Integrating management control and operational control

Eindhoven
University of Technology
the Netherlands

Department of
Industrial Engineering
& Management Science

Integrating management control and operational control

by
Johan J.A. Bakker
Jacques A.M. Theeuwes
Johan C. Wortmann

Report EUT/BDK/14
ISBN 90-6757-013-3
Eindhoven, 1984

INTEGRATING MANAGEMENT CONTROL AND OPERATIONAL CONTROL

by

Johan J.A. Bakker
Jacques A.M. Theeuwes
Johan C. Wortmann

Report EUT/BDK/14
ISBN 90-6757-013-3
Eindhoven, 1984

Eindhoven University of Technology
Department of Industrial Engineering and Management Science
Eindhoven, Netherlands

CIP-GEGEVENS KONINKLIJKE BIBLIOTHEEK, DEN HAAG

Bakker, Johan J.A.

Integrating management control and operational control / by Johan J.A. Bakker, Jacques A.M. Theeuwes, Johan C. Wortmann. - Eindhoven : University of Technology. - (Report / EUT, Eindhoven University of Technology, Department of Industrial Engineering & Management Science ; BDK/14)
Met lit. opg.
ISBN 90-6757-013-3
SISO 366.6 UDC 65.012.7 UGI 540
Trefw.: bedrijfsorganisatie ; controlesystemen / budgettering.

INTEGRATING MANAGEMENT CONTROL AND OPERATIONAL CONTROL

Johan J.A. Bakker

Jacques A.M. Theeuwes

Johan C. Wortmann

TABLE OF CONTENTS

Eindhoven, 1984

INTEGRATING MANAGEMENT CONTROL AND OPERATIONAL CONTROL

ABSTRACT

Budgets are quantified plans, specifying aggregated values for goal variables and intermediate variables. They are agreements as well. As control instruments they should follow the control structure of an organization as closely as possible. This brings the need for integrating management control and operational control, and for integrating decision-oriented and period-oriented control instruments.
In a case study these views are elaborated for a manufacturing department, concentrating on control for the manpower resource.

1.0 INTRODUCTION

Manufacturing firms continue to play a vital role in society. Production departments whithin these firms convert physical inputs into outputs. In most cases several steps are needed, to transfer physical inputs into outputs, using labor and equipment capacity. The finished goods will, ultimately, be sold and converted into cash. Hopefully, some profit is left after all costs have been deducted.

In a previous paper ´) we discussed the distinction between (I) strategic control, (II) management control, and (III) operational control as described by Anthony (1965) and others. As a supplement to these control levels, we distinguished two control types. The first one (type A) focusses on single decisions and actions of a specific decision

´) Bakker, Wortmann & Theeuwes--Participative Development of an Operational Control System (1984) center. Type (A) control is decision oriented. The second type (B) focusses on the aggregated results from decisions and actions, occuring during a certain period of time. Control type (B) is period oriented. The resulting control taxonomy is repeated here in figure 1.

CONTROL TYPE	CONTROL LEVEL (I) Strategic	(II) Tactical	(III) Operational
(A) ACTION TRIGGERED CONTROL - Focus: . individual decisions . individual actions - Occurrence: . ad hoc . intermittent . continuous	(1)	(3)	(5)
(B) PERIOD TRIGGERED CONTROL - Focus: . aggregated results - Occurrence: . periodic	(2)	(4)	(6)

Figure 1. A control taxonomy

In this paper we will concentrate on the second control type (B), more in particular on "box" (6). Both in litterature on budgeting, and in practice, this box seems to be an underdeveloped area. To illustrate our ideas, we will use the same context--a diffusion department for manufacturing integrated circuits--as described in our previous paper. We will plead for an integration of management control and operational control, as far as control type (B) is concerned. Furthermore, at the operational control level, we advocate an integration of information (sub-)systems in support of both control types, taken together. These views boil down to a plea for the integration of all control subsystems, belonging to boxes (4), (5), and (6) in our taxonomy.

In the next section we will elucidate type (A) and type (B) control along the time dimension at level III, the operational control level.
In section 3 budget control, by means of analyzing variances, is explored. In addition, we will redefine the term "budget", in order to give it a somewhat broader meaning than customary.
In section 4 we will give a detailed example as to the use of budgets for controlling input-output performance. This example concerns the input of man-hours, in relation to production-output in the diffusion department mentioned.
A short summary constitutes this paper's final section.

2.0 THE TIME DIMENSION

In Principle any control process is cybernetic by nature. It starts by making plans to reach given goals, objectives, or targets. Actual operations are compared with plans; if performance is unsatisfactory there is some corrective action or a revision of plans. This can be illustrated by figure 2 (source: Anthony & Dearden, 1976).

