or excessive depreciation is caused more frequently under the group or composite procedure than under the unit procedure.

Under the unit procedure, insufficiency or excess of depreciation is due to error in estimate of life or the occurrence of abnormal phenomenon, such as accident or contingent obsolescenec, assuming that the problem of estimate of salvage value is put aside.

Under the group or composite procedure, insufficiency or excess of depreciation is due beyond these causes to the change in the weights which are used to find out the weighted arithmetical or harmonical mean of lives of structural elements of a group.

Certainly, abnormal phenomenon is contained in the frequency distribution of experimental lives used to find out the mathematical expectation. Therefore, if a group consists of a number of homogeneous assets, to which the mathematical expectation can be applied, abnormal phenomenon is not regarded as the cause for insufficient depreciation. However, in other cases, which are rather prevalent in practice, the occurrence of abnormal phenomenon results inevitably in insufficient depreciation.

Generally speaking, the causes of insufficient or excessive depreciation, in the case of the group or composite procedure are classified into two causes; the changes in the composite life for a group, including the changes in the weights (for example, the costs or the quantities of structural elements), and the occurrence of abnormal retirement.

If insufficient or excessive depreciation is due to the former cause, it is necessary to revise a depreciation rate for future income determination. If insufficient depreciation is due to the latter cause, it is not necessary to revise a depreciation rate for future income determination.

It should be noted that in either of these cases, insufficiency or excess of depreciation resulting from the change in the structural elements of a group (including the change in the weights) should be corrected.

As regards the problem of correcting insufficient or excessive depreciation, there are some practical difficulties in judging what time it should be recognized as loss or gain, or in measuring what amount should be recognized as insufficiency or excess of depreciation.

Although it is clear that insufficiency or excess of depreciation, resulting from the changes in the composite life of a group (including the changes in the weights) or the occurrence of abnormal phenomenon, should be, as a rule, adjusted, in practice there is no alternative but to neglect a slight change in the composite life or a trifling abnormal phenomenon.

One of the important questions concerning the prevailing group or composite procedures lies in what amount should be regarded as insufficient or excessive depreciation. In practice, the danger of looking to individual structural elements of a group in measuring insufficiency or excess of depreciation is often seen.

Such a tendency is not condemnable if the weighted harmonical mean is used as a composite life under the composite procedure. For, if the weighted harmonical mean is used, the annual charge in the composite procedure is always equivalent to total annual charges computed if the unit procedure is, looking to individual structural elements, applied.

In the foregoing example, in which the costs and lives of the structural elements, are $1,000, $3,000, $2,000, and 2 years, 3 years, 4 years, respectively, salvage value being 10 percent of original cost, the annual charge amounts to $1,800. Meanwhile, the individual annual charges of the structural elements, A, B, and C, in the unit procedure, amount to $450, $900, and $450, respectively; which total $1,800.

In case the weighted harmonical mean is adopted under the straight-line method, the composite procedure yields results that are essentially the same as those yielded by the unit procedure under which the cost of an individual structural element is separately written off.

However, in case the weighted arithmetical mean is applied to a group, from which the substitutes for existing structural elements are excluded under the straight-line method, or in case the declining-balance method is applied, the annual charge for group or composite depreciation deviates before the expiration of a given period, such as the period covering the longest life among lives of structural elements (in the case of a closed group) or the least common multiple of their lives (in the case of an open group), from total annual charges of structural elements, computed if unit depreciation is made, looking to individual assets, subject to replacement.

To illustrate how to measure insufficient or excessive depreciation, let us assume, in the foregoing example that a structural element C, having the life of 4 years is actually retired at the end of the third year, the other conditions being the same.

If the weighted harmonical mean is used as a composite life under the straight-line method, insufficiency of depreciation is regarded as $450 as follows;

$$(\$2{,}000-\$200)\times\frac{1}{3}\times3-(\$2{,}000-\$200)\times\frac{1}{4}\times3$$

Current Depreciation Allowance   Actual Depreciation Allowance

$=\$1{,}800-\$1{,}350$

$=\$450$............Retirement Loss

Whether retirement may be due to the error in estimate of life or to the occurrence of an abnormal cause, retirement loss is regarded as $450, in this case.

However, in case retirement is due to the error in estimate of life, the rate must be revised as follows, while it need not be revised if retirement is due to the occurrence of an abnormal cause.

