

**Equitable payment and performance related payment in  
engineering and construction<sup>1</sup>**

**A. General**

This paper aims at giving an updating about the performance related payment, as engineering and construction companies apply it.

In theory, the basic criteria that can be used to pay subordinate people can be classified with regards to the method that is used to define the amount to be given as well as with regards to the means of payment.

In this paper, we are only considering cash payments. However, some other forms of payment do exist, such as:

- Benefits in kind: company, company car, and other fringe benefits.
- Shares or share options, normally given only to top management positions.
- Insurance or pension schemes.

The value of some of those benefits should be added to the nominal wage, and in several cases it's necessary to perform this operation for fiscal reasons. This is the case of the pension schemes, shares and sometimes of the company car.

On the other side, other benefits such as the food and lodging for people working abroad are to be considered as a reimbursement, provided that their amount is congruous. The relevant value is not to be added to the nominal wage.

The paper also does not consider the severance payment that is still used in some countries, Italy between them. As a matter of fact, the severance payment is not to be considered as a gratuity, while it is a kind of delayed payment and should then be part of the gross remuneration. We also do not consider the possibility of giving a signing-on bonus which is used only in particular cases and is substantially unknown in our sector.

Speaking about pay or wages, we should take into consideration that, with the same word, we could mean:

- The net wage  $W_n$ , namely the amount of money that the person actually receives in his pocket,
- the gross wage  $W_g$ , namely the nominal amount given to him by the employer and used to pay, besides the net wage, the social contribution charges  $Sc$  as well as the individual income tax  $T$
- the total cost of the wage  $C_w$ , that is equal to the gross wage plus some other social charges to be paid by the employer

The simplified formula is then:

$$\begin{aligned} C_w &= W_g + Sc' = W_n + Sc + T + Sc' \\ W_g &= W_n + Sc + T \end{aligned}$$

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The real formula is very complicated and a lot of other minor factor is present.  
The table below shows some data relevant to the Italian case:

<b>Wg</b>	<b>Cw</b>	<b>Wn</b>	<b>Cw/Wg</b>	<b>Wn/Wg</b>	<b>Wn/Cw</b>
<b>kLit</b>	<b>kLit</b>	<b>kLit</b>	<b>%</b>	<b>%</b>	<b>%</b>
30 000	43 706	22 848	145,7%	76,2%	52,3%
40 000	58 275	28 998	145,7%	72,5%	49,8%
50 000	72 608	34 952	145,2%	69,9%	48,1%
60 000	86 940	40 875	144,9%	68,1%	47,0%
70 000	101 273	46 558	144,7%	66,5%	46,0%
80 000	115 606	51 822	144,5%	64,8%	44,8%
90 000	127 919	56 508	142,1%	62,8%	44,2%
100 000	141 585	61 789	141,6%	61,8%	43,6%
120 000	168 919	72 350	140,8%	60,3%	42,8%
140 000	196 252	82 911	140,2%	59,2%	42,2%
160 000	223 281	93 475	139,6%	58,4%	41,9%
180 000	250 154	103 443	139,0%	57,5%	41,4%
200 000	276 253	113 255	138,1%	56,6%	41,0%
250 000	335 386	139 607	134,2%	55,8%	41,6%
300 000	393 320	166 607	131,1%	55,5%	42,4%
400 000	509 188	216 748	127,3%	54,2%	42,6%
500 000	625 055	265 748	125,0%	53,1%	42,5%

As it appears from the table, the relationship between Wn, Wg and Cw is not a linear one, since it depends from a lot of factors related to the person as well as to the company. A further difficulty is given by the fact, while the sensitivity of people is clearly related to the net amount Wn, the only objective amount is the gross Wg. This means that all market analysis, negotiations between parties, labour contracts and so on are referred to the gross salary Wg, while the parameter to be considered for calculation of the equitable payment, namely the parameter that people feel as the real wage is the net amount Wn. However, is quite common to refer all consideration to the gross salary Wn, and we shall do the same.

## **B. Forms of payment**

### **B.1. Fixed payment**

#### a) General

Speaking about payment of people involved with an organisation, with a subordinate or coordinate relationship, we have to consider that they are normally getting paid on a fixed monthly or weekly salary.