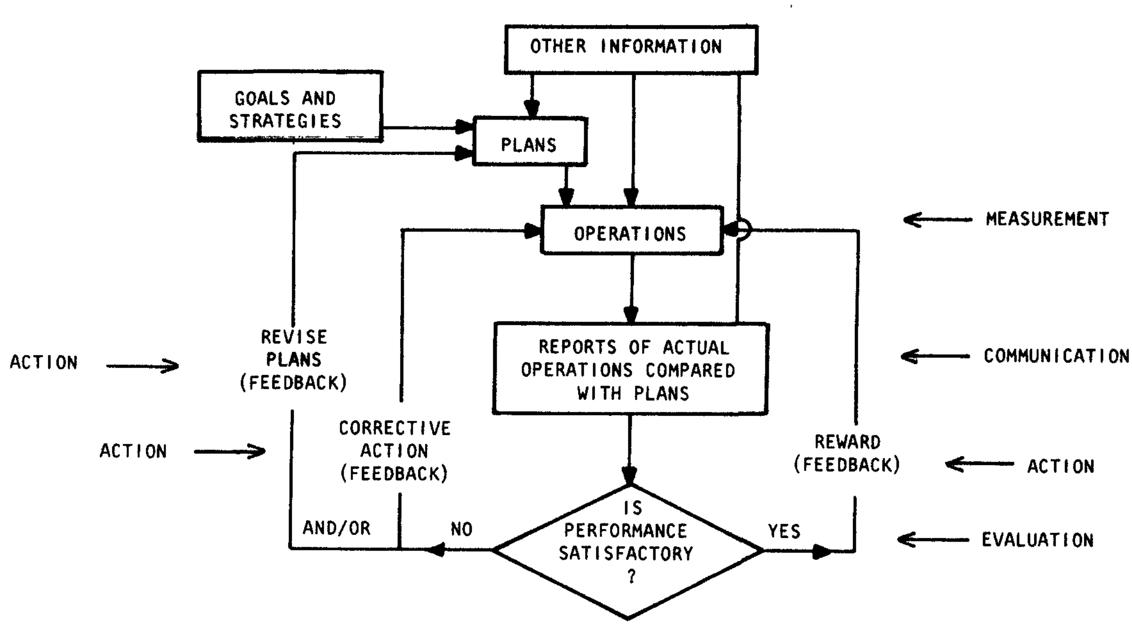

Figure 2. The control process (Anthony & Dearden, 1976, p.102, adapted)

INTEGRATING MANAGEMENT CONTROL AND OPERATIONAL CONTROL

The time-dimension will be discussed now. It is on this dimension that we find a significant difference between production scheduling and progress control (control type A) on the one hand, and traditional budget control (control type B), on the other.
Scheduling concentrates on individual jobs, which have to be completed at given due-dates (the job due-dates). For each operation in the job a planned date for its completion can be determined (the operation due-date).

We define an operation as a set of some given physical transformations, executed by the same person or group of persons. In a job-shop situation these persons have to deal with operations to be performed sequentially or simultaneously on a number of jobs. When reports of actual operations show unsatisfactory performance of a given job, corrective action is aimed at the remaining operations of the same job to be performed during the next period. Thus, in a job-shop situation, scheduling means planning operation due-dates for a collection of jobs, within the context of capacity constraints along the time-dimension. Progress control aims at keeping the deviations between actual completion dates and due-dates within narrow limits. Especially after-due completion is frowned upon.
As representatives from decision-oriented control (type A), scheduling and progress control follow all jobs and the operations thereon from start to finish. This control direction is shown in figure 3.
In contrast to scheduling and progress control, the accent for period-oriented control (type B) at the operational control level is on performance over a certain period. Aggregated performance for individual tasks, and for individual operations, is compared with standards set for the same period. The control direction in this type of control is shown in figure 4. The case illustrated in this figure is, of course, a much simplified one.

At the operational control level, both control types (A) and (B) are concerned primarily with the dimensions

- Quantity (physical units of inputs and outputs)

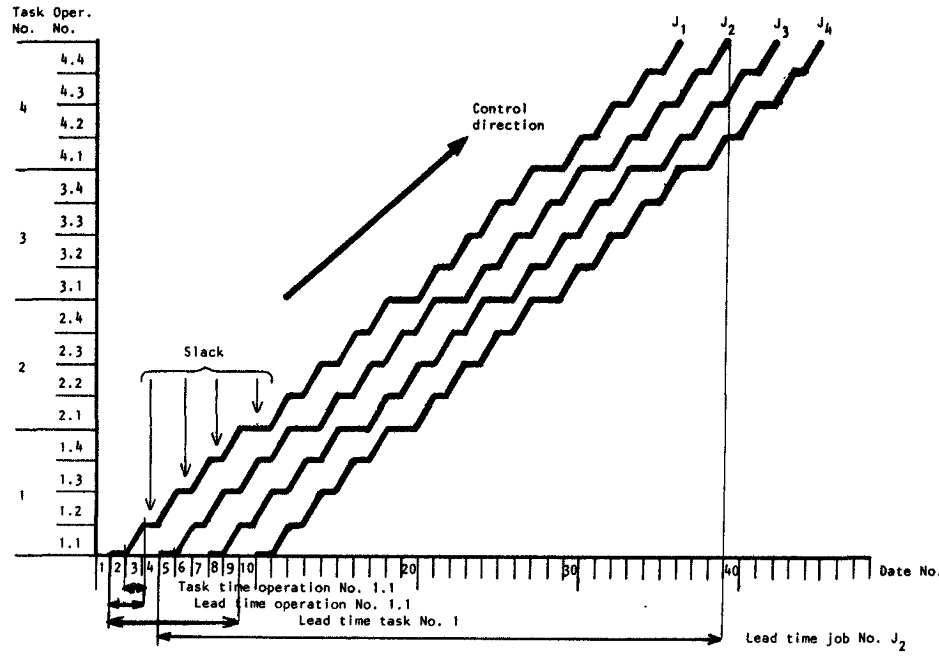

Figure 3. Control direction in scheduling and progress control (Production Control)

