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STRUCTURAL PREREQUISITES FOR THE DESIGN OF INFORMATION SYSTEMS: A CYBERNETIC DIAGNOSIS OF A STEEL DISTRIBUTION ORGANISATION

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ABSTRACT

Information systems design has been strongly influenced by computer technology. However, there are other aspects which can also influence information systems design. It seems that organisational design can greatly influence the success of information systems design. In this thesis we set out to investigate this very issue.

This research begins by the discussion of information systems design. The conclusion from this initial probing of the subject is that an information system is a mirror image of the organisation for which it is designed. Also, the notion of the hierarchical structure is built into the models of informations systems and information systems design methodologies. This is being the case, the logical step to follow is to investigate the models of the organisation.

The remaining chapters of part I are devoted to discussing models of the organisation. It is argued that, apart from the cybernetic model, none of the other models provide good enough basis for information processing and transmission. These models may differ in certain aspects; however, they are all (except the cybernetic model) built on the hierarchical notion of the organisation. It is argued that an hierarchical structure is a major hindrance to the smooth flow of information inside an organisation.

As to the cybernetic model, as examplified by Beer's viable system model (VSM), the picture is fundamentally different. This model discards the traditional notion of hierarchy, and replaces it by that of logical hierarchy. The

model of organisation it provides is built around the information needs of the organisation. The organisation is provided by an elaborate network to facilitate its internal functioning, and enable it adapt to its environment. Since it is our chosen model of the organisation for providing a suitable basis for information systems design, the totality of part II is dedicated to this model.

In part III we set out to test the model. The means by which this is carried out is an emirical investigation of a steel distribution organisation. In this empirical part the model proved to be a very powerful diagnostic tool. By mapping the model onto the organisation in question we could discover that the problems of information processing and transmission of the organisation are largely due to its faulty design. Before we can seriously attempt to redesign its information system, we must look into the organisation itself. In other words, there need be certain structural prerequisites for successful information system design.

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LIST OF ABBREVIATIONS

BEI : Bordereau d'Enregistrement des Impayes (unpaid due payments register).

BRC : Bordereau d'Enregistrement des reglements au Comptant (cash payments register).

BRD : Bordereau d'Enregistrement des Reglements Defferes (deferred payments register).

BRE : Bordereau de Regularisation d'Ecritures (register for the regularisation of bookkeeping entries).

BSC : Bon de Sortie au Comptant (bill of sale for cash).

BSD : Bon de Sortie-Factures pour les ventes Directes (bill for directes sales).

BST : Bon de Sortie a Terme (bill of sale for credit).

CCP : Compte Courant a la Poste (current account at the poste office).

CDP : Commades Directes liverees depuis le Port (direct orders delivered from the port).

CD SNS: Commades Directes liverees depuis les usines ex. SNS (direct orders delivered from the local factories).

COB : Centre Operationel de Base (basic operational centre).

CVD : Commandes Ventes Directes (orders for direct sales).

DF : Direction Financiere (Financial Directorate).

EDG : Entite De Gestion, i.e Management Entity.

EDGP : Entite De Gestion et de Patrimoine (Entity of Management and Patrimony).

ENS : Entreprise Nationale de Siderurgie (National Steel Enterprise).

ERI : Etat Resultat des Inventaires (inventories statement result)

GCL : Groupe CommerciaL (Commercial Group).

GOI : Group Organisation et Informatique (group of organisation and computer services but it is in fact the computer centre).

JBE : Journee de Bascule Entrees (Weighing day of incoming products).

JBS : Journee de Bascule Sorties (Weighing day of out-going products).

LC : Ligne de Consolidation (line of consolidation).

LPC : Ligne de Production et de Consommation (line of production and consumption).

PCN : Plan Comptable National (the national accounting system).

PS : Point of Sale (Point de vente).

R0 : Recursion level 0, corresponding to ENS.

R1 : Recursion level 1, corresponding to GCL (the system in focus).

R2 : Recursion level 2, corresponding to the RUs.

R3 : Recursion level 3, corresponding to the PSs.

RFA : Releve des Factures et Avoirs (statement of bills and credit).

RU : Regional Unit (Unite Regionale).

RUC : Regional Unit of the Centre (Unite Regionale Centre).

SCBF: Systemes Comptables, Budgetaires et Fiscaux (the integrated accounting, budgeting and fiscal system).

SCCC: Service Central de Coordination Commerciale (the central service of commercial coordination).

S/D EPO: Sous-Direction Etudes, Programmation et Organisation (sub-directorate of studies, programming and organisation).

S/D FCO: Sous-Direction Finances et Comptabilite (sub-directorate of finance and accounting).

