A management information system for project control: a valuable aid to design management

V. P. LANE

Mr L. S. Smalley, West Midlands County Council

Mr Lane's Note was read with great interest, as similar developments in the area of management information and control systems have been taking place in the West Midlands authority during the recent past.

20. The type of system described is of particular value to large organizations where many functions entail contributions from a number of disparate, specialist groups, and additionally where the sheer volume and variety of the tasks undertaken render the traditional informal, personal type of management no longer practicable.

21. On the debit side, however, there is a tendency for the introduction of formal processes to engender a certain amount of staff opposition. There are many reasons for this, most of which can be overcome by careful design and implementation of the system in order to avoid the situation where staff at any level feel that their contribution towards the servicing of the system outweighs the benefits derived, and to ensure that the flow of information upwards is counterbalanced by a corresponding flow of decisions or comments downwards. It is suggested that one further important aspect in the successful introduction of such processes is in the judicious selection of targets against which performance is measured. From an inspection of the Note it is apparent that the targets so used are 'Total design value' and 'Budgeted man hours'. Unfortunately Mr Lane does not elaborate on the derivation of these key standards.

22. In my own department, for example, the design element of civil engineering projects is related wherever possible to standard fee scales such as those specified for model agreements for the employment of consultant engineers and the trunk road sliding scale.

23. The application of these scales needs to be tempered in certain areas to include duties not covered by the relevant agreement and implies control in terms of total scheme life rather than over a fixed term as propounded in the Note. However, it is a relatively simple matter to make due allowance for the extra duties inherent in 'in house' work and also, if considered advisable, to phase the total staff requirement derived from consideration of the scales into whatever increments of time are necessary over the whole project life.

24. It is considered that the targets so derived are not only more acceptable to the managers involved but also go some way to satisfying questions of accountability.

25. Turning to the testing of performance at various stages of project completion described in § 11, it would be interesting to know how the percentage completion (for example the quoted 25%) is in fact decided with sufficient accuracy to allow an objective performance judgement to be made.

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DISCUSSION

Mr H. Gorzelany, H. Gorzelany Consultants

I found in this Note an interesting and introspective view into the workings of a public authority merely by studying Fig. 2.

27. If the progress report for the project is not fictitious (and my life's experience tells me very likely it is not), and if I understand the figures correctly then the 'Total design value' item should be $\pounds 38\,400 \times 2.5 = \pounds 96\,000$ (!), the 2.5 multiplier being the value by which the cost of salaries of the technical staff must be multiplied to cover non-productive time between jobs; administrative management; sickness and days off; rent and rates; telephone; typing; professional indemnity and other insurances (including National Health contributions); superannuation; stationery; books and codes; accounts; tea and cleaning; furniture and equipment depreciation; post. . . . to mention a few.

28. It has been, for some time, generally considered in the private sector that this multiplier is too low at 2.5. A figure in excess of 3 would now be more realistic in view of the rising costs of running an office, VAT, modern code requirements, etc.

29. On the basis of the most onerous ACE conditions to Schedule 2, Class 1 work, the design costs of a $\pounds 400\,000$ project would work out thus:

On the first $\pounds 200\,000$	Design	=	$\pounds 19\,450$
On the next $\pounds 200\,000$	Design 74%	=	$\pounds 14\,500$
$\pounds 400\,000$	Total fee		$\pounds 33\,950$

plus travel, printing, out of pocket expenses and computer costs.

30. The Author's figure of $\pounds 48\,000$ is very high, even if it includes the 2.5 multiplier, which is not clear. The $\pounds 9600$ included for overheads is very low and totally unrealistic in comparison with the private sector.

31. In my experience a project of $\pounds 400\,000$ value in the private sector would have been evaluated, for example, as follows:

Staff requirements and average salary:

1 principal	10% of time on project at, say $\pounds 12\,000/\text{year}$	=	$\pounds 1\,200/\text{year}$
1 associate	25% of time on project at, say $\pounds 9\,000/\text{year}$	=	$\pounds 2\,250/\text{year}$
2 engineers	100% of time on project at, say $\pounds 7\,500/\text{year}$	=	$\pounds 15\,000/\text{year}$
3 draughtsmen	100% of time on project at, say $\pounds 5\,680/\text{year}$	=	$\pounds 17\,040/\text{year}$
1 trainee engr	100% of time on project at, say $\pounds 4\,510/\text{year}$	=	$\pounds 4\,510/\text{year}$
8 staff		total	$\pounds 40\,000/\text{year}$

Average salary $\pounds 40\,000/8 = \pounds 5\,000/\text{year per man}$.