To be more precise, we define as fixed payment a payment that is actually proportional to the time: people are paid with a fixed amount for every month (or day, or week; in Italy normally people is paid monthly, while the salary is calculated in euros per year.

The payment is related to a normal working time, so that additional payments can be allowed for overtime, at least at the lower levels of the organization, as well as for special efforts or for abnormal working conditions. On the other side, the payment is not related to performances: good or bad performances are duly considered for the evaluation but are not considered as a factor for the monthly payment.

This is to say that the majority of the risks remain with the employer, since the workers shall be entitled to get paid even in case the works he performed are badly performed or performed in a not efficient way. As a matter of fact, the only risks

belonging to the worker are the technical risks (not to be able to perform the works assigned to him).

On the other side, the employer can put in operation a proper control system to ensure that the works are in any case conforming to a certain standard.

This is the way of paying people normally used for managers of major organizations as well as for employees and workers of all organizations with a subordinate relationship. Such a system can be very well working,

- if the payment is equitable and,
- if there is a proper system of evaluation of the performances.

The evaluation of the performances is used for advancement without being used for current payment. However, it is an important factor of motivation.

#### b) Equitable payment

The theory of the equitable payment is based on studies carried out by Elliot Jaques and others (Brown, Rawbottom, Billis, etc.). It has not been widely applied since, in the 20.th century, due to the fact that both parties (unions and employers) have decided to rely on negotiation instead of relying on an objective criterion.

The illusion of both parties has been that they, through negotiation, could afford the best results. As a matter of fact, a lot of distortion has been created owing to the fact that the labour market is an imperfect market if compared to the free market conditions as normally described by the economists. As a matter of fact, the risk implied in the free market system when applied to the labour relationship are relevant to the fact that low level works can be paid more than higher level works due to temporary scarcity as well as to local conditions. By this way, a distortion is originated with regards to the relationship between level of the work and salary.

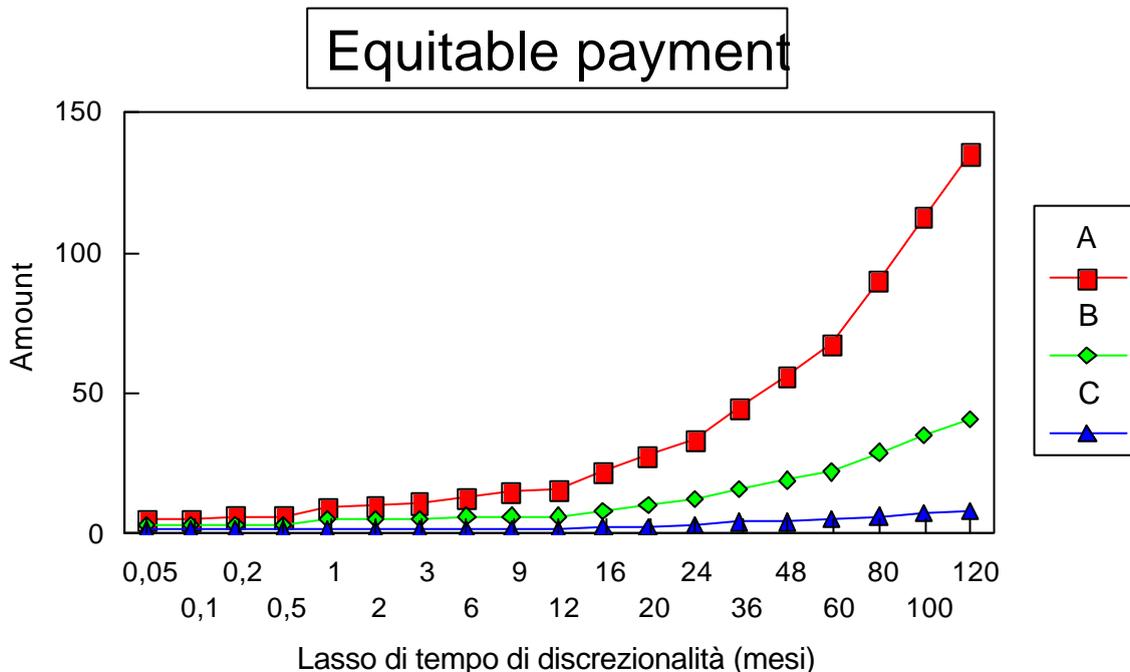
Without describing the whole theory, let us summarize the main issues:

- ▶ The level of the work pertaining to a specific role in any organization can be measured by the **time span of discretionality  $T_d$** , which can be used also to compare the level of the work pertaining to roles in different organizations. The above time span of discretionality is equal to the longer duty or group of duties assigned.
- ▶ The time span of discretionality can be used as a guideline to create a system of ranks in order to divide rank from role. This is quite normal in major organisations; reference can easily be made to the military structure.
- ▶ Each person at a certain time of his life is able to work at a certain individual time span of discretionality  **$T_i$**  corresponding to his level of culture, experience, and professional capacity as well as of psychological maturity. The individual time span of discretionality increases with the age, the time span corresponding to 55 years of age is defined as nominal time span of discretionality  **$T_n$** .
- ▶ For each role there is an **equitable payment**, that is the pay statistically considered as equitable by people for the work they are actually doing (without considering neither the work they would like to do nor the work they feel to be able to do).
- ▶ The equitable payment can be calculated as:

$$R_e = R_0 \exp \frac{?}{?_0}$$

- $R =$  equitable payment for a work whose time span of discretionality is equal to  $?$
- $R_0 =$  equitable payment for a work whose time span of discretionality is near to zero (minimum wage or unemployment allowance in the considered country)
- The term  $?_0$  is a parameter depending to the general economic level of the country considered
- The conditions to be satisfied in order to have satisfaction, good performance and motivation in the short term are:
  - $T_i = T_d$  (all people should work to a level corresponding to their capacity),
  - All people should receive an equitable payment
  - The further condition to motivate people in the long term is to give them the possibility that their potential be understood, developed and utilised in due time.

According to the theory, if the above conditions are met, there is no need to relate the payment to the performance since people should be enough motivated to give the best performance.



The curve shows the equitable payment relevant to three different countries. It is worthy to note that:

- "A" is a high level country, the level of the wages is clearly higher and a higher differential is accepted, as a matter of fact the ratio of the maximum wage to the minimum wage is about 24.
- "B" is a medium level country; the ratio of the maximum wage to the minimum is about 11.
- "C" is a low level country, the level of wages is clearly lower and the differential is barely accepted, as a matter of fact the ratio of the maximum wage to the minimum wage is about 6.

Some investigations made in very poor countries, although not fully valid on statistical point of view, show that the differential is felt as scandalous; as a matter of fact the above ratio is between 2 and 3. This is a good matter to think about for politicians, trade unionist, sociologists and other concerned people.

## B.2. Sensitivity

Speaking about equitable and variable payment, we should make some considerations relevant to sensitivity of people to the variation of their payment. There are not yet fully reliable data on that matter. If we refer to developed countries with a mixed and stabilised economy with good welfare allowances, like most of European Union countries, we can take into consideration the following criteria:

- The “normal” person can be motivated through an additional payment that gives him, in one year, an additional income more or less equivalent to its normal monthly income, if his payment is equitable. This is to say that amounts below 10% about of the yearly income are not taken into real consideration as a real motivation factor. In general we can define, for each situation and economic level, a sensitivity parameter **s**.
- On the other side, it seems that the “normal” person starts to take into consideration to deviate from correct behaviour if he is proposed a payment equivalent to his yearly income. This is not to say that anyone has his price, because we are not making any kind of ethical consideration but we only are relying on statistics. Furthermore, due to the extreme difficulties to get any kind of reliable information on such matter, more than relying on statistics we are actually guessing. However, this could be a parameter to be considered for taking under control the corruption and other kind of deviation.

Sensitivity is probably increasing with the general economic level. It should be about 15% in country "A", 7 to 10% in country "B", less than 5% in country "C".

## B.3. Payment proportional to the quantities

In this case, the payment shall be proportional to the quantity of the work performed, provided that the works are conforming to the standard.

