

# INFORMATION SYSTEMS: A FRAMEWORK FOR DEVELOPMENT



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*In hierdie artikel word die konsep van 'n bestuurstruktuur ontwikkel. Die interafhanklikheid van beplanning en beheersisteme, inligtingsisteme en bestuurstruktuur word geïllustreer en daar word aangetoon hoe die bestuurstruktuur gebruik kan word as 'n verwysingsraamwerk vir die ontwikkeling van bestuursinligtingsisteme.*

*Die konsep van bestuurstruktuur verteenwoordig die resultaat van beide teoretiese en empiriese navorsing in die ontwikkeling van bestuursinligtingsisteme in Suid-Afrikaanse nywerhede wat oor 'n aantal jare onderneem is. Alhoewel die navorsing aanvanklik slegs in nywerhede onderneem is, is die normatiewe bestuurstruktuur as riglyn vir die ontwikkeling van beplanning, beheer en inligtingsisteme met groot sukses reeds in mynweese, finansiële instellings, distribusie-organisasies en in professionele diensorganisasies gebruik.*

Can formal information systems needed in an organisation be identified? What are their characteristics? Can they be classified in some logical manner? And finally, can such a classification serve a useful purpose from an information systems development point of view?

Anyone who has been deeply and seriously involved in information system development has repeatedly sought answers to these crucial questions. In the subsequent paragraphs such an attempt is made, followed by a proposal for a framework which can serve as a guide for the development of formal information systems within an organisation. The framework is developed in three stages:

- Firstly it is recognised that formal information systems support, primarily but not exclusively planning and control systems. Planning and control systems should therefore be analysed, their characteristics established and finally they should be classified in some manner that will facilitate the classification of the information systems that support them.
- Secondly, once organisational planning and control systems have been classified, the characteristics of the information systems supporting them need to be identified.
- The third and final stage is in many respects the most important, and yet the most neglected in both theory and practice. Planning and control responsibilities are vested in individuals. The planning and control responsibilities implicit in the various planning and control systems have therefore to be related to the various levels of management which are responsible, i.e. to the organisational hierarchy. The final stage of development is the analysis of the management structure of the organisation

and is in effect, a model reflecting the above relationships.

## PLANNING AND CONTROL SYSTEMS

Planning and control is only part of a manager's task and therefore managerial involvement in planning and control at various levels can only be analysed in relation to their total task.

The first division of managerial time is illustrated abstractly in figure 1 and illustrates that management both operates and manages.\* It also illustrates that top management spends relatively less time in operating than in managing than does supervisory management.

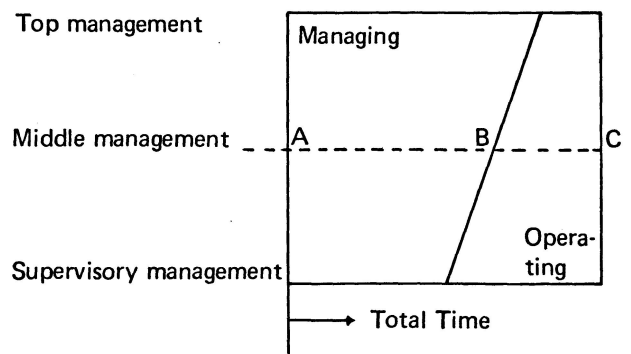


FIGURE 1

\* If the sales director of a motor manufacturer negotiates a franchise with a national dealer he is operating, not managing.

The second division is within the managing function itself. Although the managerial function comprises numerous components it is possible to group all of these components into two broad functions. These are the function of planning and control and the function of activating. This division is illustrated abstractly in figure 2 and indicates that top management spends relatively more time on planning and control than on activating than supervisory management. Conversely supervisory management spends relatively more time on activating than on planning and control than top management.

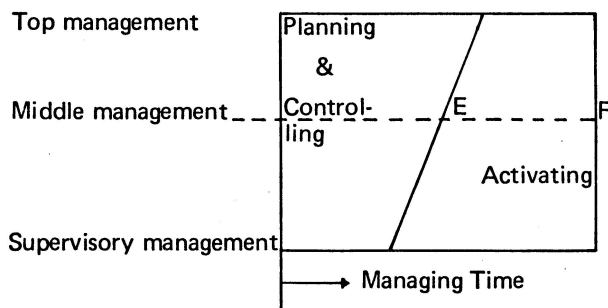


FIGURE 2

Having broken down a manager's time into the three broad categories of operating, activating and planning and control we can now proceed to analyse their planning and control responsibilities.