Correct Composite Rate ... in case the retirement is due to error in estimate of life

	A	B	C	Total
Original Cost	1,000	3,000	2,000	6,000
Salvage Value	100	300	200	600
Depreciable Cost	900	2,700	1,800	5,400
Life (in years)	2	3	3	
Annual Charge	450	900	600	1,950

$$\text{Composite Rate}=\frac{1{,}950}{5{,}400}=0.36112$$

If insufficiency of depreciation is due to the error in estimate of life under the declining-balance method, it is necessary to find out the correct depreciation allowance or the correct book cost, which would have been accumulated if the correct rate had been used at the date of retirement of a structural element. In the foregoing example, the reasonable allowance is shown at the date of retirement of C as follows;

$$\frac{1{,}000(1-r)^2-100}{1-(1-r)^2}+\frac{3{,}000(1-r)^3-300}{1-(1-r)^3}+\frac{2{,}000(1-r)^3-200}{1-(1-r)^3}=0$$

r ....Revised Rate

Solving this equation,

$1-r=0.432$ $\qquad$ $r=0.568$

Then, the book cost amounts to $5,373, at the end of the third year, as follows;

$$\{1{,}000(1-0.568)^3+1{,}000(1-0.568)^{3-2}\}+\{3{,}000(1-0.568)^3+3{,}000(1-0.568)^{3-3}\}$$
$$+\{2{,}000(1-0.568)^3+2{,}000(1-0.568)^{3-3}\}-1{,}000(1-0.568)^{3-2}-300(1-0.568)^{3-3}$$
$$-200(1-0.568)^{3-3}=5{,}373$$

Meanwhile, the recorded book cost amounts to $ 5,479 as follows;

$$\{1{,}000(1-0.544)^3+1{,}000(1-0.544)^{3-2}\}+\{3{,}000(1-0.544)^3+3{,}000(1-0.544)^{3-3}\}$$
$$+\{2{,}000(1-0.544)^3+2{,}000(1-0.544)^{3-3}\}-100(1-0.544)^{3-2}-300(1-0.544)^{3-3}$$
$$-200(1-0.544)^{3-3}=5{,}479$$

Insufficiency of depreciation is found out by subtracting the correct book cost, amounting to $5,373, from the recorded book cost, amounting to $5,479. Therefore,

Recorded Book Cost	$ 5,479
Correct Book Cost	5,373
Insufficient Depreciation	106

As shown above, insufficiency of depreciation to be absorbed as retirement loss, amounts to \$106.

Note: The formula for computing the book cost at the end of the pth year, is shown as follows; assuming that the costs, the salvages, and the lives of structural elements, are indicated by C_1, $C_2,\ldots$, s_1, $s_2,\ldots$, and n_1, $n_2,\ldots$, respectively.

$$
\begin{aligned}
&\{C_1(1-r)^p+C_1(1-r)^{p-n_1}+C_1(1-r)^{p-2n_1}+\ldots\ldots\}\\
&+\{C_2(1-r)^p+C_2(1-r)^{p-n_2}+C_2(1-r)^{p-2n_2}+\ldots\ldots\}\\
&\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\\
&-\{s_1(1-r)^{p-n_1}+s_1(1-r)^{p-2n_1}+\ \ldots\ldots\ldots\ldots\}\\
&-\{s_2(1-r)^{p-n_2}+s_2(1-r)^{p-2n_2}+\ \ldots\ldots\ldots\ldots\}
\end{aligned}
$$

If the retirement of C is due to an abnormal cause, it is assumed that its substitutes will have a life of 4 years although the initial component had a life of only 3 years.

Considering that C is retired one year earlier than estimated, however, the original rate must be revised so that it may be applicable to the case in which C is acquired one year earlier than other structural elements. The rate is computed, as follows;

$$
\begin{aligned}
&\{1{,}000(1-r)^{12}+1{,}000(1-r)^{10}+1{,}000(1-r)^{8}+1{,}000(1-r)^{6}+1{,}000(1-r)^{4}\\
&+1{,}000(1-r)^{2}-100(1-r)^{10}-100(1-r)^{8}-100(1-r)^{6}-100(1-r)^{4}-100(1-r)^{2}\}\\
&+\{3{,}000(1-r)^{12}+3{,}000(1-r)^{9}+3{,}000(1-r)^{6}+3{,}000(1-r)^{3}-300(1-r)^{9}\\
&-300(1-r)^{6}-300(1-r)^{3}\}+\{2{,}000(1-r)^{13}+2{,}000(1-r)^{9}+2{,}000(1-r)^{5}\\
&-200(1-r)^{9}-200(1-r)^{5}\}=100+300+200(1-r)
\end{aligned}
$$

r............Revised Rate

Solving this equation,

$1-r=0.437 \qquad r=0.563$

Note: The formula for computing the composite rate in case the cost, the salvage value, and the life of a structural element, which is acquired g years earlier than other elements, are indicated by C_p, s_p, n_p, respectively, is shown as follows;