It is not meant to imply here that eight staff is the optimum number for any office. The optimum may be as low as one depending on the complexity of the job, competence of the engineer etc. The optimum number is generally inversely proportional to the competence and productivity of the office and must be left to the discretion of the principal or technical manager. An engineer performing administrative management duties is considered here as overheads, i.e. nontechnical functions seldom required in a consulting engineer's office.

Allowable cost of salary and duration of work in office:

Allowable cost of salaries = $\pounds 33\,950/2.5 = \pounds 13\,580$ (c.f. $\pounds 38\,400$)

(which also compares with contractor-designers' average allowance for design staff of 3.5% of contract value, in this case $\pounds 14\,000$)

Average salary rate = $\pounds 5000/(52 \times 37.5) = \pounds 2.564/\text{h}$ (c.f. $\pounds 4.68/\text{h}$)

Number of 'gross' man hours (including holidays) required = $\pounds 13\,580/2.564 = 5296\text{ h}$ (c.f. 10 240 h)

Total 'net' (productive) man hours required = $5296 \times 1650/(52 \times 37.5) = 4481\text{ h}$, productively working 100% of recorded time in time sheets.

Therefore, on this project time sheets should not exceed the following hours worked

1	principal	71
1	associate	176
2	engineers	1411
3	draughtsmen	2117
1	trainee	706
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8	total	4481 h

32. It can be seen here that a simple productivity check can be made on the basis of time sheets alone without the use of a computer, even if it happens to be available, irrespectively of the size of the design office.

33. The real comparison of efficiency and productivity can only be achieved when it is related to market values of the work of the private sector, and therefore in this case to a maximum target figure of £13 580 for salary cost, not allowing overheads to exceed £20 370. The latter is often grossly underestimated in the public sector since it is always provided at public expense, irrespective of efficiency or productivity of the organization.

34. The ACE schedules of charges have been subject to much criticism by commercial clients and local authorities as excessive.

35. In view of all the above I would be pleased to know the Author's own justification of the fee 'yardstick' used and the breakdown of salaries, and the efficiency of the disposition of the technical man power used in the example. In my example the salaries have been deliberately inflated above those paid in average private consultants' offices today.

36. Profit occurs when either (a) total hours are kept below those allowed; (b) overheads are kept low; or both (a) and (b) are kept fairly low. I would also point out that the principal's own salary is also termed as profit for tax purposes, if he is self-employed.

Mr R. H. Rooley, Donald Smith, Seymour and Rooley

I have read with great interest Mr Lane's description of methods which have been used to monitor progress in a large design office. The actual method of monitoring progress appears sound under the given conditions with a number of comments.

38. It is noted that overheads are the difference between income and direct salary costs. The system our group practice uses to monitor performance collates all overhead costs incurred each month in rent, rates, and other disbursements, and apportions them over the projects. There appears a danger in taking overheads as stated in the Note that an excess of expenditure over income (or loss) can be disguised. Overheads do differ from department to department and office to office, so it is not always possible to monitor a sum of overheads plus profit to give a real conclusion.

39. It is noted that on one example the team were close to target on man-hours but salary costs were more than budgeted. This would appear to question, in my mind, the need to differentiate between hours and salary costs. The Author states that delegation should be complete within certain controls. A team leader should be able to use his staff with maximum efficiency using cost measurements. I would conclude from § 13 that performance was not satisfactory.

40. The system put forward appears satisfactory in retrospective project control, but there appears to be a great need for a satisfactory budgeting system against which the historical control can be matched, and in the Note this is quickly dismissed as being notoriously difficult. If notoriously difficult on large projects, how much more so in the normal consulting engineer's practice where there are often a large number of projects of varying sizes.

41. My organization finds that budgeting has to be carried out on a team performance basis, the cost of a team being apportioned as the cost of engineers' salaries, plus a percentage addition for overheads and non-technical staff. A very tight control must be

kept at all times on the ratio between the overheads and technical salaries. The budgeting of a team's performance can then be evaluated on the percentage of income which is likely to be earned by the team during the ensuing 2 years, in 6 month increments. The increment time of half a financial year is convenient in offices with a wide spread of medium and large size projects. Where there are smaller projects it may be necessary to budget on a 3 month period.

42. Experience has shown that to attempt any detailed budgeting system with small cost elements in an office with a large number of projects is costly on administrative time and inaccurate. One of the problems of any such system is accounting for the unseen. The different members of the design team are not necessarily working to a fully integrated programme, and there are always additional duties which have to be accommodated.