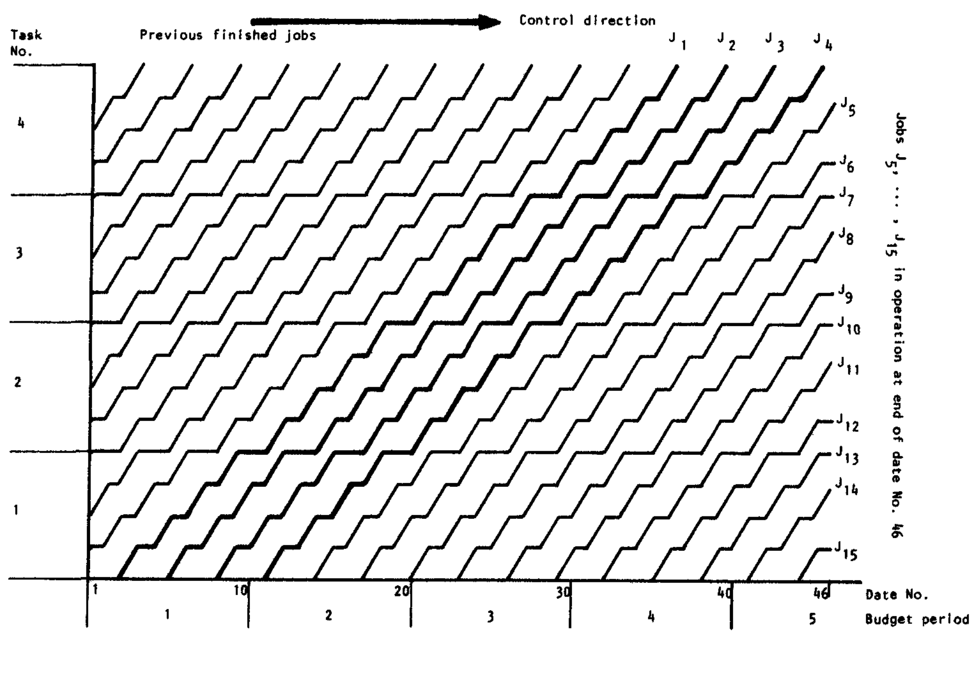

Figure 4. Control direction in budgetary control

- Time (capacity-hours used; lead-times, waiting-times, etc.; completion dates)

- Quality; in our previous paper we gave an example directed at this dimension.

For management control purposes, money as a common denominator is important. At this level, budgets are most commonly used, both for allocating financial resources to departments, and for cost control. Most budgets are assigned for a certain period, usually one year. Therefore budgets are typical instruments for control type (B).

3.0 BUDGET CONTROL

3.1 Traditional budgeting

Traditional budgeting is a method for short-range planning--usually one year. Budgets represent firm commitments by managers regarding their most reasonable plans and expectations of what will occur over the next year (Montgomery, 1979, p. 58). Horngren (1978, p. 148) defines a budget as "a formal quantitative expression of management plans." Budgeting uses to be perceived as an instrument for cost control. This statement implies that plans have to be translated from physical units into monetary terms.

In a traditional budget control system for a production department, agreements are made as to the volume of outputs for a given period of time, and as to the quantities of resources to be used. Demand assessment over this period may be regarded as an agreement: it should not be a mere estimation. Customer departments should commit themselves to "buy" future outputs.

From here on, traditional budgeting concentrates on the usage of resources and the way costs are absorbed by products. The link with organization structure is laid by assigning particular revenues and costs to the centers having the pertinent responsibility (Horngren, 1978, p. 246). By comparing actual costs with the planned costs, information is gathered to enable managers to take actions to correct divergencies. This is the kernel of traditional variance accounting.

3.2 Variance accounting and responsibility accounting

Variance accounting is the conventional management accounting technique for standard costing and budgetary control, as opposite to direct costing or marginal costing (Hart, 1981). It is associated with the "Absorbtion-Costing Method" (cf. Horngren, 1978, pp. 458 ff.). The technique may be described as follows:

> ". . . the planned activities of an undertaking are expressed in budgets, standard costs, standard selling prices and standard profit margins, and the differences between these and the comparable actual results are accounted for. Management is periodically presented with an analysis of differences by causes and responsibility centres, such an analysis usually commencing with operating profit variance. The technique also includes the establishment of suitable arrangements of accounts in the principal ledger--either in the general ledger or the cost ledger." (Laidler, 1976, p.13).

Traditional variance accounting translates actual inputs and outputs in monetary units, and compares them with budgets. Variances are analyzed to separate

- Price-variances for inputs and for outputs
- Efficiency-variances, i.e. the financial results, generated when actual quantities of direct inputs diverge from the corresponding standard-quantities for the output-volume produced
- Overhead variances:
  - volume variances or denominator variances, i.e. the financial results attributed to output volumes higher or lower than budgeted. They are the "conventional measure of the cost of departing from the level of activity originally used to set the overhead rate." (Horngren, 1978, p. 462)
  - variances in fixed-cost levels, due to price changes, etc.

Following the absorption principle, Laidler (1976, pp. 113 ff.) breaks down operating profit variance under at least fifteen headings; many of them broken down still further. In addition to the analyses of variances in relation to standard costs, Tilanus & Theeuwes (1976, p. 152) distinguish

> "two stages, a short and a long term. Standard costs are esta-

blished in the long term, based on production circumstances and price structures that are considered normal, and investment and other strategic decisions are based on them.

. . . in the short term, tactical considerations play a part and circumstances change. Short-term budgeted costs may differ from long-term standard costs, even if both are conceived as flexible budgeting curves rather than fixed amounts."

In practice costs are regarded to be either "variable", i.e. output-volume dependent, or "fixed". To calculate "variable" labor costs, direct labor hours have to be multiplied by some calculated hourly rate. Reports on variances may be used in the so-called <u>responsibility accounting</u>. For this purpose, "Ideally, particular revenues and costs are recorded and automatically traced to the one individual in the organization who shoulders primary responsibility for the item." This idea forms the basis for the so-called responsibility accounting. (Horngren, 1978, p. 246) "In practice, however, the diffuse of control throughout the organization complicates the task of collecting relevant data by responsibility centers." (ibid.). Laidler (1976, p. 47) remarks, "It is impracticable to apply a set of rules whereby the only costs chargeable to a budget centre are those fully controllable by the person in charge."