Cost	C_1, C_2, C_3, ..., C_N
Salvage Value	s_1, s_2, s_3, ..., s_N
Life	n_1, n_2, n_3, ..., n_N
m	Period Covering Least Common Multiple of Lives of Components

$$
\begin{aligned}
&\{C_1(1-r)^m+C_1(1-r)^{m-n_1}+C_1(1-r)^{m-2n_1}+\ \ldots\ldots\ldots\}\\
&+\{C_2(1-r)^m+C_2(1-r)^{m-n_2}+C_2(1-r)^{m-2n_2}+\ \ldots\ldots\ldots\}\\
&\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\\
&+\{C_p(1-r)^m+C_p(1-r)^{m-n_p}+C_p(1-r)^{m-2n_p}+\ \ldots\ldots\ldots\}\times(1-r)^g\\
&+\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\\
&+\{C_N(1-r)^m+C_N(1-r)^{m-n_N}+C_N(1-r)^{m-2n_N}+\ \ldots\ldots\}\\
&-\{s_1(1-r)^{m-n_1}+s_1(1-r)^{m-2n_1}+\ \ldots\ldots\ldots\ldots\}\\
&-\{s_2(1-r)^{m-n_2}+s_2(1-r)^{m-2n_2}+\ \ldots\ldots\ldots\ldots\}\\
&-\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\\
&-\{s_p(1-r)^{m-n_p}+s_p(1-r)^{m-2n_p}+\ \ldots\ldots\ldots\ldots\}\times(1-r)^g\\
&-\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\\
&-\{s_N(1-r)^{m-n_N}+s_N(1-r)^{m-2n_N}+\ \ldots\ldots\ldots\ldots\}\\
&=s_1+s_2+\ldots\ldots\ldots+s_p\times(1-r)^g
\end{aligned}
$$

or

$$\frac{C_1(1-r)^{n_1}-s_1}{1-(1-r)^{n_1}}+\frac{C_2(1-r)^{n_2}-s_2}{1-(1-r)^{n_2}}+\ldots+\frac{C_p(1-r)^{n_p}-s_p}{1-(1-r)^{n_p}}\times(1-r)^g+$$
$$\ldots\ldots+\frac{C_N(1-r)^{n_N}-s_N}{1-(1-r)^{n_N}}=0$$

The correct book cost at the date of retirement of C, is computed by using the above composite rate (that is, 0.563) as follows;

$$\{1{,}000(1-0.563)^3+1{,}000(1-0.563)^{3-2}\}+\{3{,}000(1-0.563)^3+3{,}000(1-0.563)^{3-3}\}$$
$$+\{2{,}000(1-0.563)^4+2{,}000(1-0.563)^{4-4}\}-1{,}000(1-0.563)^{3-2}-300(1-0.563)^{3-3}$$
$$-200(1-0.563)^{4-4}=5{,}299$$

Note; The formula for computing the book cost at the end of the tth year, is as follows, assuming that the cost, the salvage value, and the life of a structural element, which is acquired g years earlier than other elements, are indicated by C_p, s_p, and n_p, respectively.

Cost	$C_1,\ C_2,\ C_3,\ \ldots\ldots\ldots\ldots,\ C_N$
Salvage value	$s_1,\ s_2,\ s_3,\ \ldots\ldots\ldots\ldots,\ s_N$
Life	$n_1,\ n_2,\ n_3,\ \ldots\ldots\ldots\ldots,\ n_N$

$$\{C_1(1-r)^t+C_1(1-r)^{t-n_1}+C_1(1-r)^{t-2n_1}+\ \ldots\ldots\ldots\ldots\}$$
$$+\{C_2(1-r)^t+C_2(1-r)^{t-n_2}+C_2(1-r)^{t-2n_2}+\ \ldots\ldots\ldots\ldots\}$$
$$+\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots$$
$$+C_p(1-r)^t+C_p(1-r)^{t-n_p}+C_p(1-r)^{t-2n_p}+\ \ldots\ldots\ldots\ldots\}\times(1-r)^g$$
$$+\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots$$
$$+\{C_N(1-r)^t+C_N(1-r)^{t-n_N}+C_N(1-r)^{t-2n_N}+\ \ldots\ldots\}$$
$$-\{s_1(1-r)^{t-n_1}+s_1(1-r)^{t-2n_1}+\ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\}$$
$$-\{s_2(1-r)^{t-2n_2}+s_2(1-r)^{t-n_2}+\ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\}$$
$$-\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots$$
$$-\{s_p(1-r)^{t-n_p}+s_p(1-r)^{t-2n_p}+\ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\}\times(1-r)^g$$
$$-\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots$$
$$\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots$$
$$-\{s_N(1-r)^{t-n_N}+s_N(1-r)^{t-2n_N}+\ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\}$$