S/D GP: Sous-Direction de Gestion des Projets (sub-directorate of project management).

S/D MI: Sous-Direction du Marche Interieur (sub-directorate of the internal or local market).

S/D TRC: Sous-Direction des Transactions Commerciales (sub-directorate of commercial transactions).

SMP : Steel and Metallurgical Product

SRGS : Service Regional de Gestion de Stock (the regional service of stock control).

SRR : Service Regional Recouvrement (the regional service of the client credit recovery or management).

SRVI : Service Regional des Ventes Interieures (the regional service of home sales).

TBR : Tableau de Bord Regional (an overall register).

VS : Viable System.

VSM : Viable Systems Model.

Chapter 1

INTRODUCTION

The initial purpose of this research was to study the problems of information processing and transmission in an actual organisation; in other words, to find ways to improve the performance of the existing information system in order that the organisation in question (see part III) can function better. However, after close examinatiom of the question of information systems design a different picture began to take shape. It seems that the problems of information systems design are intimately related to those of organisational design. A serious treatment of information systems design cannot be undertaken outside the organisational context. In other words, it became clear that an information system is no more than an image of the organisation to which it belongs. This implies that we have to reorder our priorities and start with the organisation, probe the models of the latter and find out which is best placed to provide a basis for information processing and transmission.

In chapter two an attempt is made to deal with the question of information systems design. We begin the chapter by elaborating the common ground between the organisation and its information system. The conclusion from this first section of the chapter is that an information system is a mirror image of the organisation. In the following section we discover that the existing models of information systems are a reflection of the organisation of an hierarchical structure. Information systems design methodologies adopt the same pattern (however implicitly), that is, the design framework is an organisation with an hierarchical structure. This will be emphasised in the subsequent section when we tackle the information requirements of an organisation. Tradition has it that an information system, to meet the requirements of the organisation for information, must be built around the pyramidal structure of the organisation.

At the end of the chapter we shall deal with the notion of participation in information systems design. In this regard it is argued that this participation is itself influenced by the operating structure of the organisation. Also, we consider that participation can have only little meaning if the channels of communication are restricted by a hierarchical structure in which only few have access to information.

Having gained this knowledge of information systems design we devote the rest of part I to the models of organisation, and see which is best suited to provide a basis for information processing and transmission. In this respect we shall be dealing with four models of organisation, namely: the classical model, the behavioural model, the systems model and the cybernetic model of the organisation. We reserve a chapter for each model. The approach followed is that we first elaborate the model, then see how it can provide a basis for information processing and transmission. It is hoped by this means to demonstrate that it is the cybernetic model which is best suited to provide a proper basis for information processing and transmission. The cybernetic model (exemplified by Beer's Viable System Model) being the suitable model of the organisation with regard to information systems design, we have reserved part II for the full elaboration of the model.

We begin chapter seven with a brief introduction to the identification of the system in focus according to the VSM, after which the building blocks of the viable system (i.e. its operational elements) are put in place. Chapter eight is dedicated to the mechanisms necessary for the internal regulation of the viable system. The first of these is system two, which has the function of coordinating the activities of the operational elements of the viable system. In the following section we present system three, which is the integrator and controller of the same operational elements. The internal regulation of the viable system is completed by the introduction of the monitoring activity, which is the subject of the last section of the chapter.

In chapter nine we present the intelligence and the policy functions of the viable system. In presenting the intelligence function, which plans the future of the viable system, it is thought appropriate to briefly discuss the planning function in an organisation, and show how it ought to be done in the viable system model context. Having such understanding we can then proceed to the presentation of the intelligence function as the planner of the future of the viable system. The policy function will be the subject of the second section of the chapter. It is discussed in terms of the balance between the antithetical tendencies of the control function and the intelligence function.

With all the subsystems of the viable system in place, we try in chapter ten to present the dynamics of the viable system model as a working whole. With this recapitulatory chapter we mark the end of part II.

We begin part III by the presentation of the organisation which is to be the subject of our empirical investigation, namely the Commercial Group (Groupe Commercial: GCL). The choice of this organisation as the subject of an empirical investigation is largely governed by the researcher's familiarity with it, and the advantage of easy access to the material necessary for the research. Apart from a few documents which were obtained from the Ministry of Heavy Industry, the rest of the research material of this empirical part (part III) was obtained from the internal services of the organisation (GCL). Moreover, the existence of informal relations with people working in the organisation increases the chances of having this research implemented.