In most accounting systems, at least some overhead costs are apportioned to the rates for direct labor hours. The decision centers controlling these overheads, usually have a higher hierarchical level in the organization's structure. Still, managers of a manufacturing department are held accountable for budget variances as reported by the accounting department. In addition, apportioning rules, and calculation methods, are often quite complex; the calculation models do not always reflect the relationships as dictated by the technological structure of the manufacturing processes. No wonder that this type of management accounting reports make little sense for controlling operations within a single department. Hofstede (1976, p. 12) reports for a company where budget variances were reported as above, "In the particular company studied, none of the first or second line management receivers of the budget variance reports were able to explain the difference between volume and other variances."

The problem here is that variance accounting mixes up two concepts:

- Costs apportioning, aiming at the computattion of standard-prices for products, and
- control, aiming at improving the company's future performance.

Neither for cost-apportioning nor for control purposes a break-down of overhead costs at the operational level is required.

3,3 Budgets redefined

From now on we will use the term budget control at the level of management control as well as at the operational control level. Furthermore, we will abandon the one-year period, and use the term budget for longer or shorter periods too. Thus, the term budget control becomes synonymous for control type (B) as a whole.

We define a budget as any quantified plan specifying values for all goal variables and intermediate variables, aggregated over a certain period of time. This plan has to be accepted by the parties involved; therefore, it should be regarded as an agreement. Among the variables stated in such an agreement, output targets (goals) and necessary inputs (means) usually take a dominating position.
For management control purposes, i.e. for allocating resources and for the "delegation of responsibility", the plan may be translated in monetary terms. The department manager gets the authority to use these resources, and is held accountable for reaching the planned efficiency, i.e. the budgeted input-output relation. Usually the latter relation plays a major role in the standard costing system as well. In contrast to cost accounting, which aims at allocating costs to products, "responsibility accounting" should follow the control-structure as closely as possible.

3.4 Budgeting for operational control

A budget system for operational control demands specification of plans and performance at task-level, maybe even at the level of operations. For every task, all inputs required for a certain output should be assessed in physical quantities. Not only the quantities, but also the quality aspect(i.e. the values of quality parameters), and the timing of outputs per task, should be specified and monitored. Furthermore, other parameters which may affect these variables, should be prognosticated. Later on, actual values of these parameters should be compared with their forecasts, in an effort to analyze variances between actual and budgeted input-output ratios.

A budget system as described above, could be an important tool for operational control. Its purpose should be to inform both the department management and its subordinates about relevant variances, and assisting them in finding possible causes like

- a faulty decision procedure to correct activities,
- incorrect information as an input in past decisions
- tasks which are not carried out as intended.

Ideally all persons involved, managers as well as subordinates, should be provided with all information that is both necessary, and sufficient, for their control tasks and for self-control.

Conversion of physical quantities into monetary terms may be useful for management control purposes, especially for allocating resources to various departments. For operational control, monetary terms are of limited value. In order to make the department's functioning optimal in an economic sense, a control structure with variables, expressed in <u>physical terms</u> is necessary.

When alternatives are comparable in monetary terms only, conversion into these units is unavoidable. In those cases, care must be taken to use rates by which only the financial consequences, due to each individual alternative, are made visible. This means in particular that apportioning overhead costs should be avoided. Most costs are actually fixed during a certain period of time; the length of these periods depends on the type of costs involved. For machine costs, such a period may be related to the time needed to effectuate an investment decision, for labor costs to the time needed for hiring or firing personnel. Solely costs of raw materials--in most cases--may be regarded as really variable.

For decision making, only those costs should be taken into consideration, which are variable in the lead time that elapses between the moment the decision is made, and the moment its effect vanishes. This holds true for decision-oriented control as well as for period-oriented control (type B), be it management control or operational control. Thus, traditional variance accounting should be regarded as a questionable basis for proper decision making.

It will be clear by now, that a budget system which meets all requirements for both operational control, and management control, might be quite complex. It must follow production tasks and the department's decision structure very closely. As suggested by figures 3 and 4, there is a strong interconnection between scheduling and resource management. Furthermore, quality control is closely linked with the utilization of resources. Hence, it is desirable to integrate all information subsystems which support the activities mentioned here. The budget system should be embodied in this integration. As a further development these subsystems and the underlying data may be incorporated in a decision support system.

3.5 Some further thoughts on budgeting

As stated, a budget should be an agreement. In this agreement, parties controlling intermediate and/or goal variables, commit themselves upon attaining values for these variables as specified in the plan. This agreement is binding, provided uncontrollable variables remain within limits as stated in the plan.

In order to make up the basis for a budget, agreements have to be consistent with reasonably expected values for uncontrollable variables. All ex ante values specified in a budget--controllable as well as uncontrollable--should be confronted with their actual ex post values. To explain variances, detailed information should be available about decisions made, and about all circumstances which might be relevant to actual outcomes. Analyzing variances thus becomes a <u>learning experience</u>.

The process of budgeting encompasses the whole cycle: budget preparation--reporting--analyzing variances--corrective action--budget preparation for the next period--and so on. Within a budget period, decisions are made upon controllable variables to effectuate the agreements. These decisions may be operational by nature, they also may take the form of new agreements within the scope set by former agreements. The latter agreements, in turn, become the basis for shorter term budgets within the former budgets.