The book cost which is recorded at the date of retirement of C amounts to $5,479, as stated above, and therefore, insufficient depreciation is regarded as $180 as follows;

Recorded Book Cost	$ 5,479
Correct Book Cost	5,299
Insufficient Depreciation	180

In this case, insufficient depreciation, amounting to $180, is absorbed as extraordinary loss. While insufficient depreciation caused by the error in estimate of life, amounting to $106, is regarded as additional past expense, insufficient depreciation resulting from abnormal causes, referred to above, is regarded as contingent current loss.

Besides the foregoing example, there are various cases in which the rate, the book cost or the depreciation allowance should be corrected.

For instance, a structural element is not always replaced by its substitute equivalent in cost or life. If the cost or life of the substitute is different from the cost or life of the retired, the composite rate should be revised and the difference between the recorded book cost (or the depreciation allowance) and the correct book cost (or the correct depreciation allowance), if any, should be charged to loss or gain.

Under the group or composite procedure, it is advisable to correct the rate, the book cost, or the depreciation allowance, if the change in cost or life of a structural element is keenly reflected in either of them.

(14) Conclusion

It must be mentioned that capital recovery means, from an economical point of view, that capitals invested in goods or services revert to capitals in the form of cash or claims to cash.

In accounting, it is common to think that, when the sales of goods or services cause an inflow of cash or claims to cash, gross revenue has been realized. When gross revenue has been realized, the costs of goods or services, related to it, are charged against it, as current expense, in oder to determine net income.

Usually the realization of gross revenue means that capitals, invested in goods or services, revert again to cash or claims to cash. Costs of goods or services mean capitals invested in goods or services.

The accounting practice for capital recovery is to absorb the entire costs of goods or services which are beneficial to an inflow of gross revenue.

It indicates that the amount of capitals invested in goods or services is subtracted from the amount of capitals which revert again to cash or claims to cash.

If attention is directed to capital recovery, the common conception is that net income means the excess of the amount of capitals recovered over the amount of capitals invested in goods or services.

According to the principle of matching, revenue, meaning accomplishment, is matched with expense, meaning effort. The investment of capitals indicates effort, while the recovery of capitals indicates accomplishment.

In absorbing costs of goods or services, it is necessary to consider what sections of capitals, invested in goods or services, have been recovered.

One of the important problems is that the sections of capitals recovered should be measured within the limit of an accounting period. In the case of plants or equipments, capitals invested in them are recovered over the period containing more than one accounting period; during which time they are devoting their services to operations. Insofar as the sections of capitals recovered are measured within the limit of an accounting period, it is necessary to measure what sections of capitals invested in them, based on some objective criteria, such as mathematical law. The typical example for this measurement is the depreciation procedure in plant accounting.

Sometimes, the pool concept is adopted in absorbing the costs of properties. The application of the weighted-average method for inventory assets or the retail inventory method is a typical case. If defined strictly, the lifo or fifo method can also be included in this category, since the assumption that "last-in first-out" or "first-in first-out" is nothing but a hypothesis. In plant accounting, group or composite depreciation belongs to this category.

Under these circumstances, the central theme of modern accounting is how to cut through a continuing stream of costs and correctly assign portions to the present and to the future.

In this connection, importance is attached to the fact that the foregoing assignments should be made so that all the costs of plants or equipments, or all the costs of assets intermingled into a pool, may be absorbed, in the long run, when capitals, invested in these properties, have been entirely recovered.

Another problem is raised, in connection with the application of the current cost or replacement cost approach.

Generally speaking, there are two different aspects in plant accounting; replacement accounting and retirement accounting. In replacement accounting, the cost of a plant is absorbed on a replacement cost basis, while in retirement accounting the cost of a plant is absorbed on an original cost basis.

The procedure for plant accounting, in the double account system in England, is included in the former category while modern accounting should be classified in the latter category.

Therefore, if it is desirable to measure the operating result at the current price level, the amount of capitals invested in goods or services should be restated on a current cost basis. Or if a specific section of capitals, committed to an enterprise, must be invested in a certain constant quantity of goods or services continuously, such capitals should be restated on a replacement cost basis.

If the current cost approach or the replacement cost approach is applied in modern accounting, the balance resulting from the discrepancy between original cost and current cost or replacement cost is credited or debited to the adjustment account; which means the account for neutralizing profits or losses resulting from the changes in price level.