The genesis of the organisation (the object of our modelling) is provided in chapter eleven. This gives the raw material for the modelling process in later chapters. The background information of this chapter is particularly relevant for chapter twelve in which an attempt is made to define the organisation (GCL) as the system in focus. With the determination of the appropriate recursive dimension and the identification of the levels of recursion, we can begin the cybernetic modelling of the organisation. This will be the subject of the remaining chapters of part III.

In building the viable system model (VSM) of GCL we follow the same logic adopted in part II. Chapter thirteen is dedicated to the primary activities (the operational elements) of GCL. In the subsequent chapter we deal with the internal regulation, and chapter fifteen will concentrate on the intelligence and policy functions of GCL. Throughout this modelling process we proceed by describing the present system, then diagnose its ills and give the cybernetic alternative.

This research is intended to demonstrate that an information system is a mirror image of the organisation which it is serves. By examining the models of the organisation (part I) we show that an hierarchically built structure for an organisation is not a good enough basis for information processing. A suitable model of the organisation (from an information systems design standpoint) is one which is built around the information needs and requirements of the organisation. In other words, there are structural prerequisites for an organisation before we can seriously attempt to design its information system. It is our firm belief that these prerequisites and requirements are adequately met by the cybernetic model as exemplified by the VSM.

The empirical investigation of part III is meant to provide tangible evidence of the problems associated with an organisation built on the classical hierarchical structure. Also, the study attempts to show how the alternative structure, i.e. a cybernetically built organisation, can falicitate information flows and enable smooth control of the organisation.

PART I

MODELS OF THE ORGANISATION

Chapter 2

INFORMATION SYSTEMS DESIGN

The concept of information systems, for many people, remains a hazy one. Nevertheless, information systems are a reality of the daily life of modern organisations. Information systems for management are characterised by a multitude of aspects; as such they can be approached and studied from more than one angle and it is not surprising that there is no agreed definition of an information system in an organisation [Davies, 1974]. This lack of agreement about a definition of a management information system must be due as well to the diversity of management information systems research and the many disciplines which have contributed to its development. These include systems theory, control theory, information theory and information economics [Dickson, 1981; Jenkins, 1985].

Many authors assume, however implicitly, that a management information system is a formally built system, i.e. a system which transmits data and information within agreed rules and procedures. However, it is important to point out that, in addition to the recognised formal information systems in an organisation, there runs a parallel set: the informal systems [Peaucelle, 1981]. Although the latter may not be as valuable to decision makers as the formal, they are still of considerable use.

Every organisation strives to have its own information system, even to the extent that individual functional parts tend to construct their own information subsystems [ibid].

As will be seen later (ch.11 and ch.13), these subsystems or specific systems satisfy the needs for information for particular organisational functions at the operational level. The assumed objective of an organisation's information system must, therefore, be to cover or include all the information flows within the organisation; this implies that we expect an information system to encompass all the individual subsystems and their relationships. In other words, the objective of a management information system might be "to provide all levels of management with the information necessary for the conduct of the business in the most efficient manner" [Forkner and Mcleod, 1983: p.8]. However, we might question whether achievement of this objective is really a desirable end to be sought. There are those who argue that total integration of the subsystems is itself "a poor design concept" [Gorry and Scott Morton, 1971: p.67].

The argument espoused here is that an information system is a reflection of the organisation for which it is the information system. If the organisation is of an hierarchical character, then the information system will reflect the hierarchical characteristics of the organisation. In the remainder of this chapter an attempt is made to develop this argument through the following points:

.To show that the information system is the image of the organisation of which it is the information system.

.Discussion of frameworks for information system design. A brief summary of the different models of information systems for an organisation. The proposed models (i.e. the frameworks) for information systems design turn out to be a faithful reflection of an hierarchical model (however implicitly) of the organisation.

.A discussion of methodologies for building an information system in an organisation. The design methodologies also seem to be tailoring the information system to fit an hierarchical organisation.

.The structural requirements of an information system. In this section we shall see that the information system is built to correspond to a three-layer hierarchical structure of the organisation.

.The importance of the individual (or group) user in the process of design and implementation of an information system. Discussing user-participation will enable us to highlight the fact that participation is influenced by the operating organisational structure.

I. THE IMAGE OF THE REAL SYSTEM

The data contained in the management information system is no more than a reflection of the real system or organisation for which it is an information system [Lucas, 1976(a); Mason and Mitroff, 1973]. An information system is not an end in itself, it exists as auxiliary to another system: the object system or the managed system; "...the object system will often be an organisation" [Langefors, 1973: p.199]. The data (or a datum) is always a reference to the state(s) of the system at a particular time. The information system is the tool by which management gets the information to enable it perform its "planning and control functions over the physical system of the firm" [Forkner and Mcleod, 1973: p.7]. As such the structure of the management information system follows closely the structure of the system or organisation of which it is an image [Shave and Bhaskar, 1982; Verrijn-Stuart, 1987]. The fundamental assumption is that the information system "must be a true reflection of the real system in order to be effective" [Verrijn-Stuart, 1987: p.98].