The plan and agreements on which a shorter term budget was based, will have to be revised (cf. figure 2) when corrective action is not possible, although performance is regarded as unsatisfactory in relation to the longer term budget. Shorter term agreements and shorter term budgets then are based on these revised agreements. Therefore, when comparing actual ex post values with longer term budgets, the following procedure is advisable: make first in-between comparisons by confronting the longer term budget with the corresponding figures in the short term budgets; then confront the most recent short term budget with actual ex post values.

Preferably variables in budgets are expressed as numerical values. As can be seen from the quality control example in our previous paper, some variables hardly can be quantified. Nevertheless, a goal variable like "quality of operations" could be translated in terms of rejection rates. For an intermediate variable, like "machine functionning" targets could be set for down time, mean time between failure, maximum variance in product-tolerance, etc.
The example also showed that, in many cases, the distinction "controllable" vs. "non-controllable" is not a sharp one, as there may be a continuum between the two extremes. Moreover, actual values for controllable variables may result from joint decisions, made by different persons or groups. Moving to the intermediate and goal variables, the number of decision types influencing the outcomes, may increase. Nevertheless, for <u>each</u> variable a person, or a well-defined team, should have the "prime responsibility" for the agreements made, as well as for actual outcomes. Preferably such teams should be small; when responsibility is dispersed over many persons, the task structure may need a redesign!

We now will limit our attention to budgeting with regard to <u>performance</u>.Performance in our terminology is an input-output relation; it encompasses both effectiveness and efficiency.

effectiveness--as we see it--is the realized extent of compliance with agreements made for the budget period analyzed. effectiveness has as many aspects as explicitely or implicitely are covered by the agreements made. Some of the most important aspects will be the technical quality of products and due-data-performance.
Efficiency is an input-output relation, defined here as getting a given output with a given quality, while minimizing resources. Stated the other way round: efficiency is getting a maximum output with a given quality, using a given quantity of resources.
Effectiveness prevails over efficiency, i.e. the significance of any efficiency measure relies upon the extent to which effectiveness measures have been met.

4.0 MANAGING OPERATOR CAPACITY

4.1 Introduction

In this section we will illustrate our ideas on budgeting for performance control by concentrating on the efficiency-aspect of manpower utilization in a diffusion department. This department was described in greater detail in our previous paper. A short recapitulation follows here.

> In the department integrated circuits (I.C.´s) are manufactured in a great number of types. The manufacturing process takes place in batches; each batch comprises a number of identical silicium slices. Each finished slice contains several hundreds of identical I.C.´s. Manufacturing takes well over one hundred operations in a typical job-shop situation. There is only a very limited number of different process-sequences, each sequence being called a different "process". Within each process a nearly unlimited number of I.C.-types may be produced.
> The average batch flow time for a whole process is about five weeks. Thus, on average, four to five operations have to be done each day on every batch.
> Many operators have multi-task capabilities, i.e. they can be allocated to a number of different working stations.

4.2 Man-hour management

The term man-hour management is used here with regard to both the allocation of manpower to the department as a whole (management control), and the allocation of manpower to specific work-centers within the department (operational control). In both cases man-hour management is used as a means for efficiency control. Because operator capacity in this department is a bottle-neck resource as compared with equipment capacity, efficiency control narrows down to man-hour-management.
Within a one year period man-hours should be regarded as the main input to be controlled. In the monthly agreements, attention is focussed on the following issues:

a. Attuning manpower to expected demand for physical output (planning horizon at least three month)

b. Monthly reconciling customer demands and expected available manpower.

These issues require agreements between the diffusion department and the material managements department which acts as the "customer" for finished I.C.´s. Agreements also have to be made with other production departments, regarding the allocation of manpower to the diffusion department (decision a). In order to meet demands, as specified in the monthly agreement (decision b), disturbances within the diffusion department have to be dealt with, available manpower has to be allocated to work-centers, etc. Consequently, managing operator-hours is one of the main tasks for the department management.

Besides efficiency, maintaining short and reliable batch flow times is another ultimate goal variable. In order to obtain satisfactory performance with regard to the latter goal, capacities are not loaded up to 100%, but only up to a lower level, viz. a predetermined "capacity loading limit" (C.L.L.). This method is used for operator capacity as well as for machine capacities.

In daily operational control activities, attention is focussed on the operations on batches. Besides these "direct" tasks, there are other tasks to be performed by operators. Among these are operator-tasks, such as daily starting-up of equipment, weekly small equipment-maintenance, etc. Capacity needed for these tasks is nearly independent of the number of batches handled, and may be regarded as fixed. Furthermore, operators have to be trained and instructed to improve their multi-task capabilities. Training and instruction consume part of the available operator capacity but--in the short run--these may be postponed.

For all operations on batches there are fairly accurate standard task times. For the periodic operator-tasks like starting-up of equipment etc., there are standard task times as well. These tasks, like training, may be planned. However, because of absenteeism, turn-over, etc., operator availability is only partially controllable. In the agreements mentioned, and in the budgets derived from these agreements, estimated values as to operator availability should be taken into account.

Operator-hours are not the only hours to be managed. Just as in most production departments, several tasks are performed by staff personel other than operators. The amount of work to be done at this level is nearly independent from demand for physical output. Methods and procedures for these tasks should be evaluated critically, but here an evaluation once a year should be sufficient, unless there are special problems to be solved. In the shorter run, staff capacity, as well as staff-hours required, may be treated as fixed.

4.3 Man-hour budgeting

To support man-hour management, budgets should be prepared for all decision horizons mentioned. The budgeting process is depicted in figure 5 by numbers 1 to 9.

1. A year budget, stating expected demand and output in physical terms is prepared. The agreed output level is "translated" into the capacity needed for the production of the required output by means of standard task times of operations.

2. Operator capacity, to be allocated for "direct" tasks, is derived from standard task time needed, by taking into account the capacity loading limits for each work-center.