43. There appears to be greater need with to-day's large projects, which are processed very rapidly in a design team of varying disciplines, for further study of the role of the project manager; his task is not simply to ensure that dates are met, but that the actions of each member of the team are strictly compatible. Thus, the reduced efficiency and frustrations resulting from haphazard operation are overcome to the advantage of the engineer and, perhaps of greater importance, to the client.

Mr J. E. Gray, Institute Technology Mara, Selangor, Malaysia

Referring to § 7, as I have remarked before it is a shame that in a rich language like English a better word than 'control' is not used for 'control of an individual', referring to delegation.

45. In Chambers dictionary it is defined as 'restraint, authority, command, regulation'; that is, a negative or mechanical connotation. Such a word tends to arouse resentment rather than co-operation when used of people.

46. It is not mere semantics, especially when using English in a specialized and, hopefully, rigorously logical way to insist on words such as 'direction' or 'guidance', even in some cases 'leadership', when 'management' by itself is not sufficient. Even 'under the orders of' is better when this is necessary. If management is to be developed as a subject it is important to get the semantics right. And in its original meaning, to control people is bad management.

Mr Lane

Both **Mr Rooley** and **Mr Smalley** refer to the underlying principles of management information systems, i.e. the method of dealing with overheads and the procedures for establishing targets and estimates.

48. With respect to overheads, there are the two extremes. On the one hand it may be decided that no attempt should be made to monitor actual overhead costs on a project. Therefore at the end of the project or at fixed periods during the design work, overhead costs may be apportioned to that project. This is simple, but it must be realized that it does not, except by chance, give the exact design cost of the job, because overheads vary from project to project as implied by Mr Rooley. Apportionment² *per se* must lead to inaccuracies. At the other extreme attempts may be made to allocate,³ as opposed to apportion, all indirect costs incurred by a project. The more costs which are allocated the more accurate the final analysis, and in the Note a system⁶ was mentioned in which this approach was followed.

49. The procedure described by Mr Rooley is similar to the first of the methods indicated in § 48 and similar to the system described in detail in the Note: similar because this method makes no attempt to find the actual overhead for a project. In the system described in the Note, overhead costs and non-productive time were accumulated within a number of cost centres. Management controlled these figures directly. The figure which is used for monitoring purposes is not the sum of overheads plus profit as suggested by Mr Rooley, but is the direct salary costs incurred in the design.

50. Mr Rooley also states that there is need for only one monitoring parameter, i.e. the salary costs, on the basis that the project leader should only be interested in this. This is quite acceptable but it is only part of the story. If the analysis as illustrated in Fig. 2 was reduced in content in the way implied, then one would only show the salary costs incurred and the design value earned and it would be impossible to complete an analysis of the progress as demonstrated in §§ 11–13. However, the objective of a hierarchy of information reports for more senior management, as described in § 10, give an even greater significance to the earnings per hour of technical staff, the average salary rate and the productivity. Senior management thereby know what is happening on a project without asking the project leader. Therefore the project leader does not need to report to senior management with cost information for a project; this reduces the degree of unnecessary interference and the project leader feels free, with more apparent delegation. Senior management knows automatically of the financial status of each project and only becomes involved in each project when there is real need.

51. The ultimate target for the design team, in both private and public sector is to achieve a satisfactory engineering objective with the maximum economy of resources. The Note addressed itself to the measurement of the latter through measurement of productivity by means of establishing a design value.

52. In the final analysis, the relationship for the private sector design office may be expressed as the maximizing of the difference between income (i.e. design value) and total expenditure on that project, i.e.:

$$\text{Surplus or profit} = \text{fee value} - \text{direct salaries} - \text{overheads} \quad . \quad . \quad . \quad (1)$$

or

$$\text{Fee value (private sector)} = \text{salaries} + \text{overheads} + \text{profit} \quad . \quad . \quad . \quad (2)$$

Productivity is the relationship between fee value and salaries.

53. In the public sector the productivity target is more difficult to establish because there is no real fee value. Both Mr Gorzelany and Mr Smalley refer to this. Mr Smalley suggests that the public body should use the standard fee scales as specified in the model agreements of the consultants. This is an acceptable starting point, but it must be remembered that this is only a small part of setting a target for productivity; the fee scales indicate the income, but what is the justifiable expenditure to earn this income? The position in the public sector might be stated as:

$$\text{Fee value (public sector)} = \text{salaries} + \text{overheads} \quad . \quad . \quad . \quad (3)$$

54. If it is assumed that efficient offices will complete similar designs through use of similar resources, i.e. comparable expenditure for salaries and overheads, then it is apparent from comparison of equations (2) and (3) that fee value (public sector) should be smaller than fee value (private sector). In this sense, Mr Smalley is incorrect to suggest that one should use the simple fee value from the consultants' fee scales. A figure lower than this must be the aim.