The organisation lives by its information system, whatever shape or structure it may have. There is no escape from the need for communication between its members. The functional division has long been a currency of the modern organisation. The division of the organisational task into distinct functions: production, marketing, finance, etc., may improve the level of efficiency and productivity of the organisation, but, in turn, this task specialisation necessitates coordination and supervision and without an information system this cannot be performed properly. Moreover, organisational conflicts are another source of demand for information. The information system in this case can be employed to enhance the antagonistic positions, or can supply the means to alleviate or eliminate conflict, if the conflict itself is due to mis-information.

However, as a means of communication in the organisation, an information system has its own specifications as opposed to the natural language we all use in all organisations. The information system as a language of communication has to be exact, accurate, speedy and verifiable [Hicks Jr., 1984]. If we make an analogy with the natural language, then the words of the information system are the data (which in fact reflect the states of the real system or the organisation). This paramount importance given to data in management information systems explains the tendency of designers to begin with considerations of data structure and organisation, as a necessary prerequisite for the design of management information systems.

For the present state of the art, the specificity of the management information system as an organisational language of communication goes even further. As we shall see later in part III, the fragmentation of the organisational task into subtasks, is mirrored by the information system, where subsystems are created to match the organisation's subfunctions. "An MIS is a federation of functional systems" [ibid: p.28]. This tendency has the advantage of matching the specific problems of a particular organisational subfunction with a relevant and suitable language, i.e. specific information subsystem (refer to ch.11). At the same time, however, the diversity of the information subsystems creates a problem of communication between the subsystems, and for the integration of the total management information system. One way of bringing together the functional subsystems is by sharing the same database management system [ibid].

Turning to the nature of the real (object) system, we cannot but be struck by the dominance of hierarchy. The ubiquity of the hierarchical structure of organisations is a testimony to its hold on contemporary organisational thinking [Graia and Torreadea, 1986]; "the hierarchical structure is that most used by man when working with complex systems" [ibid: p.20]. This hierarchical character of organisations stems from "the need to reduce the apparent complexity of the system" [Emery, 1969: p.21]. Structuring the organisation in order to reduce its complexity brings with it the need and necessity for coordinating the parts or subsystems thus created. Information systems design is, therefore, usually based on hierarchical principles.

Change is a fundamental characteristic of modern organisations. If this change does not come from an awareness of the necessity to anticipate environmental changes before they happen, it will come later as a reaction, arising from the necessity to meet external pressure. Since the information system is coupled to the organisation, it also is prone to change and adaptation. Technical improvements relating to information systems (hardware as well as software) make reviewing of an information system of an organisation a continuous task: "It is essential to be aware of the chain reaction that any system change is likely to bring and which, with the growth of information technology, becomes more important with each successive advance" [Anderson, 1986: p.132].

The computer occupies a central place within a modern information system, and the incessant sophistication information systems accumulate over time makes it (the computer) increasingly more important in the organisation. The rapid change characterising computer technology has forced itself into the organisation. The computer has become a powerful tool of information processing. As such, and in certain situations, it has evolved to a position where the organisation, i.e. the real system referred to above, changes position and becames the image of its image (its information system). A point worth making here is that the information system (the image system) can influence the organisation (the real system). As we shall see later (in ch.11 and ch.13) the shape of the organisation can be determined by the information system in place.

II. FRAMEWORK FOR DESIGN AND DEVELOPMENT

Having seen that an information system is the image of the organisation, we now attempt to show (not pretending to be comprehensive) how the existing models of information systems reflect a particular image of the organisation. There are a number of researchers who have had a particular impact on the development of management information systems research in the period since the beginning of the seventies [Dickson, 1981; Ives et al., 1980]. The distinct research contributions of these writers is summarised briefly in the following:

II.1 THE LUCAS MODEL

Lucas has adopted a behavioural approach to information systems design [Lucas, 1975(a,b), 1976(a,b)]. He stresses the influence of personal and attitudinal factors on the performance of the information systems user. The relationships between the elements affecting managerial performance, as described by the model, are presented in the pictorial version of fig.2.1 below.