This is to say that parameter is fixed to measure the quantity of work performed and the payment is related to such parameter proportionally or with a different relationship.

$$P_Q = pQ$$

This is the case of the workers paid in proportion to the quantities installed (*cottimo*) as well as the case of the salesmen paid with an agency fee or success fee proportional to the sales. To be fair, the system should allow the worker to get an amount higher than the equitable payment for the same kind of work (taking into consideration differences in fiscal treatment, if any) with an average effort. According to what it is said in the following paragraph about sensitivity as well as the different allocation of the risks, whose majority (commercial and economic risks, sometimes financial risks) belongs to the worker, this amount should be at least 20% to 25% more than the equitable payment for a work of the same level.

$$p(Q_0 - ? Q) = k R_e$$

**$Q_0$  = expected quantity**

**$Q_0 \pm ? Q$  = expected range**

Such form of payment, to make sense, has to be applied only to persons free to organise their work as they like, and therefore not properly belonging to the organisation itself or, at least, related to the organisation with a coordinate relationship without being subordinates.

c) Mixed formula

In most cases, a mixed formula is used (basic fixed payment plus additional payment proportional to quantities).

To design a mixed formula based on equitable payment, the equitable payment should be theoretically known as well as the sensitivity of people to variation of the payment itself. The basic payment should be no more than 90% of the equitable payment, in general the formula should be

$$P_m = (1-s) R_e + rQ$$

Where  $r$  is calculated so that  $P_m$  is equal to  $R_e$  if the quantity are equal to the expected level (to be more correct, to the minimum level of the expected range).

$$R_e = (1-s) R_e + r (Q_0 - ? Q)$$

$$sR_e = r (Q_0 - ? Q)$$

We can increase the effectiveness by using a parameter higher than  $s$  to define the basic salary (of course  $r$  should be modified accordingly). In those cases the effectiveness increases while the general situation becomes progressively more similar to the case of the payment in proportion to quantities.

$$P_m = (1- ns) R_e + r'Q$$

$$R_e = (1-ns) R_e + r' (Q_0 - ? Q)$$

In general, in those cases, instead of a formula based on a basic payment plus additional quota, it should be better to revert to the previous formula (payment proportional to quantities) with a minimum fixed value independent from the quantities actually performed.

### **C. Performance related payment**

#### **C.1. General**

The main limitation in using the payment based on quantities or based on mixed formulas is that we take under control only global quantities without the possibilities of controlling their distribution and their optimisation. It is very well known the case of sales people that, since they are paid on turnover, tend to increase their sales by any means even in case this be not profitable for the company; in several cases, this behaviour has been modified by relating their payment to the profit contribution instead than relating to the turnover (that is, relating the payment to a performance parameter instead of relating to a quantity parameter)

The criterion of fixed payment can be modified introducing a payment proportional to performances, where the parameter should take into consideration how the work has been performed, besides considering only the quantity of works performed.

In this case the payment shall not be related to the quantity of work performed, while to the actual quantity we want to take under control. This is to say that we are to define a parameter that measures the performance required, this parameter can be the profit contribution or can be a parameter related to physical quantities such as productiveness, efficiency etc.

#### **C.2. Identification of the parameter representing the performance**

This is actually the main problem we have to solve, in order that the formula used be not deviating, this is to say that the objective of the company be not different from the objectives of people trying to maximize their income.

A basic condition is that the parameter considered be actually under the control of the concerned person. It makes sense to pay a project manager in proportion to the

profit contribution of the project managed by him, it does not make sense to pay the whole of the workers in proportion to the profit of the company, since it is not directly under their control while depending on several factor, most of them are completely beyond of their control. This is why a lot of schemes used by major companies did not give the expected results.

The payment based on production is very close to the payment based on quantities with mixed formula described above. This is based on a standard production rate defined in quantity/hour and on an efficiency factor calculated as ratio of the earned working time to the total working time. The original formula was studied for the car industry (FIAT 30/04/1946; the portion of salary related was 15% to 30%).

In the recent times, reference is made to objectives that can be calculated through the cost control procedures, such as the profit contribution or other parameters related to the production (efficiency of manpower, plant utilization, etc.). Other schemes are gain-sharing schemes (based on the difference between budget and actual), profit-sharing schemes, etc.