We will first look at planning and control systems.

A lot of work has been done and a lot has been written about the classifications of organisational planning and control systems. From a practical systems development point of view none is more appropriate than the work done by Robert N. Anthony<sup>1</sup> where he distinguishes between three types of planning and control systems, i.e. strategic planning, management planning and control, and operational control. The characteristics that distinguish the systems from one another are analysed by Anthony in detail, and are reflected in his definitions presented in the box.

**STRATEGIC PLANNING:** "Strategic Planning is the process of deciding on the objectives of the organisation, on changes in these objectives, and on policies that are to govern the acquisition, use, and disposition of these resources."

(Anthony, p. 24)

**MANAGEMENT PLANNING AND CONTROL:** "Management control is a process by which managers assure that resources are obtained and used effectively and efficiently in the accomplishment of the organisation's objectives."

(Anthony, p. 27)

**OPERATIONAL CONTROL:** "Operational control is a process of assuring that specific tasks are carried out effectively and efficiently."

(Anthony, p. 69)

We are here primarily interested in the information systems that support these three types of planning and control systems. The result is that the characteristics that are emphasised and the differences that are highlighted, differ from those of Anthony. The analysis involves reading more into Anthony's classification of planning and control systems that was explicitly illustrated by him, and is in a sense an elaboration of his work.

Strategic planning deals with change in an organisation's resource and product market structure. The objective of the systems is therefore to assure growth and survival over the relatively long term, that is longer than, say three years, in the face of rapidly changing technology, products and markets.

The system is therefore characterised by

- the continuous search for opportunities both external and internal
- the continuous identification of threats internal and external to the organisation
- project and/or feasibility studies to guide investment decisions, primarily relating to opportunities and disinvestment decisions primarily relating to threats.

Management planning and control deals with the effective and efficient use of resources within the existing resource and product-market structures. The objective of the systems is to achieve results, i.e. sales volume, market share, profits, profitability, etc. which have been quantified as objectives in the relative short term, e.g. one month to about three years, in the face of an uncertain and often hostile environment.

The system is therefore characterised by the fact that

- the "best" way to achieve results cannot be specified in advance with any degree of accuracy.
- it is always prospective and relies heavily on forecasts which to a large extent are the results of human judgment
- it is a continuous process which in part compensates for the effects of errors in human judgment
- action aimed at achieving future results, is continuously initiated in the light of current forecasts of future events
- planning and control cannot be separated as to its process, time of occurrence or persons involved, as control involves continuous replanning.

Operational control deals with the efficient performance of relatively well-specified tasks in the physical resource conversion process. The major objective of the system is to manage the performance of routine repetitive relatively well-specified tasks in a relatively certain environment on a continuous basis.

The system is therefore characterised by the fact that

- the "best" way to perform a task can, in most cases, be specified in advance
- input-process-output relationships can be optimised

- efficiency standards are thus established in advance, i.e. planning
- it is always retrospective and involves a comparison of performance against the pre-established standard after the event
- action is aimed at bringing performance back in line with standard performance
- planning and control are separated as far as the process, time of occurrence, and more often than not, the people involved, are concerned.

Having characterised the three types of planning and control systems identified by Anthony, from an information support point of view, the characteristics of the information systems supporting them can now be enumerated.

## INFORMATION SYSTEMS

It is generally accepted that the development of formal routine information systems in support of the strategic planning function, is both impractical and inadvisable as the information supporting this function is ill-structured, irregular, extremely diversified, and cannot be anticipated.<sup>3</sup> The emphasis, therefore, is on the development of the information systems supporting management planning and control and operational control.

### Strategic Planning Information Systems

The fact that the information supporting the strategic planning function exhibits the characteristics described in the previous paragraph, does not, however, mean that formal information systems supporting the function cannot be developed. On the contrary they can and should. They are developed with the objective of providing information which, on analysis, leads to the identification of actual or probable strengths and weaknesses, both internal and external to the organisation.