In this model, Lucas tries to relate various classes of variables to performance and use of an information system. We can see from fig.2.1 below that performance is determined by personal and situational factors, such as level of education and the length of time an individual has spent in his actual position. The model also shows that the use of information is partially determined by attitudes and perceptions. For example positive attitudes towards computerisation may lead to high level use of the information systems. Fig.2.1 is not explicit about the shape of the organisation for which it is intended. However, for Lucas information systems are "designed to support decision making" [Lucas, 1976(a): p.18]. Also, he considers that Anthony's three layer hierarchy [Anthony, 1965] is a convenient framework for the design of information systems: "A framework proposed by Anthony (1965) offers an in-depth view of the three types of decisions made in an organisation" [ibid: p.24]. This amounts to saying that the organisational structure implied by the Lucas model is basically hierarchical.

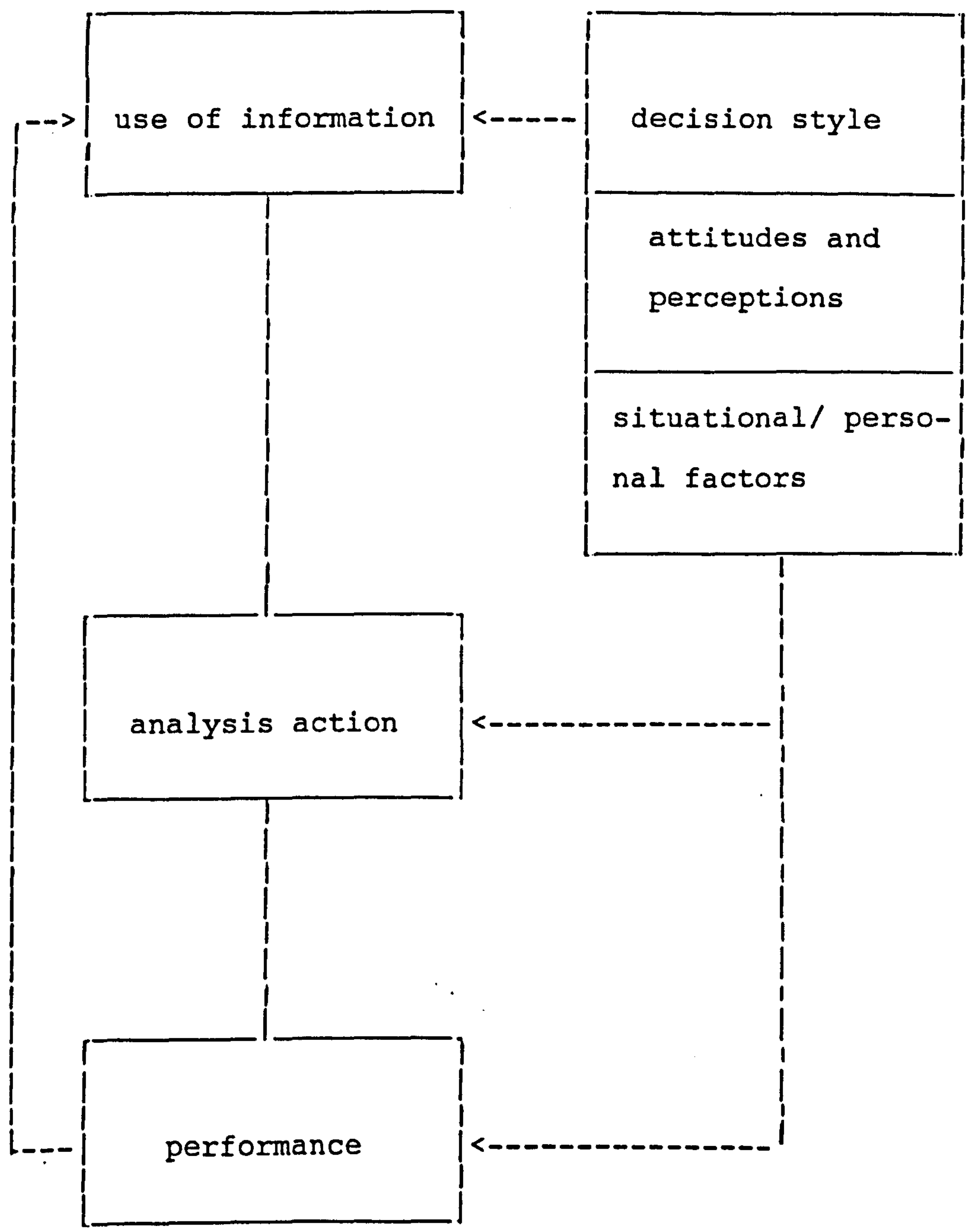

Fig.2.1. Lucas descriptive model

II.2 GORRY AND SCOTT MORTON MODEL

In their model, Gorry and Scott Morton set out to show the importance of information to management. In their view "information systems should exist only to support decisions..." [Gorry and Scott Morton, 1971: p.56]. They based their framework for management information systems on Anthony's identification of three management levels: the strategic level, management control level and operational level [Anthony, 1965], as well as on the work of Simon [Simon, 1960].