### C.3. Relationship between payment and parameter

In the **linear** case, the relationship between the payment and the parameter **Z** identified as indicator of the performance can be written by means of a linear formula, as it has been shown before:

$$P = (1 - ns) R_e + t Z$$

$$R_e = (1 - ns) R_e + t (Z_0 - ? Z)$$

The point corresponding to the equitable payment can be actually chosen at the minimum, average or maximum point of the expected range:

$$R_e = (1 - ns) R_e + t (Z_0 - ? Z)$$

$$R_e = (1 - ns) R_e + t Z_0$$

$$R_e = (1 - ns) R_e + t (Z_0 + ? Z)$$

The weak points of this criterion are that we give a reward also for performances below the expected, while the total payment does not increase substantially in case of performance higher than the expected.

This is why a different formula (**linear modified**) has been studied:

$$P_0 = (1 - ns) R_e$$

$$P = P_0 + t' [Z - (Z_0 - ? Z)]$$

where the values into [...] are to be considered equal to their calculated value only if they are positive and are to be put equal to zero if they are negative

A more complicated formula has been studied, aiming at giving a payment related to the performance with a **linear progressive** relationship that can be described as follows:

$$P_0 = (1 - ns) R_e$$

$$P = P_0 + t' [Z - (Z_0 - ? Z)] + (t' + t'') [Z - (Z_0 + ? Z)]$$

where the values into [...] are to be considered equal to their calculated value only if they are positive and are to be put equal to zero if they are negative

This is to say that

- For  $Z < (Z_0 - ?Z)$  the payment shall be not effected and equal to  $P_0$
- For  $(Z_0 - ?Z) < Z < (Z_0 + ?Z)$  the payment shall be proportional to the difference between the actual value of the parameter and the lower level of the expected value
- For  $Z > (Z_0 + ?Z)$  the payment shall be proportional, with a higher coefficient of proportionality, to the difference between the actual value of the parameter and the higher level of the expected range.

This is a typical progressive formula that can be divided into more segments. The equitable payment should be related to the lower value of the expected range, as it has been seen before. The easier way to realize a progressive incentive is to establish some fixed progressive bonuses related to milestones or well identified objectives.

In the more general case, this formula can be modified in an exponential formula, which is **full progressive**

$$P = P' + t \exp(Z / Z')$$

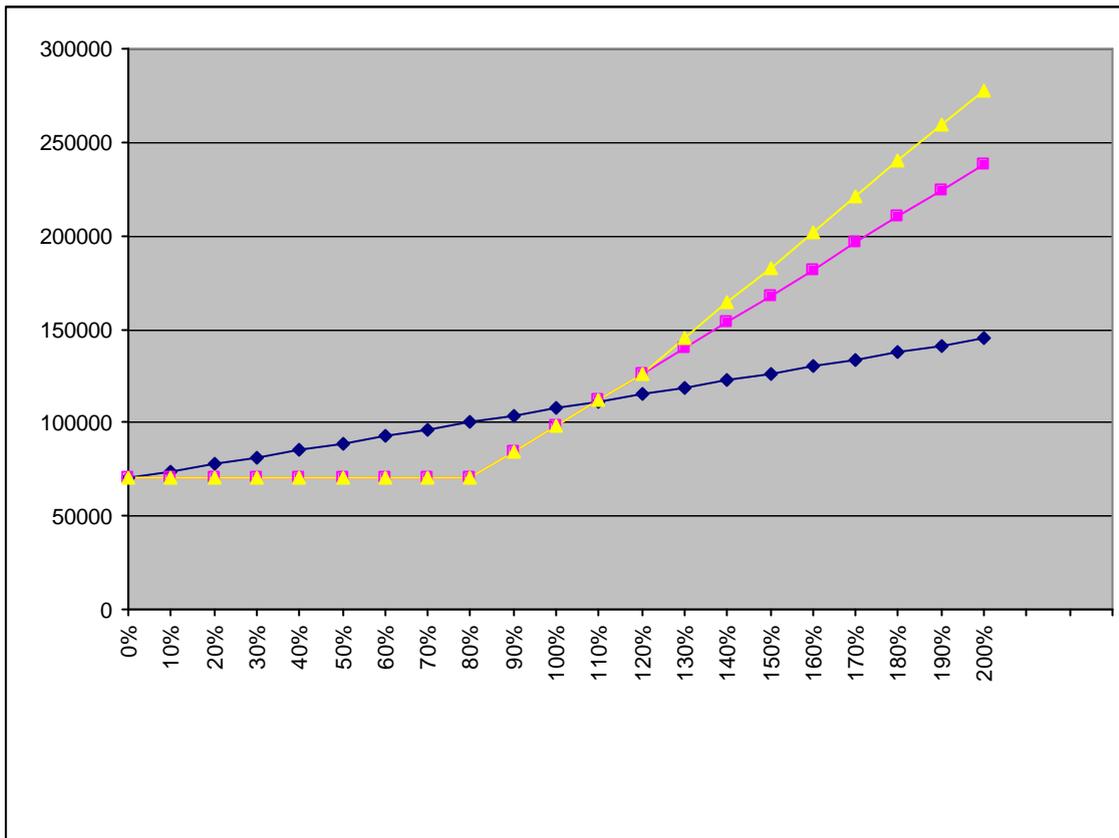
**Regressive linear** formulas are not normally used. However, we should put some limit to the performance related payment. Very high performances are to be rewarded in some other way, at least in our opinion.