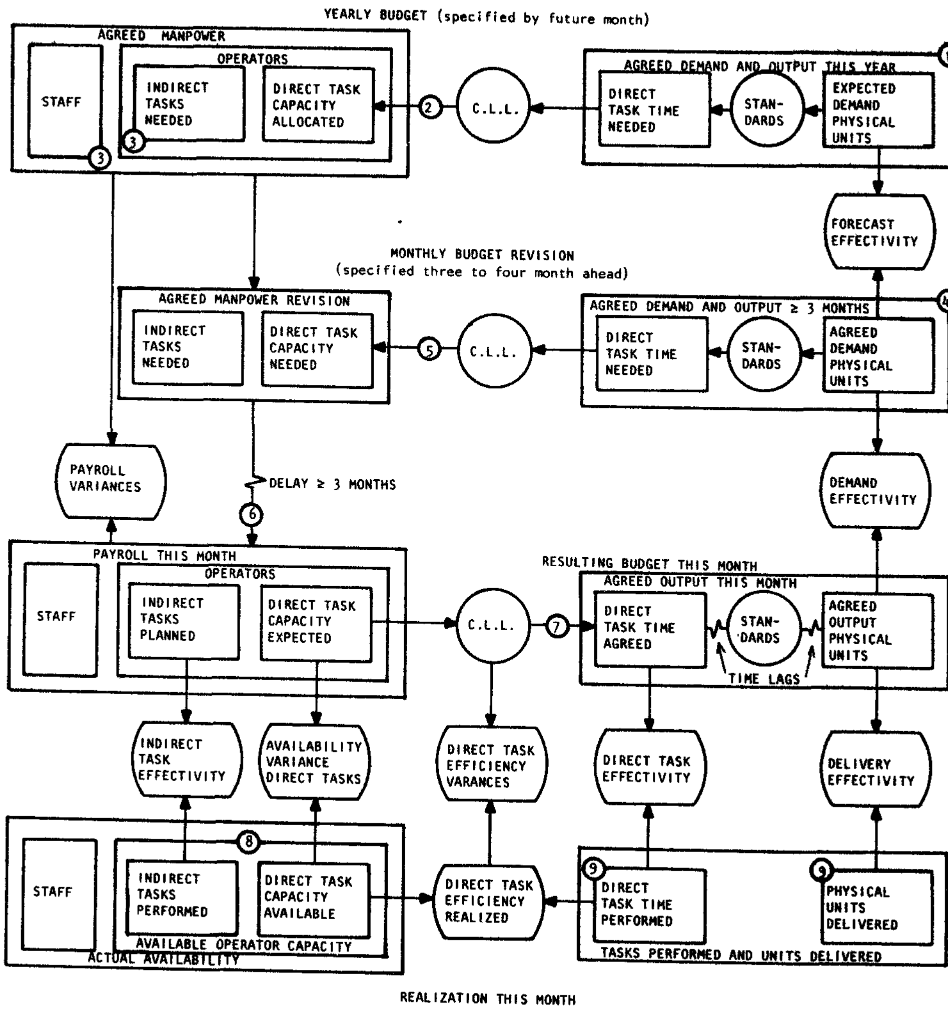

Figure 5. The man-hour budgeting process

3. Man-hours needed for other operator tasks, and for training, etc., are quantified. Expected absenteeism is assumed to be given, so now the number of operators needed can be calculated. Taking into account expected operator turn-over, a plan for hiring and training new operators during the forthcoming year, can be made. Agreements are also made upon the number of staff personnel needed.

It will be clear that the agreed number of operators and staff should be identical to the corresponding figures, used by the accounting department in preparing the yearly financial department budget, but from here on, man-hour budgeting takes its own course.

INTEGRATING MANAGEMENT CONTROL AND OPERATIONAL CONTROL

In preparing shorter term budgets, i.e. the monthly agreements of the production level, deviations from earlier expectations are analyzed. Moreover, monthly actual outcomes are confronted with the corresponding latest estimates. When analysing deviations, it should be kept in mind that agreements--being the bases for all budgets--always have to be regarded as <u>conditional</u> agreements. The implicit condition is, that uncontrollable variables will be in the same order as expected when the agreements were made. Subsequent decisions will be aimed at meeting agreements in the best possible way, but agreements will have to be revised whenever uncontrollable variables differ substantially from former estimates. The monthly made budgets are most important, because they constitute the connection between the year budget at the one hand, and operational day to day decisions on the other.

4. A new demand estimation, three to four months ahead, is made each month as basis for a revolving budget. The accuracy of the previous yearly estimation is tested, leading to a "forecast effectivity"

5. Revisions in the agreed number of operators are calculated in the same way as explained for the yearly budget. Under normal circumstances the number of staff personnel is regarded as "fixed"

6. The revised year budget for operator capacity is the basis for decisions for hiring and training new operators. Because of the lead-times involved, new personnel will be available about three months later

7. Available operator capacity for the coming month being given--setting aside uncontrollable fluctuations in absenteeism--agreements are made with regard to the output for this month. Output is specified here <u>both</u> in physical units (the number of slices to be finished per type during the month) and in direct operator hours, i.e. the sum of the standard task times needed for the tasks to be performed during the coming month. The latter value, of course, should be consistent with the expected available operator capacity, taking into account the capacity loading level (C.L.L.)
   Comparing the agreed output with earlier demand expectations, leads to a notion of what we have called "demand effectivity". In our

opinion, the material management department--the customer--should be committed by previous demand expectations, on which the actual hiring and training of operators was based.
Man-hour management from day to day is supported by the production control and scheduling system (boxes (3) and (5) in our control taxonomy--cf. figure 1). For day-to-day management, box (6) is "empty". Monthly realizations however, are compared with budgets