In their article they argued that every managerial level requires specific attention in the design of information systems. For the strategic planning level, the information required is varied and generally obtained from sources outside the organisation. Also the demands for information are usually infrequent [Gorry and Scott Morton, 1971]. The information requirements of the operational level "stand in sharp contrast to those of strategic planning" [ibid: p.58]. Information for operational control is detailed and generated from within the organisation. Owing to the frequent use of this information, it is necessary for it to be adequately presented to meet the requirements of accuracy and precision. Information for management control falls between these two extremes. In their framework, Gorry and Scott Morton emphasise the importance of the informal sources of information for this and the strategic level.

II.3 MASON AND MITROFF MODEL

In research on management information systems, Mason and Mitroff also focus on the management information system as a tool to aid the decision making process. They define a management information system as that which consists of at least [Mason and Mitroff, 1973: p.475]:

1. One person of a certain psychological type, who faces
2. a problem within some
3. organisational context for which he needs
4. evidence to arrive at a solution; the evidence is made through some
5. mode of presentation.

The organisational context referred to in their model is similar to that of Gorry and Scott Morton, namely:

1. Strategic planning.
2. Management control.
3. Operational control.

The information system presented in this model is closely intertwined with the organisational structure; "this is because an organisation's structure and its information system are in reality just two sides of the same coin" [ibid: p.483]. It is important, they also argue, that information system design pays more attention to the less structured problems of management beyond the operational level.

II.4 IVES, HAMILTON AND DAVIS MODEL

These authors argue that the other models "suffer from a common drawback in that each takes a limited view of the MIS field" [Ives et al., 1980: p.916]. They consider an information system as a "collection of subsystems defined by functional or organisational boundaries" [ibid: p.910]. In their model, they identified five environmental variables which "define the resources and constraints which dictate the scope and form of each information subsystem" [ibid: p.916]. In addition to the environmental variables, the model includes the information subsystem itself and the process variables. These are the measures of the interaction between the information system and the environmental variables above.

The authors of this model assume that the information system is intimately coupled to the organisation, and as far as the latter is concerned the hierarchical character is taken for granted. The model may differ in emphasis from the previous models; nevertheless, and regarding the organisational context, all the models stand on the same side, namely that the organisational structure is mainly hierarchical.

As a summary to this section, then, we can deduce that these models of information systems portray an image of the organisation which is basically traditional (refer to ch.3). The pyramidal character of the organisation is assumed and the structural arrangement of the information system follows that of the decision making process in the organisation (see fig.2.5 below). The models appear to differ in their emphasis, for example Lucas stresses the behavioural issues and user attitudes and their influence on the performance of an information system. Ives, Hamilton and Davies emphasise more than the others the importance of the environmental variables and how they determine the shape of an information system in an organisation. It seems, however, that the underlying assumption of these models is that an information system is a reflection of an organisation structured like a pyramid, layer after layer, where the base of the pyramid corresponds to the operational level and the top of the pyramid is the highest authority in the organisation.

III. INFORMATION SYSTEM DESIGN METHODOLOGIES

In the previous section we have attempted to show that information systems models mirror an hierarchical organisation. In this section we try to show that designers also aim (however implicitly) to build information systems tailored to fit an hierarchically built organisation.

There is no doubt that information processing and handling in an organisation is not a simple activity. It is a mixture of varying inputs: technical, personal, organisational, linguistic, etc. Information systems design, as a discipline to help researchers find their way and understand this hybrid activity, is not yet a mature discipline and perhaps, "it may never become one" [Antill, 1985: p.203]. The relative immaturity of the discipline and the multi-dimensional nature of the information processing activity are probably the major factors which explain the multiplicity of methodologies invented by the various practitioners to deal with the problems of information systems analysis and design.

To develop an information system, one is faced with a variety of methodologies; it is not an easy task to opt for a particular one. However, the methodologies treating the design and development of information systems do overlap; choosing one methodology, it would seem that it is possible to get (indirectly) some of the benefits of the others [Episkopou, 1986]. The common characteristic of these design methodologies, however, is that the real system (i.e. the organisation) for which they endeavour to build an image (i.e. the information system) is invariably hierarchical.