We believe that this limit should be about 200% of the equitable payment. To be more correct, the limit should be defined as below.

$$(1 - ns) P_e < P < (1 + kns)$$

$$k = 2.5 \text{ to } 4$$

On the theoretical point of view, the best way should be to use a logistic curve or some other sigmoid curve such as the Janoschek growth curve. The point of inflection should be in the middle of the expected range and should correspond, more or less, to the value of the equitable payment.



**PERFORMANCE RELATED PAYMENT**

Performance RELATED PAYMENT	Linear	Linear modified	Linear progressive
0%	70000	70000	70000
10%	73750	70000	70000
20%	77500	70000	70000
30%	81250	70000	70000
40%	85000	70000	70000
50%	88750	70000	70000
60%	92500	70000	70000
70%	96250	70000	70000
80%	100000	70000	70000
90%	103750	84000	84000
100%	107500	98000	98000
110%	111250	112000	112000
120%	115000	126000	126000
130%	118750	140000	145000
140%	122500	154000	164000
150%	126250	168000	183000
160%	130000	182000	202000
170%	133750	196000	221000
180%	137500	210000	240000
190%	141250	224000	259000
200%	145000	238000	278000
<b>Equitable payment</b>	<b>€100 000,00 per year</b>		
<b>Sensitivity</b>	<b>15%</b>		
<b>Expected range</b>	<b>80 to 120%</b>		

#### **D. Effect on costs**

Eventually it has to be noted that all incentives are to be carefully considered in cost management, since incentives are additional costs that can effect the profit contribution.

They are to be calculated so that they create a synergic action between people and company, this is to say that the value of the incentives be not bigger than the additional profit contribution related to them and that there are not incentives for profit contribution below the expected value.

The best formula to grant this result seems to be the linear modified one, while the linear progressive should be used only for real top project management positions, whose action can be heavily effecting the final results.

With reference to the enclosed example, where different ways of calculating the incentive pay for the project management team have been considered, the following are to be considered:

→ In case of low profit contribution the best alternatives are the linear modified and linear progressive, since they reduce the damages due to the reduction of the contribution margin.

→ If the profit contribution is within the expected range, all the alternatives give results within a restricted range

→ If the profit is more than the budgeted, the highest incentive schemas can reduce the actual profit. In the example as shown some cases where the increase in profit contribution gives to the company a decrease of the final profit due to the different distribution of the profit contribution itself.