The first type of system dealing with the external environment, can be termed "environmental scanning systems" and is developed to indicate trends in the economic, political, social, technological and competitive environments in which the organisation operates.

The second type of information system has to provide information regarding internal strengths and weaknesses. It need not be specifically developed as this information is provided as a by-product from both the management planning and control information systems and the operational control information systems.

These information systems serve as triggers for further analysis in the form of ad hoc projects and/or feasibility studies. If these systems are to be used successfully in support of the strategic planning function the information they provide has to be analysed and interpreted in terms of potential strengths and weaknesses, which in turn lead to the identification of opportunities and threats to the organisation. This is the sole objective of the analysis.

## Management Planning and Control Information Systems or (MIS)

These information systems deal with the future with the result that the information provided is based largely on forecasts of future events.

The objective of the information provided is to measure the achievement of one or more specified objectives over some future period and/or at some future date. It always focusses attention on anticipated future performance — often distant anticipated future performance.

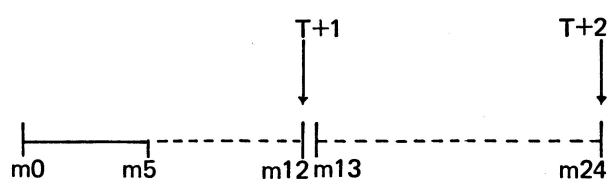
The structure of the information system therefore represents a model (explicit as opposed to conceptually implicit) of the particular system to be managed.

The information system is further characterised by the following four basic types of data input all of which are essential if it is to measure the achievement of one or more specified objectives over some specified future time-period or at some specified future date:

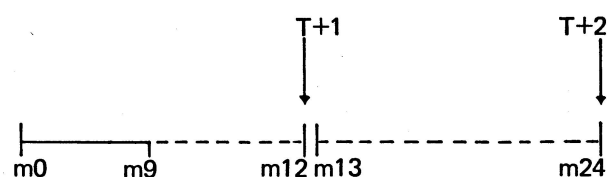
- forecast based on historical events which reflect the innate momentum of the system
- forecasts of anticipated future environmental influences and their impact on the system
- forecasts of the anticipated impact of past (in as much as it is not already reflected by the innate momentum) and planned management action aimed at bringing about change in the behaviour of the system and finally
- to the extent that past performance falls into the period of measurement, historical performance forms the fourth basic type of data input into the system.

The dynamics of the information systems are abstractly illustrated in Figure 3:

AT MONTH 5:



Compare  $(m_{0-5})$  actual +  $(m_{5-12})$  forecast with objective  $T + 1$ , and  $(m_{13-24})$  forecast with objective  $T + 2$ .



Compare  $(m_{1-9})$  actual +  $(m_{10-12})$  forecast with objective  $T + 1$ , and  $(m_{13-24})$  forecast with objective  $T + 2$ .

- m = month 0.2.3.4 etc.
- = actual performance
- = forecast future performance including the influence of innate momentum, environmental change and management action

FIGURE 3

It should be noted that it is always the forecast of future performance at time  $T + 1$  and  $T + 2$  etc., that is measured and compared to some objective — not historical performance.

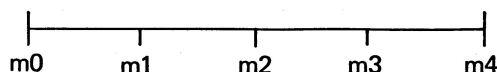
### Operational Control Information Systems (OCIS)

This information system deals with past events. The objective of the information provided is to measure and compare historical performance against some pre-established standard of performance. It focusses attention on past performance and triggers action aimed at bringing performance back to standard. Many a so-called MIS described in the literature is, according to these concepts, in reality an OCIS.

As the information system compares past performance with a pre-established standard, the information provided by the system is characterised by its high degree of accuracy.

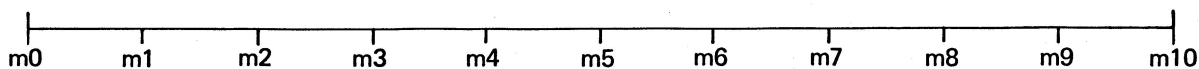
The dynamics of the information system are abstractly illustrated in Figure 4 and illustrate the fact that historical performance is compared with some pre-established standard, i.e. a standard cost, a utilisation rate, an inventory turnover rate, or a budget, etc.