III.1 THE SYSTEM LIFE-CYCLE

The concept of the systems life-cycle [Hicks Jr., 1984], although it is an old concept, still largely remains the guiding framework for the development of information systems [Miles, 1985; Maddison et al., 1983]. However, researches carried out during the eighties do not fully follow the exact order of the original system life-cycle, they "do not start at the very beginning of the system life-cycle but assume that the system's objectives, or even the system's requirements, have already been fixed" [Veryard, 1986: p.89]. Nevertheless, the system life-cycle remains the widely accepted framework for information system development. In this section we attempt to give a brief account of the stages of this methodology which are [Senn, 1985; Miles, 1985; Maddison et al., 1983; Page-Jones, 1980]:

.Feasibility study.

.Analysis.

.Design.

.Implementation.

III.1.1 FEASIBILITY STUDY PHASE

The main aims of the feasibility study are to identify the objectives of the prospective client [Hicks Jr., 1984], and to screen the potential application in order that an approximation of its costs and benefits can be obtained [Emery, 1987]. During the feasibility study phase we need to answer three types of questions [Senn, 1985]. Firstly, the feasibility study needs to discover whether the system to be developed is technically possible within the framework of available technology, hardware and software, and the available personnel, or whether investment is necessary in new technology, or training of personnel is required for the implementation of the proposed system.

Secondly, in addition to being technically feasible, the system to be designed must also be economically feasible. In other words, the cost benefit analysis must show that the benefits from installing the system outweigh the costs. The benefits versus costs considerations include unquantifiable savings. This is particularly relevant if the designed information system goes beyond a transaction processing system to include operational and managerial control systems [Lucas, 1976(a)].

The third feasibility criterion is whether the designed system can be made operational. That is to say, given the benefits expected, can we run the system? For example (see ch.13 and ch.14) can input data be collected in time; can encoding errors be corrected so that the system can run and produce the information within the expected cycle, say a week? If the frequency of errors in the input data is so great that corrections cannot be made quickly enough, the information system cannot run on schedule and the benefits of accuracy and speed sought from the introduction of the system are lost. These are not the only factors which can undermine the feasibility of an information system, most importantly perhaps are the user attitudes which can grossly reduce the success of an information system.

At the feasibility study stage, one is tempted to include the discussion of the user's needs. In the context of the system life-cycle methodology the user is usually seen in the narrow sense, as the client who commissions the project. However, owing to the importance played by the user (i.e. the individuals operating the system as well as those served by it) in an information system, it is thought appropriate to allocate a full section (section V) to user involvement in the design of information systems.

III.1.2 THE ANALYSIS PHASE

There is a lack of agreement among practitioners on the terms and scope of analysis [Maddison et al., 1983]. The observed divergence between the various methodologies may be due to the inherent subjectivity involved in viewing a social system like an information system: "the differing viewpoints arise because it is so difficult to observe objectively a system that exists 'out there' in the real world" [Wood-Harper and Fitzgerald, 1982: p.14]. The Wood-Harper and Fitzgerald taxonomy shows that the approaches they have analysed are not just mere alternatives, the differences between them would suggest that they are based upon different world-views. For example, some of the approaches to information systems analysis (and probably to the other stages as well), although conceptually identified with the systems paradigm, in their way still adopt the reductionist practices of the scientific method [ibid].

The majority of practitioners, however, adhere in a straightforward manner to the concepts of the system's life-cycle [ibid]. For these, before the information system can be designed and implemented, "it is first necessary to understand the scope, the required functions and the building blocks of the system" [Maddison et al., 1983: p.44]. One of the approaches adopted in this analysis phase is the examination of the orientation of the analysis, out of which two distinct orientations can be discerned, "those of process analysis and data analysis" [Fitzgerald et al., 1985: p.226].

In the process analysis, it is the organisational process (functions or activities) which is the main concern of the analyst. The importance of data is viewed in the context of supporting the process or the activities of the system [ibid]. Process analysis orientation implies studying and understanding the existing system, evaluating the current methods and how they work, then considering if adjustments are necessary and/ or possible. It is assumed that by understanding the existing system, one can recognise the requirements of the system to be designed.

In the data analysis orientation, the emphasis is more on the identification of the data used and the information produced from that data. Here "data is regarded as more fundamental than the processes because it is less likely to change over time" [ibid: p.227]. Those who opt for this orientation tend to produce database solutions as the outcome of their systems development efforts [ibid].

The process analysis may be advantageous in that it is understood by the ultimate users, which means that they can contribute to the understanding and validation of the system's requirements as provided by process analysis [ibid].

The identification of these two orientations of analysis, does not mean that when a particular methodology is adopted, one is necessarily excluding the other: "A methodology may include data and process analysis, may be oriented more to one or to the other..." [Maddison et al., 1983: p.47].

