

TIME & MONEY IN BUILDING PROJECT MANAGEMENT

A summary of a paper given by JOHN ANDREWS, Director of Building Industry Studies, University College London, to Seminars in Penang and Kuala Lumpur, Malaysia and in Singapore July 1977 and at a Seminar on Project Management in Nairobi, Kenya January 1978.

INTRODUCTION

Clients and Contractors are all looking for value for the money they both use in the construction of buildings. It is therefore very necessary to have a simple method of making sure that money is not wasted during the long period of the building contract. It is not enough to wait to the end to know what profit, or loss, has been made. It is also important to know if the work will be finished on time required by the contract.

There are two classes of building work: single projects - hospitals, schools, factories; and - housing.

SINGLE BUILDING PROJECTS

The first method enables the contractor to control work on a single building project. <u>Diagram 1</u> shows the three factors which must be kept under review each month by the contractor. (A) This is the cost expended by the contractor, on labour, materials and plant. The cost rises throughout the contract until it reaches a total. As work is done by the contractor, it can be measured at monthly stages and claims made upon the client for part payment. This is shown by (B) - measured value. These claims are submitted to the client who checks them and after a period of time pays them, holding a percentage in case of default by the contractor. This is shown by (C) - cash received against certificates.

If the contractor is to manage his job efficiently and profitably he must know the shape of each of these curves for (A) (B) and (C) and check their proper relationship throughout the work.

At any time, a vertical line drawn between (A) and (C) shows the working capital requirement for the contract. This should be kept as short as possible. If the area between (A) and (C) is measured and multiplied by the interest rate, (which is paid on borrowed money), this will give the total cost of finance required by the contractor for carrying out the job.

The efficient project manager and the contractors building manager must plan to keep this area as small as possible.

From many studies which have been carried out it is possible to say that the ideal shape for (B) - measured value, is that given in <u>diagram 2</u>. If measured value is not achieved at this rate, especially during the early stages, then the contract is likely to be delayed with a loss of profit to the contractor, and delay to the client.

HOUSING PROJECTS

The second method enables the contractor to control work on housing projects. "For housing alone the most direct method is to programme (for each project) the intended completion and handover of units then work back to the starting date by a number of significant stages or 'bits' related to the form of construction, e.g. foundations, fabric, finishings, internal services, external works - but usually 5 - 10 stages (expressed as percentages of a finished unit) suffice. Theses stages - 'bits' and completions - 'units' are cumulated and set out as budgets or targets in either tabular or graphical form. It is desirable but not necessary for all bits (of houses) or units (completed houses) to be of standard size or value. What is important is that within any control period (say 1 year) the numbers of bits and units to be generated cumulatively at standard intervals (say monthly) is known. Significant alterations or additions to the programmes of bits and units are recorded and noted as variances to the original budget or target for each project.

Thereafter each individual site records the starts, bits and units actually produced and these are cumulated and compared with the programme or targets.

THE 'EQUIVALENT' HOUSE

It is necessary at this point to discuss the concept of the 'equivalent' house. It is clear that although unfinished 'bits' of houses represent progress and accrued value, only 'units' - finished houses have utility. To make the point plain, more and more housing projects could be started to the point where all resources were absorbed in producing more and more bits of houses - but no finished units were available for handover and occupation. Any aggregated programme should therefore show clearly the relationship between the rate of starts, production of completed units and the rate of production of collections of unfinished bits of houses equal in value or 'equivalent' to the the value of a completed unit e.g. 10 foundation bits or 5 fabric bits, or 6 internal services bits could be regarded as the equivalent of one completed house, and these three factors should be kept in balance. If the number of 'equivalents' produced increases significantly at the expense of the number of finished units then resources must be redeployed and the incidence of starting new projects reduced until a balance is reached." (1)

Diagram 3 shows an example of the very simple method of recording the Target - 'T' and Actual - 'A' for each stage of the housing project, for each week of the contract period. The targets are agreed at the beginning of the contract. It will be seen that, for example, at week 106 it is expected that 551 roofs will be completed and 446 houses will be decorated. Then each week the number of stages actually completed are counted and recorded and compared with the target. In fact at week 106 554 roofs were actually finished but only 339 houses were decorated. This means that urgent attention must be given to increasing the number of painters, or providing more paint, or gettin painters to paint faster.

It is very important to keep Hand Overs - 'H/O' and Equivalents - 'E' in balance.

In the example, <u>diagram 3</u>, it can be seen that 414 houses should have been completed, but in fact only 324 were actually handed over. This means that the hand over programme is badly delayed.