AT MONTH 4:



Compare  $m_4$  actual with standard for  $m_4$  and  $(m_{1-4})$  actual with standard for  $(m_{1-4})$ .

AT MONTH 10:



Compare  $m_{10}$  actual with standard for  $m_{10}$  and  $(m_{1-10})$  actual with standard for  $(m_{1-10})$   
 m = month 0.1.2.3.4 etc.  
 — = historical performance

FIGURE 4

It is clear that the MIS and OCIS systems are interrelated, as the OCIS serves in part as a data base for the MIS system, inasmuch as

- past performance is an indication of future performance and thus historical performance is needed as a data base for extrapolating and thus forecasting future performance, and
- past performance falls into the particular planning period and must be added to anticipated future performance to provide information on the aggregate of future performance over some specified past and future period or periods or as at some specified future date.

A MIS is therefore dependent on OCIS but only as a data base. The information provided by each system is completely different as the OCIS system provides historical information on the efficient performance of task and task elements whereas the MIS system provides future information based primarily on forecasts involving not individual tasks or task elements, but the results achieved by performing numerous interrelated and interdependent tasks.

### MANAGEMENT STRUCTURE

Management structure reflects the relationship between organisational planning and control systems and organisation hierarchy, or stated differently, it illustrates the planning and control activities in which line management at the various managerial levels should be involved. The relationship is illustrated in terms of management involvement (the time spent) in the various planning and control activities.

The types of organisational planning and control systems that are to be related to organisational hierarchy are those defined by Anthony and characterised in more detail in the foregoing sections. They are strategic planning systems, management planning and control systems, and operational control systems.



Although it is possible to have a number of hierarchical levels exhibiting superior-subordinate relationships within an organisation, it is generally possible to distinguish what can be broadly termed, the level or levels of top management, middle management and operating management. In practice, the number of levels will chiefly depend upon the size of the organisation, with larger organisations exhibiting a larger number of levels than smaller organisations. The organisational levels to which the planning and control systems have to be related are therefore top management, middle management and operating management.

A survey of normative management theory, particularly regarding management involvement in planning and control, merely hints at what a normative management structure, as defined here, should look like. In general, normative theory as well as research into managerial planning and control practices in high-performance organisations, both strongly indicate that:

- top management should be heavily involved in strategic planning as well as in management planning and control, but only in highly exceptional cases, in operational control
- middle management should be heavily involved in management planning and control but also in operational control. To a lesser degree they are also involved in strategic planning, and

- operational management should be heavily involved in operational control, to a much smaller degree in management planning and control, and not in strategic planning at all.

### The Normative Management Structure

Accepting that the foregoing statement correctly reflects the planning and control responsibilities of line management at the various organisational levels, both according to normative theory and supported by management practice in high-performance organisations, it is possible to develop a normative management structure in the manner illustrated in Figure 5. The organisational pyramid at the gross level distinguishing between top, middle and operating management and, within that, at a more detailed level, the organisation chart illustrates a specific level of management and its relationship to the normative management structure.

The levels of management are indicated by the vertical axis and the relative average time spent on the various planning and control activities within an average year by the horizontal axis. A horizontal cut across the normative management structure at any hierarchical level will illustrate what planning and control activities a manager at that particular level, normatively speaking, should be involved in.