8. Actual manpower available is compared with actual payroll. Variances may be ascribed to fluctuations in absenteeism, turn-over, etc. Up to a certain degree, by shifting from "indirect" tasks, the capacity available for "direct" tasks, may be safeguarded and vice versa. This leads to some measure of "indirect task effectivity" and a resulting "availability variance for direct tasks"

9. Operating tasks, performed during the previous month, are multiplied by corresponding standard task times; so performance is measured as "standard task hours performed". Under normal circumstances it may be expected that direct task efficiency realized--i.e. the ratio between standard task hours performed and capacity available for direct tasks--is in the same order as the capacity loading limit for direct operating tasks. This comparison leads to a measure for direct task efficiency variances.
By comparing direct task hours performed in a given month, and agreed output for the same month, expressed as operator hours to be performed, one gets the "direct task effectivity" as the extend to which the agreed operator effect has been realized. At the physical output side, the "delivery effectivity" pertains to the quantity, the quality and the timeliness of the slices completed during the month.

Let us summarize the performance-indicators developed above, and depicted in figure 5. These are:

- Forecast effectivity, i.e. demand volume as expected in the yearly budget vs. the demand volume used as a basis for hiring and training new operators

- Demand effectivity, i.e. the latter demand volume vs. the agreed volume as expressed in the "customer-order" for the coming month
- Payroll variances, i.e. manpower envisaged in the yearly budget vs. actual payroll this month
- Delivery effectivity, i.e. "customer-order" vs. physical units delivered. Variances here are measured on two dimensions: the volume and the timelyness of deliveries
- Direct task effectivity, i.e. standard task hours performed this month as compared to the standard task hours mentioned in the agreement with the customer-department
- Indirect task effectivity, i.e. indirect tasks performed in relation to planned activities
- Availability variances for direct tasks, resulting from fluctuations in absenteeism, shiftings from indirect tasks, etc.
- Direct task efficiency variances, i.e. the ratio between standard task hours performed this month and available capacity, as compared with the normative capacity loading limit.

None of these indicators can be found from traditional variance accounting. Yet they are very useful for budget control. Translating some performance indicators into monetary terms may be interesting for management control decisions, for operational control purposes such a translation may be harmful, as it hides more than it reveals.

Analyzing deviations between ex post values and agreed values of the performance-indicators will be easy in many cases. However, sometimes, in order to explain significant deviations, underlying detailed information over day-to-day disturbances and measures taken should be consulted. Here the budget system gets its real signal function for which it was intended, because now consequences of prior actions become visible in a more aggregate form than in day to day routine.

5.0 SUMMARY AND CONCLUSIONS

Budgeting for operational control is an underdeveloped area, both in litterature and in practice. Budgets are widely used for cost control and the allocation of resources at the management control level. Variance accounting generates reports on deviations from standard costs. Ideally discrepancies are traced to departments and individuals. However, in most firms this ideal for the so-called responsibility accounting is not practiced in full. Lower level managers do not understand the reports issued by accounting departments.

We defined a budget as any quantified plan specifying aggregated values for goal variables, and for intermediate variables, over a certain period of time. The period length may be chosen such that most stochastic influences at this aggregation level are filtered out from the variances between budgets and performance, and only trends remain. According to the decisions involved, the period length may be as much as four years (for long term investments), it may be the conventional one-year period, or it may be as short as one month or even one week.
By using this broad definition, we abandon the idea that all budgets should be stated in financial terms.

Budgeting concentrates on the aggregate results from decisions and actions during a period. As a control instrument it is most useful for decisions and actions which are more or less repetitive by nature. It differs from scheduling and progress control at the operational level in its "control direction": budgeting is oriented at the overall task performance during a certain period; scheduling and progress control aim at individual job streams.

In its broader sense, budgeting may be a useful tool for operational control. The management at this level is accustomed to think in physical events and in physical quantities. Following the goal structure and the control structure along this dimension is relatively easy as compared to the translation into "costs".
The control structure is the basis for delineating responsibilities. Thus, at the level of operational control "responsibility reporting" in physical terms will be much easier than traditional varience accounting at this level. Nevertheless, the reporting system may be quite complex if it has to cover separately all variables that have to be controlled.

INTEGRATING MANAGEMENT CONTROL AND OPERATIONAL CONTROL

For management control purposes and, more in particular, for allocating financial resources to the various departments within a firm, physical units have to be translated into their common denominator money. However, the budget system as a whole should be consistent. For this reason budgets for management control should be based on the same data as the budgets for operational control.

A budget may be seen as a set of agreements; each agreement has to be made by a person or a well defined team. Those persons shoulder the responsibility for bringing about the outcomes as agreed upon. A special category of agreements refers to future performance, i.e. effectivity and efficiency pertaining to inputs and outputs. In a manufacturing environment the most important resources are manpower, materials, and equipment.

To illustrate our ideas on the integration of budgeting for both management and operational control, we elaborate a detailed example where "man-hour budgeting" at the operational level was embedded in, and seen as an extension from, the conventional yearly budget.

The budgeting process as a whole encompasses budget preparation, reporting, analysing variances, and corrective action. This process may take place at a number of time-horizons, in our example one year, three months, and one month respectively. Agreements regarding the allocation and the use of manpower were grouped according to these period lengths.

Apart from being an instrument for the allocation of resources, a budget system has a signal function, i.e. it indicates consequences of prior actions, and thus it may mark possible problems. In the latter case more, and detailed information will be needed to analyse and to solve those problems. But from here on the skill and the creativity of all persons involved become the paramount factors.