The situation is made worse because although 90 houses have not been handed over there are actaully 584 'equivalent' houses on the site.

This means that too many houses are being started, and the stages are not being finished in a balanced way to enable the houses to be completed and handed over for occupation on time.

The contractor will be losing money because he cannot get his payments until completion. The clients also lose for they cannot live in uncompleted houses.

CONCLUSION

This brief note has outlined <u>principles</u> for the planning and control of a single building project and a housing project. The <u>techniques</u> of planning (programming) and control (progressing or monitoring) are available and with the exception of the concept of 'equivalent' houses, described at (1) above, are to be found in most textbooks and many technical papers, and journal and magazine articles.

The problems are intensified when attempts are made to plan and to control <u>multiple</u> building and housing projects at regional and national level. The <u>principles</u> for dealing with these multiple projects are outlined in the summary of a paper "The Managerial Control of housing and other construction programmes at regional and national level" (1) given by the author at the Cairo Conference on Low Cost Housing April 1975. This summary is attached at Appendix 1.

There are few well developed <u>techniques</u> described in the literature, and available for those attempting the management of multi-projects. Much further work requires to be carried out in this important and largely neglected field.

DIAGRANE 1

THE RELATIONSHIP BETWEEN CONTRACTORS COSTS, MEASURED VALUE AND CASH RECEIVED DURING A HUILDING PROJECT



Source: Institution of Civil Engineers

NOTES: Contract Costs (A) are the actual sums laid out by the Contractor. These costs may include setting up the site, paying labour and plant, carrying our temporary work, etc. They begin to accrue immediately the contract starts. Thus the contractor is in debt until he begins to do work for which he may make a claim for the first 'interim' payment. This claim is based upon the rates in the bill of quantities, or as previously agreed. This measured value B show at (B) above. When this claim is submitted to the client it is checked and if found correct, a payment is made to the contractor by the client for the agreed amount less a proportion held by the client as a retention against poor perform ance. This cash received against certificates is shown at (C) above. The difference between the total costs and cash received represents the contractors final margin from which he must pay: overheads, finance and make a profit. If he has performed badly then the cost of remedial work carried out by him during the maintenance period will reduce his margin and thus his profit. If the contract period over-runs the: the margin is likely to be further reduced, due to added interest charges, and the effects of inflation. Also resources remain tied to the project and may not be used profitably elsewhere.



CONTRACT PERIOD

Notes:

There are techniques, well described in the literature, for producing analytically an 'actual' shape for the curve of measured value for individual projects. This percentage method for producing an 'ideal' curve is useful when cost information is not immediately available, e.g. during the briefing, and designing stages. It is also useful for checking the validity of the curve produced by analytical methods. e.g. if a contractor submits a normal programme for the project, it may be converted analytically into such a curve. If this curve is then plotted onto a conventional 'ideal' curve, and if there is a marked discrepancy between these two curves then further checking of the contractor's programme should be undertaken and the reasons for the differences ascertained. This is especially necessary when the 'actual' curve is to the RIGHT of the 'ideal' curve, and even more so when it is significantly to the RIGHT during the early stages of the project.

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DIAGRAM 3

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A METHOD OF REPORTING ACTUAL (PROGRESS) AGAINST TARGET (PROGRAMME) ON HOUSING PROJECTS

ABC CONTRACTORS

JOB NO XYZ - Anywhere

Ref:

Weekly Housing Report

Situation as at w.e. 12.6.60

Job Week No.

Tan	tane	
16	ECU	

Actual

106

	STAGES	T	A
1	Works below D.P.C.	815	826
2	Brickwork 2 lifts, joists lat floor	611	680
3	Brickwork complete. Topped out.	581	599
4	Roofing complete	551	554
5	Services, Carcessing, Flooring, Stairs	536	510
6	Ceiling boarding, partitions, 1st fix plastering	491	486
7	Water/Gas/Electricity services, outbuilding 2nd fix	461	454
8	Decorations	44.6	339
9	Paths, fencing, ground floor flooring	430	332
10	Clean-up, ready for handover.	414	324
E	Equivalents:	(-)	584
4/0	Handovers:	414	324

Notes:

An equivalent house is any collection of finished stages, which together represent the value of one completely finished house. For further explanation refer to text. CAIRO CONFERENCE ON LOW COST HOUSING. 20 -25 APRIL 1975

"THE MANAGERIAL CONTROL OF HOUSING AND OTHER CONSTRUCTION PROGRAMMES AT REGIONAL AND NATIONAL LEVEL".

by JOHN ANDREWS SCHOOL OF ENVIRONMENTAL STUDIES UNIVERSITY COLLEGE LONDON.