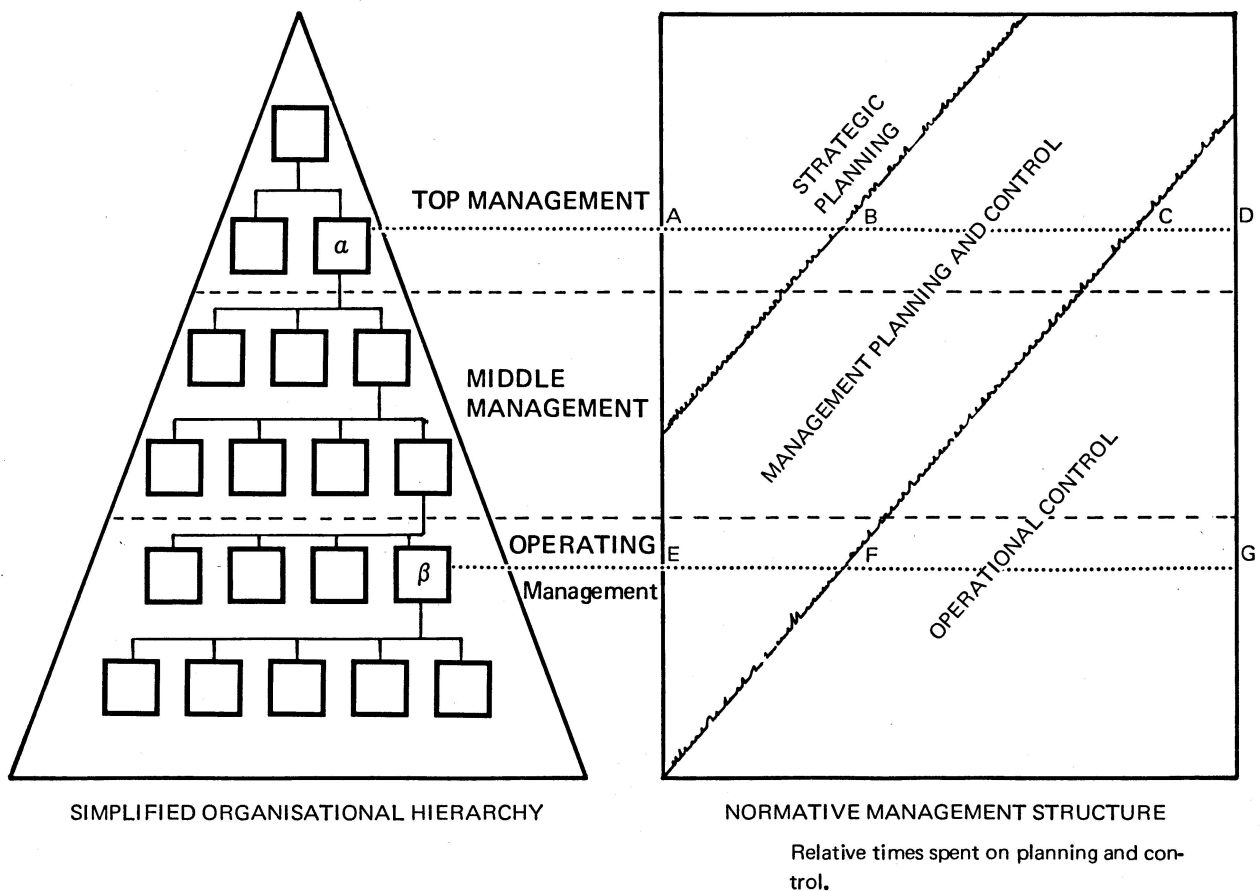


FIGURE 5

The horizontal cut will also indicate approximately, the relative proportion of his time spent on planning and control of the three types. This is so, as the management structure, although illustrated abstractly, illustrates managerial involvement in the various planning and control activities at various managerial levels relative to one another. Note that this division refers only to the time spent on planning and control and not to his total working time. The manager will typically, as already illustrated, also spend time on other activities such as interaction with his subordinates, peers and supervisors, i.e. on activating functions which do not fall into planning and control.

Referring to Figure 5, manager  $\alpha$  would spend approximately  $AB/AD\%$  of his planning and control time on strategic planning,  $BC/AD\%$  on management planning and control and  $CD/AD\%$  on operational control. Likewise manager  $\beta$  would spend  $EF/EG\%$  of his planning and control time on management planning and control and  $FG/EG\%$  on operational control.

## THE EMPIRICAL MANAGEMENT STRUCTURE

Empirical research\* has indicated that actual management practice regarding planning and control systems in existence, the management structures that come into being as a result thereof, and finally the information systems that support them, deviate significantly from that described in the foregoing paragraphs.

The research indicates a very high degree of involvement on the part of both top and middle management in operational control in the empirical situation, relative to the normative situation described here. This overinvolvement in operational control has a marked effect on the management structure as the management structure reflects the planning and control activities in which line management at the various organisational levels is involved. In Figure 6 the management structure reflecting the empirical situation is abstractly illustrated and compared with the normative management structure.