This adjustment account is sometimes offset by the plant account or the inventory account. In this case, attention should be directed to the problem of how to deal with the adjustment account.

Current cost depreciation, replacement cost depreciation, or reinvestment depreciation in plant accounting are included in this category.

According to prevailing opinion, modern accounting means income accounting which is a method to find out net income by comparing the outflow of services and the inflow of services.

However, attention should be directed to the fact that enterprise activity is nothing but the activity of circulating capitals committed to an enterprise.

The central theme of accounting is to absorb the costs of goods or services reasonably, in accordance with the process of capital recovery, and then, to determine net income suitably for measuring the periodic effect of operations.

In this study, we deal mainly with the problem of what cost of a property is absorbed and when it has been entirely absorbed, what connection it has with prevailing accounting practices and theories.

Generally speaking, the terms "original cost approach", "current cost approach", or "current value approach" seem to be used as a standard for evaluation of goods on hand in the financial statement. Under the current value approach, accountants are liable to think that the restatement of costs of assets are necessarily accompanied by reflecting the difference between actual cost and current cost in periodic income.

One example for this definition is seen in the theory of Prof. Schmalenbach. Current cost approach is, in his theory, expressed by the term "current value principle" (Zeitwertprinzip). Its aim is to reflect the extraneous profits or losses (Aussengewinn oder Aussenverlust) in periodic income. For this reason, this principle is opposite to the realization principle (Realisationsprinzip), on which the extraneous profits or losses of goods on hand at the year-end are carried forward to the period during which these goods are sold. (E. Schmalenbach, Dynamische Bilanz, 7 Auflage, S. 173)

Insofar as Prof. Schmalenbach's current value approach is applied, it is not consistent with the scheme of determining income in accordance with the process of capital recovery, referred to above.

One of the defects in his theory is that the adjustment account for equilibrium, inevitably accompanied by restating the costs of assets on the basis of other than original cost, is treated inconsistently.

In case goods on hand, in actual existence, are revalued on a current value basis, their adjustment accounts are directly treated as current profits or losses, as stated above. Meanwhile, goods already sold or used for production, are revalued on a current value basis, their adjustment accounts are eliminated by understating the asset account, if the accounts mean extraneous profits, and eliminated by overstating the asset account, if the accounts mean extraneous losses. As a result of such a treatment of the adjustment account, the asset account is shown on the credit side if the adjustment account exceeds the asset account. To illustrate the nature of the asset account on the credit side, he defines it as the adjustment account for current value depreciation (Ausgleichskonto für Zeitwertabschreibungen), in plant accounting, or as an allowance for stock maintenance (Rückstellung für Lagererhaltung), in inventory accounting. (E. Schmalenbach, ibid. 7 Auflage, S. 186, 207). In his illustration, the nature of these accounts is quite obscure. He does not clarify why it is necessary to record such special accounts, instead of asset accounts, only in case the accounts are shown on the credit side.

Whether in the case of goods on hand or of goods already sold or used for production, the adjustment accounts, meaning extraneous profits or losses, are accompanied by restating costs on a current value basis. Insofar as the adjustments accounts mean extraneous profits or losses, their treatments should be consistent.

The foregoing confusion of treatments is due to the fact that the term "current value approach" is used as a standard for evaluation of goods on hand in the financial statement, according to the prevailing custom. If it is used as a standard of measurement of cost to be absorbed in the profit and loss statement, this confusion may be eliminated. The question as to how to deal with the adjustment account is another problem.

Insofar as attention is directed to the process of capital recovery, the prevailing terminology of cost approaches, referred to above, should be scrutinized.

Insofar as income is determined in accordance with the process of capital recovery, even extraneous profits or losses should be treated in the same way as operating profits or losses. The extraneous profits or losses in goods on hand at the year-end should be carried forward to the period during which these goods or their parts will be disposed, so that their profits or losses may be reflected in periodic income when capitals invested in these goods or their parts revert to cash or claims to cash.

However, if attention is directed to the continuity of an enterprise, it might be necessary to deal with extraneous profits or losses, exceptionally, in a different way from operating profits or losses. To maintain operations continuously, the extraneous profits of goods are sometimes eliminated from income despite the fact that capitals invested in them have already been recovered, as shown by current cost depreciation.

If neutralization is defined as treating neutral, items which are not related to income determination, whether eternally or temporarily, the aim of neutralization lies in maintaining continuous operations.

The central theme of neutralization in the current cost approach lies in problems concerning what extraneous profits should be neutralized and how to deal with these profits subsequently, from this point of view.