INTRODUCTION

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There is a large and growing international literature about the techniques for the planning and controlling of substantial <u>individual</u> construction projects. These techniques may conveniently be grouped into two classes; networks - for single complex projects and, flow charting or 'line of balance' for repetitive similar units e.g. housing. The value of both classes of techniques to management for control purposes may be enhanced by presenting them in the form of time/money budgets.

This paper draws attention to the relative dearth of techniques available for programming and controlling <u>multiple</u> projects at regional and national level in the long term. It offers the principles for a control method derived by the author from his experience on large scale, up to 2,000 units, housing contracts in the U.K., and further develops the method for mixed i.e. housing and other construction projects at various locations or levels of aggregation. Attention is drawn to the concepts and special charting facilities of Gantt and MAT - moving annual totals, for long term comparative purposes.

Work by Bromilow and others draws attention to the time/cost relationship and to the dangers of attentuating the time scale of single projects. This paper stresses similarly that once the time scales for the various individual projects are determined analytically and/or conventionally the managerial control task is to monitor actual progress against these fixed time bases, so that timely corrective action may be taken or the consequences of shortfall may be anticipated. The same principle holds good at each level of aggregation, but at sharply decreasing levels of detail. For housing it is customary to monitor 'starts' and 'completions' at regional and national levels. This paper introduces the concept of the 'equivalent' house and urges its adoption as a third key measure for managerial control purposes.

SINGLE HOUSING PROJECTS

For housing alone the most direct method is to programme (for each project) the intended completion and handover of units then work back to the starting date by a number of significant stages or 'bits' related to the form of construction, e.g. foundations, fabric, finishings, internal services, external works - but usually 5 - 10 stages (expressed as percentages of a finished unit) suffice. These stages --- 'bits' and completions -- 'units' are cumulated and set out as budgets or targets in either tabular or graphical form. It is desirable but not necessary for all bits (of houses) or units (completed houses) to be of standard size or value. What is important is that within any control period (say 1 year) the numbers of bits and units to be generated cumulatively at standard intervals (say monthly) is known. Significant alterations or additions to the programmes of bits and units are recorded and noted as variances to the original budget or target for each project.

Thereafter each individual site records the starts, bits and units actually produced and these are cumulated and compared with the programme or targets. These updated comparisons are reported regularly upwards for the record. (Report A).

MULTIPLE HOUSING PROJECTS

It is necessary at this point to discuss the concept of the 'equivalent' house. It is clear that although unfinished 'bits' of houses represent progress and accrued value, only 'units' - finished houses have utility. To make the point plain, more and more housing projects could be started to the point where all resources were absorbed in producing more and more bits of houses but no finished units were available for handover and occupation. Any aggregated programme should therefore show clearly the relationship between the rate of starts, production of completed units and the rate of production of collections of unfinished bits of houses equal in value or 'equivalent' to the value of a completed unit e.g. 10 foundation bits or 5 fabric bits, or 6 internal services bits could be regarded as the equivalent of one completed house, and these three factors should be kept in balance. If the number of 'equivalents' produced increases significantly at the expense of the number of finished units then resources must be redeployed and the incidence of starting new projects reduced until a balance is reached. These updated comparisons also are reported regularly upwards for aggregation. (Report E).

At each appropriate level of aggregation Report A is filed for reference. Report B is aggregated and used for control purposes.

The simplest way to record and exhibit these targets (of starts equivalents and completions) and to compare progress in succeeding years at any level of aggregation is to utilise the Moving Annual Total concept and special 'Z' charting paper which is available for 1 to 5 year cycles. If it is then required to compare the contribution of regions, operating at different rates of starts, equivalents or completions, to the total national programme this may be done using Gantt concepts, recorded and displayed on standard charting paper.

MULTIPLE CONSTRUCTION PROJECTS. (Other than housing).

The simplest method is to determine the construction programme for each project then to report upwards for aggregation a budget showing the anticipated rate of generating value (in money terms) over time. If these analytical budgets are not available then they may be derived conventionally using a standard percentage profile. As the work proceeds the actual rate of generating value is regularly reported upwards for comparison purposes and aggregation.

MULTIPLE MIXED CONSTRUCTION PROGRAMMES.

It is easier to maintain separate records for housing and other construction work but if it is necessary at say national level to make continuing judgements about the likelihood of Regional and national programmes being achieved, and to compare the achievements over succeeding years ,then the figures for equivalents and completed houses must be expressed in value (money) terms and consolidated with the figures for other construction work and displayed in 'Z' chart form.

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