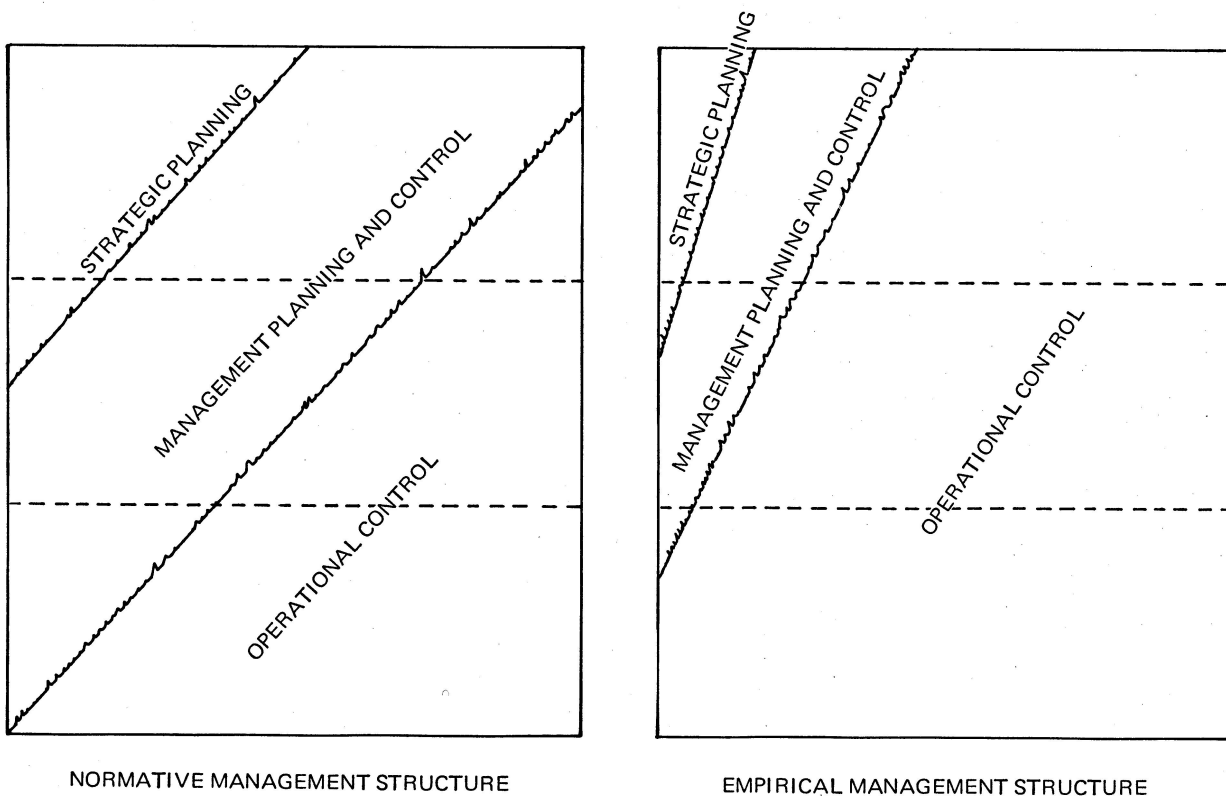


FIGURE 6

\* The empirical research was undertaken in the Republic of South Africa. It involved both personal interviews and a survey. The survey was addressed to all South African industrial companies employing more than 300 persons, i.e. 839 companies of which 26,2% responded. Three survey questionnaires were sent to each company, one each to be completed by a member of top management, middle management and operating management. The conclusions are therefore based on 661 responses.

The interdependence between management structure, planning and control systems and information systems is obvious. Management structure reflects managerial planning and control responsibilities and thus planning and control systems. Planning and control responsibilities and systems determine information requirements which in turn determine the development of information systems. Given any one of these three variables, i.e. management structure, planning and control systems or information systems, it is generally possible to fairly accurately establish the characteristics of the other two and thus the management practices in a particular organisation.