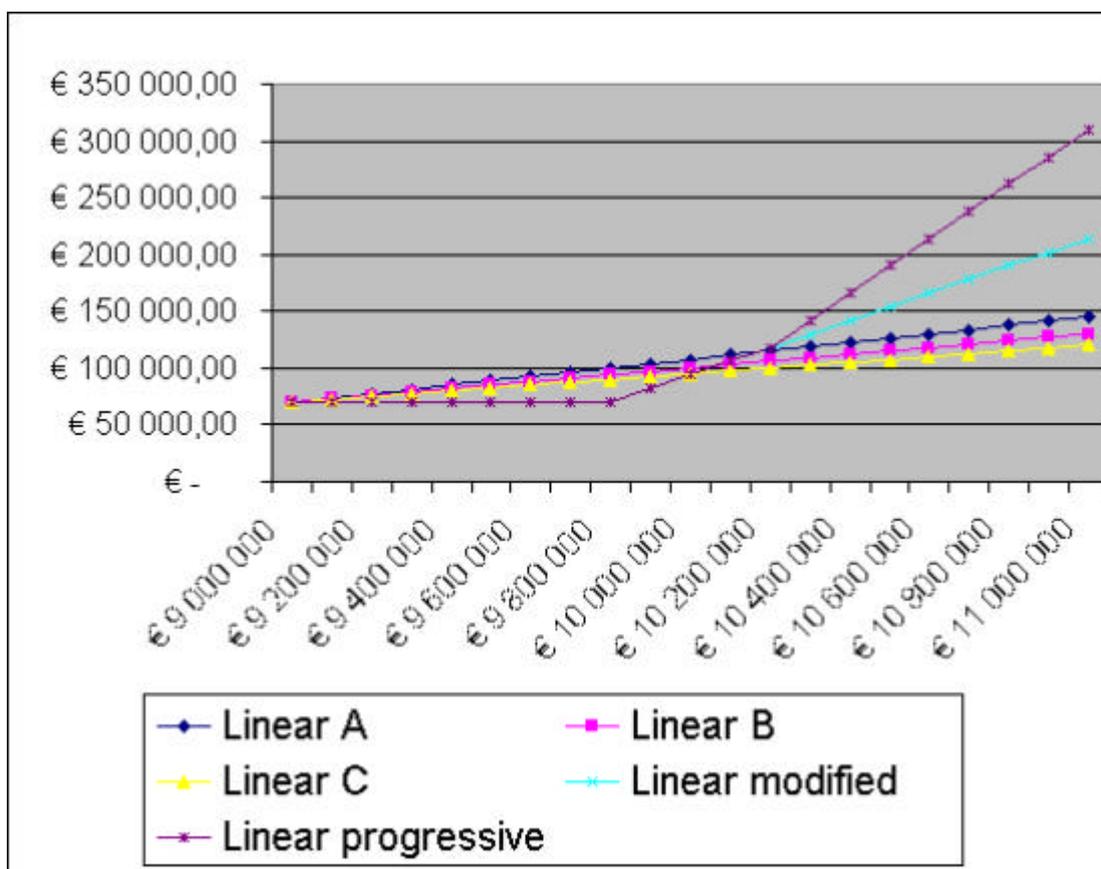
It has to be noted that the table can be considered as realistic:

- The budgeted profit contribution is 10 000 000 out of a contract price of 42 000 000, namely 23.8% that is low but included in the range provided for in the parameters of law 741 of year 1981 relevant to public works, the budgeted profit is 11% about that is quite normal.
- The range of variation of the profit contribution, from 9 000 000 to 11 000 000 to be compared to a budgeted value of 10 000 000 is realistic too, a deviation of 10% is possible and it is quite often reported in real projects.
- If we refer to the progressive incentive payment we note that the curves identified as Linear A, Linear B and Linear C have a minimum value of 70% of the equitable payment and a maximum value of 145% of the equitable payment and so are fully acceptable. The curve linear modified have the same minimum value and a maximum value of 214% to 310% of the equitable payment, they have been are oversized for the purposes of this work, an actual curve should not exceed 200% of the equitable payment. If we remain in such range, we note that there is a decrease in the net profit to 10% about at the maximum point; this could be actually acceptable if the higher incentive, by giving more motivation, can actually increase the probability of having a better result.

Remaining within the expected range, that is more realistic, we note that the incentive does not affect substantially the profit, the variation range being always less than 0.9%.