55. In this analysis, the real problem, that of estimating, as identified by Mr Smalley, has not been answered. Targets are the end product of estimating. The method of starting from a construction cost, using fixed ratios to obtain fee value from the construction cost and finally taking one third of this cost for staff costs, as suggested by Mr Gorzelany, is a relatively simple method. As an estimating discipline it might at best be described as using business norms or perhaps more accurately a rule-of-thumb procedure.

56. Setting of targets from scales of professional fees is relatively simple and must not be confused with the infinitely more difficult task of estimating which involves identifying all the activities to be completed within each of the phases of the design; forecasting the work content of each of these activities and the type of staff and other resources within this work content; and calculating the cost of such work content. This

real estimate of direct salaries produces a much more difficult goal than that ensuing from fee scales. In comparison the method outlined by Mr Gorzelany is interesting, in that targets are set without any reference to the work content. Methods which do not start from the work content of satisfying the client's brief are not estimating.

57. Working from scales of fees may be difficult, but estimating is infinitely more difficult, and consultants tendering for overseas projects are often faced with the real problem of estimating. Working from scales of fees is common and normally involves little risk because it is based on construction costs which in an inflationary economy result in fees larger than originally forecast. Mr Gorzelany starts from the estimated income and then calculates the number of design hours that this represents. Estimating starts from identifying the design work to be completed and calculating the number of hours and salary costs that this requires. The routine office design scheme will take fewer hours than the norms stated by Mr Gorzelany and the more unusual or difficult schemes greater than average.

58. The weakness of working from fixed fee scales is evident when one comes to percentage complete, as raised by Mr Smalley. The estimates will ensure that all the tasks which are constituents of the design scheme are identified. It is easier thereby to measure with accuracy the percentage completed. Mr Smalley, in his estimating procedure based on fee scales, will have had no need to identify the constituent activities and therefore will have no basis against which to measure progress. Estimating is a prerequisite of good management and is the foundation of the monitoring and control cycle.

59. The implementation of a management system for project control requires the commitment and involvement of all staff, from tracer and draughtsman to senior management. This will ensure that staff will assist in the setting of targets against which their performance will be measured. This will reduce the staff opposition which Mr Smalley has experienced.

60. I agree with Mr Gray that it is important to use language in a rigorous and logical way. However, in § 7 the use of the word 'control' is correct. Mr Gray is wrong to assume that 'control' is synonymous with delegation. In § 7 'control' and delegation are specified as different but related activities. Control includes directing staff and checking that the directions are followed. If Mr Gray is suggesting that one should delegate to staff without giving clear directives and checking that these directives are followed, then this is a recipe for catastrophe. The word 'control' has been used in management for many years and in 1916 Henri Fayol defined management⁷ as comprising five elements, including control. If this is insufficient proof for its inclusion, one might refer to the Shorter Oxford English Dictionary on Historical Principles (1975) in which 'control' is defined as the 'directing and checking of action', the perfect sense in which it is used in § 7.

61. Words should be used because of their general acceptance in a discipline and within that subject they may take a special meaning. The suggestion by Mr Gray that original meanings are the basis of acceptance or rejection appears to be a sensible proposition, but after minor examination it is evident that this approach can have serious weakness. For example, Mr Gray is confident that 'management' is an acceptable word and that management of staff is a commendable objective. The Oxford English Dictionary defines 'management' as 'the use of contrivance for effecting some purpose, often in a bad sense, implying deceit or trickery'. Using the rigorous approach of Mr Gray would mean that the use of the word 'management' would be questioned. This proposition of a rigorous approach is untenable. The use of the word 'management' is perfectly acceptable, not because of its original meaning, but because it has a specific and established meaning within that discipline.

62. It is suggested by Mr Gorzelany that the data presented in the Note are representative of

- (a) a real project
- (b) a project undertaken in a public authority design office.

These assumptions are incorrect. A different rule of life from that to which he refers states that the small print is seldom read; here the small print is in the Acknowledgements. The ideas presented in the Note are based on designing management information systems in the private sector. The data presented are completely fictitious, although the Author as a designer of management aids has had opportunity to examine performance data of design projects in the private sector. Within the Note any similarities to real projects were removed because of the confidential nature of this type of information which reflects the expertise of the practice. The use of fictitious data enables one to concentrate on the principles of management systems. The irregular relationships between design value and construction costs were selected to be quite different from the normal scale of fees, not to illustrate the efficiency of a private or public sector design office but to demonstrate the features and benefits of using management information systems.

Reference

7. STORRS C. *General and industrial management*. Pitman, London, 1949.