The empirical management structure illustrated in Figure 6 indicates amongst others, the following management practices all of which are to a greater or lesser degree supported by the empirical research:

- Management at all levels is heavily involved in operational control\*
- There is, in general, a lack of planning — both strategic planning and management planning
- There is a continuous demand for more information which when specified, relates to operational control\*\*
- All levels of management seem to want basically the same information, although often at a higher level of aggregation and summarisation\*\*\*
- There is a feverish development of computerised management information systems which it is believed will solve not only the information problem but also all management problems\*\*\*\*
- Finally, there is very little development of true management information systems as there are few explicit (often quite a number of implicit) management planning and control systems in operation.\*\*\*\*\*

A further characteristic resulting from the interdependencies of the three elements described here, is the fact that they tend to reinforce each other. If all management are heavily involved in operational control, as is the case in the empirical situation, the development of operational control information systems will have high priority and will proliferate. This in turn, will reinforce managerial involvement in operational control.

\* Indicating specialists as opposed to generalists in the higher managerial echelons and/or a general inability to delegate.

\*\* Indicating management by feedback (or crisis) as opposed to management by planning.

\*\*\* Indicating a top-heavy organisation structure or redundant levels of management.

\*\*\*\* Possibly stimulated by the flood of literature on MIS which in most cases according to the concepts proposed here, deal with operational control information systems (OCIS) which support the operational control functions.

\*\*\*\*\* Of the type proposed here.

### Specific examples of management structures

A few case histories will illustrate the value of identifying the management structure in a company. The identification is merely a means toward an end and not an end in itself as is clearly illustrated by the change that was brought about in each of the following cases.

It should be noted that in the first two case histories only managerial involvement in management planning and control activities and operational control activities are compared to the normative management structure and are illustrated. Strategic planning is therefore ignored.

#### A Mining Company

In the first case the management structure of a mining company was analysed and is illustrated in Figure 7.

The structure indicates that management in this company spends a bit too much of its time on operational control although not nearly as much as the average South African company (Figure 6). The exception, however, is the manager at level 3 who spends more than 75% of his planning and control time on operational control. An investigation showed that this position was an "assistant-to" position to management level 2. This resulted in most of the operational control responsibilities being delegated by the manager at level 2 to this level of management. The level 2 manager was doing virtually all the management planning. The investigation also showed that the job content at level 3 was uninteresting, there was often conflict with levels 2 and 4, i.e. above and below and that the staff turnover rate at this level was much higher than at any other management level.

The company subsequently eliminated this level of management by reallocating responsibility to both levels 2 and 4 with the result that all the problems were solved and the management structure was straightened out.

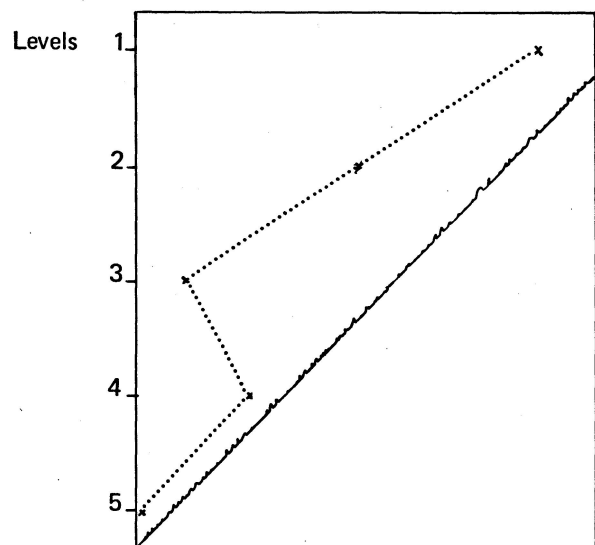


FIGURE 7

### A Departmentalised Financial Institution

The second case illustrates the management structure of a departmentalised financial institution. Two departments are illustrated in Figure 8.

control content of all managers was considerably reduced by introducing a formal management planning system with the result that the management structure subsequently approached the normative.