**BUDGET RELATED  
PAYMENT**

Profit contribution	Linear A	Linear B	Linear C	Linear modified	Linear progressive
€9 000 000	€ 70 000,00	€ 70 000,00	€ 70 000,00	€ 70 000,00	€ 70 000,00
€9 100 000	€ 73 750,00	€ 73 000,00	€ 72 500,00	€ 70 000,00	€ 70 000,00
€9 200 000	€ 77 500,00	€ 76 000,00	€ 75 000,00	€ 70 000,00	€ 70 000,00
€9 300 000	€ 81 250,00	€ 79 000,00	€ 77 500,00	€ 70 000,00	€ 70 000,00
€9 400 000	€ 85 000,00	€ 82 000,00	€ 80 000,00	€ 70 000,00	€ 70 000,00
€9 500 000	€ 88 750,00	€ 85 000,00	€ 82 500,00	€ 70 000,00	€ 70 000,00
€9 600 000	€ 92 500,00	€ 88 000,00	€ 85 000,00	€ 70 000,00	€ 70 000,00
€9 700 000	€ 96 250,00	€ 91 000,00	€ 87 500,00	€ 70 000,00	€ 70 000,00
€9 800 000	€ 100 000,00	€ 94 000,00	€ 90 000,00	€ 70 000,00	€ 70 000,00
€9 900 000	€ 103 750,00	€ 97 000,00	€ 92 500,00	€ 82 000,00	€ 82 000,00
€10 000 000	€ 107 500,00	€100 000,00	€ 95 000,00	€ 94 000,00	€ 94 000,00
€10 100 000	€ 111 250,00	€103 000,00	€ 97 500,00	€ 106 000,00	€ 106 000,00
€10 200 000	€ 115 000,00	€106 000,00	€100 000,00	€ 118 000,00	€ 118 000,00
€10 300 000	€ 118 750,00	€109 000,00	€102 500,00	€ 130 000,00	€ 142 000,00
€10 400 000	€ 122 500,00	€112 000,00	€105 000,00	€ 142 000,00	€ 166 000,00
€10 500 000	€ 126 250,00	€115 000,00	€107 500,00	€ 154 000,00	€ 190 000,00
€10 600 000	€ 130 000,00	€118 000,00	€110 000,00	€ 166 000,00	€ 214 000,00
€10 700 000	€ 133 750,00	€121 000,00	€112 500,00	€ 178 000,00	€ 238 000,00
€10 800 000	€ 137 500,00	€124 000,00	€115 000,00	€ 190 000,00	€ 262 000,00
€10 900 000	€ 141 250,00	€127 000,00	€117 500,00	€ 202 000,00	€ 286 000,00
€11 000 000	€ 145 000,00	€130 000,00	€120 000,00	€ 214 000,00	€ 310 000,00
<b>Equitable payment</b>					<b>€ 100 000,00 per year</b>
<b>Sensitivity</b>					<b>15%</b>



## E. The case of Engineering and Construction

The real problem, in engineering and construction, is the identification and definition of the parameter to be used for measuring the performances. The further problem is that, since we are working by project, this parameter has to be identified for every project and can be therefore be different from project to project.

Let us explain how the things can be managed in real cases.

### E.1. Project management people

In general, for project management people, the payment can be related to performances with a linear progressive formula. The parameter to be considered shall be the profit contribution of the project assigned to them and the formula shall be the linear modified or the linear progressive.

The expected range shall be defined with reference to the budget:

- the higher limit H shall be defined by the profit contribution resulting from budget without using the contingencies and,
- the lower limit L by the profit contribution with full use of contingencies.

The payment related to performances shall then be null below the point L, shall be linear between L and H. For results higher than H the performance related payment could still be linear with the same ratio (linear modified) or with a higher ratio (linear progressive) with an upper limit as previously described. As an alternative, fixed bonuses can be provided for different levels of the performance  $H_1$ ,  $H_2$ , and  $H_3$ .

By this way, we can keep under control both costs and time since, in case the time is exceeded, there shall be additional costs due to the longer project time and the profit contribution shall be automatically reduced.

It has to be noted that, in some cases, the budget is not considered as flexible ( $\Delta Z=0$ ). In those cases a **linear simplified** formula can be used

$$P = P_0 + t' [Z - Z_0]$$

where the values into [...] are to be considered equal to their calculated value only if they are positive and are to be put equal to zero if they are negative

An upper limit has to be established as specified above.

### E.2. Other management people

The incentive shall be calculated with the same criterion used for project management people. In case their budget does not allow for contingencies, since their management is centralised in the Project Manager, the upper and lower limit can be assumed as plus or minus a fixed percentage of the budget.

### E.3. Construction people:

Incentive should be calculated on productiveness, namely on the relationship between earned man-hours and spent man-hours. This is a very complicated procedure to be used on large construction sites, and so it is generally preferred to define some bonuses related to easy milestones.