BIBLIOGRAPHY

Anthony, R.N., Planning and Control systems (Harvard University, 1965)

Anthony, R.N. & J. Dearden, Management Control Systems, Text and Cases--3rd ed. (Irwin, Homewood, Ill., 1976)

Dearden, J. Cost Accounting and Financial Control Systems (Addison-Wesley, Reading, Mass., 1973)

Bakker, J.J.A., J.C. Wortmann & J.A.M. Theeuwes, Participative Development of a Budget System for Operational Control, E.U.T. Report, Eindhoven (1984)

Hart, J., A Review of Some Recent Major Developments in the Management Accounting Field, Accounting and Business Research, Spring 1981, pp. 99-115.

Hofstede, G., People and techniques in budgeting (In: C.B. Tilanus, ed., Quantitative methods in budgeting (Martinus Nijhoff, 1976)

Horngren, C.T., Introduction to Management Accounting, fourth ed. (Prentice/Hall, London, 1978)

Laidler, E., Variance Accounting (The Macmillan Press, London, 1976)

Montgomery, A.T., Managerial Accounting Information, (Addison-wesley, Reading, Mass., 1979)

Tilanus, C.B. & J.A.M. Theeuwes, Variance analysis, flexible budgeting and responsibility accounting (In: C.B. Tilanus, ed., Quantitative methods in budgeting, Martinus Nijhoff, Leiden, 1976)

EINDHOVEN UNIVERSITY OF TECHNOLOGY /
DEPARTMENT OF INDUSTRIAL ENGINEERING AND MANAGEMENT SCIENCE /
RESEARCH REPORTS

EUT/BDK/1 Internal rate of return - an investment decision criterion of full applicability **Mirosław M. Hajdasinski**

EUT/BDK/2 A portfolio approach to the capital budgeting decisions **L.A. Soenen**

EUT/BDK/3 Patient scheduling: A review **R.J. Kusters**

EUT/BDK/4 Researchinspanningen, technische innovatie en werkgelegenheid: Een internationaal vergelijkende studie door middel van research-indicatoren **P.W. Huizenga, C. Botter**

EUT/BDK/5 Investeren in flexibele produktie-automatisering **H.J. Hagenberg**

EUT/BDK/6 Diagnosemethoden; vraag, aanbod en kwaliteit: Een interpretatieve inventarisatie **H.G. Schotman**

EUT/BDK7 De bruikbaarheid van ontwikkelingsmodellen voor management en advisering **H.G. Schotman, R. Vonk**

EUT/BDK/8 Het functioneren van HBO-verpleegkundigen in de praktijk van de gezondheidszorg **B.Th.M.M. Pieterse, J.A. Verwey**

EUT/BDK/9 Technische processen, procesbeheersing, ontwerpkaart **H.H. van Mal, F. Kools, E.J. Hekma**

EUT/BDK/10 Variatie in onderwijsvormen binnen probleemgestuurd onderwijs: Evaluatie van een experiment **E. de Graaff, R. Mercx**

EUT/BDK/11 The cost of downtime for maintenance: Preliminary considerations **W.M.J. Geraerds**

EUT/BDK/12 Production and inventory control with the base stock system **J.P.J. Timmer, W. Monhemius, J.W.M. Bertrand**

EUT/BDK/13 Participative development of a budget system for operational control **Johan J.A. Bakker, Johan C. Wortmann, Jacques A.M. Theeuwes**

EUT/BDK/14 Integrating management control and operational control **Johan J.A. Bakker, Jacques A.M. Theeuwes, Johan C. Wortmann**

EINDHOVEN UNIVERSITY OF TECHNOLOGY /
DEPARTMENT OF INDUSTRIAL ENGINEERING AND MANAGEMENT SCIENCE /
RESEARCH REPORTS

EUT/BDK/1 Internal rate of return - an investment decision criterion of full applicability **Mirosław M. Hajdasiński**

EUT/BDK/2 A portfolio approach to the capital budgeting decision **L.A. Soenen**

EUT/BDK/3 Patient scheduling: A review **R.J. Kusters**

EUT/BDK/4 Researchinspanningen, technische innovatie en werkgelegenheid: Een internationaal vergelijkende studie door middel van research-indicatoren **P.W. Huizenga, C. Botter**

EUT/BDK/5 Investeren in flexibele produktie-automatisering **H.J. Hagenberg**

EUT/BDK/6 Diagnosemethoden; vraag, aanbod en kwaliteit: Een interpretatieve inventarisatie **H.G. Schotman**

EUT/BDK/7 De bruikbaarheid van ontwikkelingsmodellen voor management en advisering **H.G. Schotman, R. Vonk**

EUT/BDK/8 Het functioneren van HBO-verpleegkundigen in de praktijk van de gezondheidszorg **B.Th.M.M. Pieterse, J.A. Verwey**

EUT/BDK/9 Technische processen, procesbeheersing, ontwerpkaart **H.H. van Mal, F. Kools, E.J. Hekma**

EUT/BDK/10 Variatie in onderwijsvormen binnen probleemgestuurd onderwijs: Evaluatie van een experiment **E. de Graaff, R. Mercx**

EUT/BDK/11 The cost of downtime for maintenance: Preliminary considerations **W.M.J. Geraerds**

EUT/BDK/12 Production and inventory control with the base stock system **J.P.J. Timmer, W. Monhemius, J.W.M. Bertrand**

EUT/BDK/13 Participative development of a budget system for operational control **Johan J.A. Bakker, Johan C. Wortmann, Jacques A.M. Theeuwes**

EUT/BDK/14 Integrating management control and operational control **Johan J.A. Bakker, Jacques A.M. Theeuwes, Johan C. Wortmann**