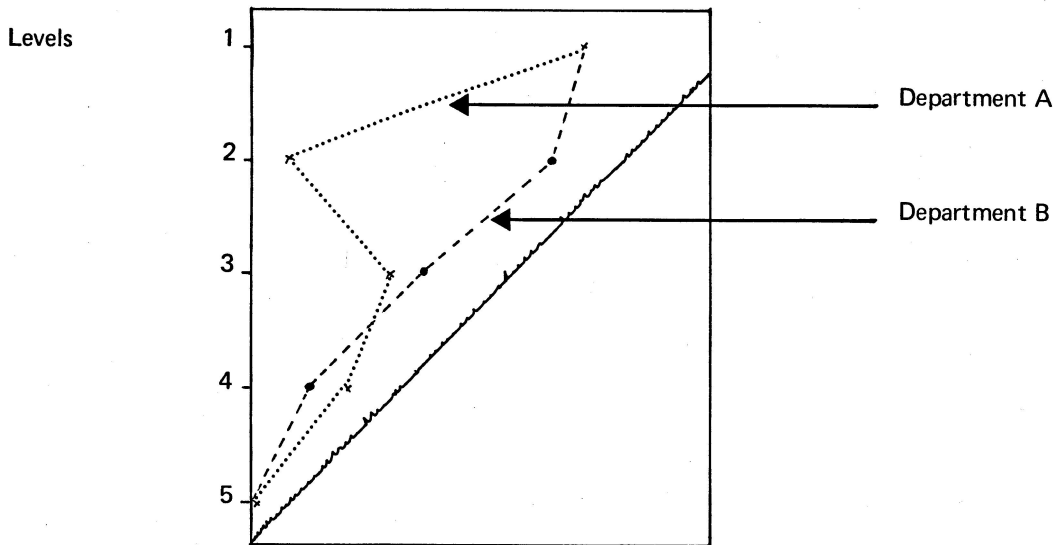


FIGURE 8

In this case all levels of management are overly involved in operational control but in a rational relation from one level to another. The exception, however, is management level 2 in department A. This person is in fact the manager of department A and has been with the company for 20 years. On analysis, it became clear that he was appointed to a level of incompetence as he was an extremely capable manager at his previous level, but unable, on promotion, to move from specialist management to general management.

The company decided to live with the problem as he would be retiring in two years.

In re-developing their information system, however, they took this into account and built the system with his successor in mind. Furthermore, the operational

### An Industrial Company

The third case reflects a large industrial company and is illustrated in Figure 9.

In this case the overall management structure is illustrated, and not as it applies to specific positions.

The pressures of a new top management and dynamic lower levels of management to increase both strategic planning and management planning is clearly evident. This is, however, countered by a fairly large group of entrenched older middle managers who, at all costs, are trying to maintain the status quo and avoid change.

The company is, as a result, involved in an extensive management development program at these levels which it hopes will help to straighten out the management structure. Only time will tell if they are going to succeed.

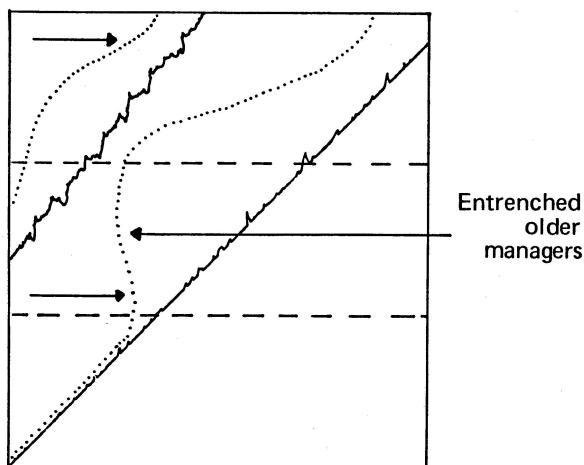


FIGURE 9

### CONCLUSION

The empirical management structure illustrated in Figure 6 reflects the generalised management practices of respondent companies in South African industry. Each organisation has, however, as illustrated in Figures 7, 8 and 9, its own unique management structure which is a function of the management practices within that organisation. It will vary from organisation to organisation and within organisations over time.

From the foregoing examples it is clear that the concept of a management structure is not only theoretically useful, but also serves as a practical method of

- Analysing current management planning and control practices in an organisation
- Subsequently improving the planning and control practices by
  - identifying and redefining managerial planning and control responsibilities at all management levels, and
  - modifying organisation structure in view of the foregoing
- And finally, serving as a framework for the development of the information systems, both MIS and OCIS, needed to support the planning and control systems at all managerial levels.

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