There are a variety of fact finding techniques which analysts use in this (analysis) phase [Senn, 1985]:

.Interview: intended to collect verbal information about the existing situation. The type of interview varies according to the degree of detail and specification sought in the information gathered through the interview. A structured interview is adopted when the analyst seeks specific application details. If, on the other hand, the information sought is of a general character, the interview is unstructured, i.e. questions are free from any particular format.

.Questionnaire: has the advantage of allowing the analyst to contact a larger number of respondants than in the case of interview. Also, since respondents can be kept anonymous, they should be unconstrained in giving honest and reliable answers.

.Observation: by directly observing the operation, the analyst can get an insight he/ she may not be able to obtain from the two previous methods. Its drawback, as a fact finding technique, is that the mere fact of being observed alters the way the task is carried out.

III.1.3 THE DESIGN PHASE

Work on the system's design normally comes after the completion of the analysis phase. However, there is a hazy area separating analysis and design, where sometimes there is an overlap between the two activities [Maddison et al., 1983; Fitzgerald et al., 1985; Jayaratna, 1986]. Design has been defined in the information system context as "a conscious process of translating the requirements into a specification of the required facilities and interfaces" [Fitzgerald et al., 1985: p.228].

Some authors distinguish between two levels in the design process, i.e. between logical design and physical design [Brooks at al., 1982]. At the logical design level the designer gives detailed specifications that meet the requirements arrived at during the analysis phase. The second stage in the design process is to build a working system with its files and software, i.e. the physical design of the information system.

Having produced the detailed specifications of the new information system, the next question is: what does the user want from it? In other words, what is the output from the information system? Output in this context refers to any information produced by the system, whatever form it may take: print, audio or displayed on a terminal screen. An important aspect in the design of the output is its layout, i.e. the arrangement of items in (for example) the printed report or document. The subsequent step is to determine the necessary input in order to produce the desired output.

The task of input design consists mainly of providing the user of the information system with specifications and procedures for preparing the data and describes how to enter it into the computer for processing [Senn, 1985]. The input design varies from one situation to another, for example whether the new system is an on-line or batch-oriented system. However, it can be emphasised that the guiding principle for the designer in the process of input design is to avoid unnecessary complication in the input requirements. The fewer inputs required by the system the fewer will be the errors of entering the data into the system and the fewer will be the bottlenecks.

III.1.4 IMPLEMENTATION PHASE

Implementation is understood to include the set of activities of converting from the existing system to the new system. However, not all the practitioners in the field of information systems are explicit about the modalities of the conversion process. Lack of implementation procedures is not seen as a handicap in some of the methodologies used in the development of information systems: "A methodology may or may not discuss tasks by which the developers create and change the computer system and end-user procedures" [Maddison et al., 1983: p.85]. Nevertheless, it is appropriate to mention some of the conversion methods and other implementation aspects considered as relevant for the success of the implementation process, like for example personnel training.

There is no single method specifying how to carry out the implementation process. One of the most common, however, is referred to as the parallel method. It is possibly the most secure, since it starts by running the old and the new system in parallel before the new system is finally put in place. There is unfortunately a double disadvantage in choosing this method. First, it is costly, because of having the two systems operating at the same time. Secondly, if there is potential user - resistance to change, the proposed system may not get a fair chance of being accepted.

To avoid these disadvantages the system's designer may opt for another method, which is the direct conversion method, i.e. when the conversion date arrives, he abruptly replaces the old system by the new one. This latter method is (understandably) a risky way of introducing the new system, but it is the method which is gaining popularity among practitioners [Hicks Jr., 1984].

Alternatively, the conversion can be operated gradually, i.e. the phasing out of the old system is undertaken at the same time as the gradual phasing in of the new system. This method is chosen "when it is not possible to install a new system throughout the organisation all at once" [Senn, 1985: p.534].

The fourth alternative, referred to as the pilot method, is more convenient when the changes brought by the new system are seen as drastic. It consists of choosing a subsystem of the organisation as an implementation area. If the system works satisfactorily there, it is then implemented throughout the organisation. Within the pilot method, the designer may adopt any of the previous three methods.

In the conversion process, attention and emphasis should be given to the "non-machine components of the system" [Hicks Jr., 1984: p.371]. Prior to converting to the new system, therefore, training of the personnel involved is necessary. Successful implementation and operation of the system depends largely on how well trained are the personnel expected to use it. An important area of training is that on data capture from transactions and data entry for computer processing. Documentation and manuals of the system, however elaborate, cannot replace good training for good implementation of a new system.

Fig.2.2 below is a graphic summary of an information system life-cycle.

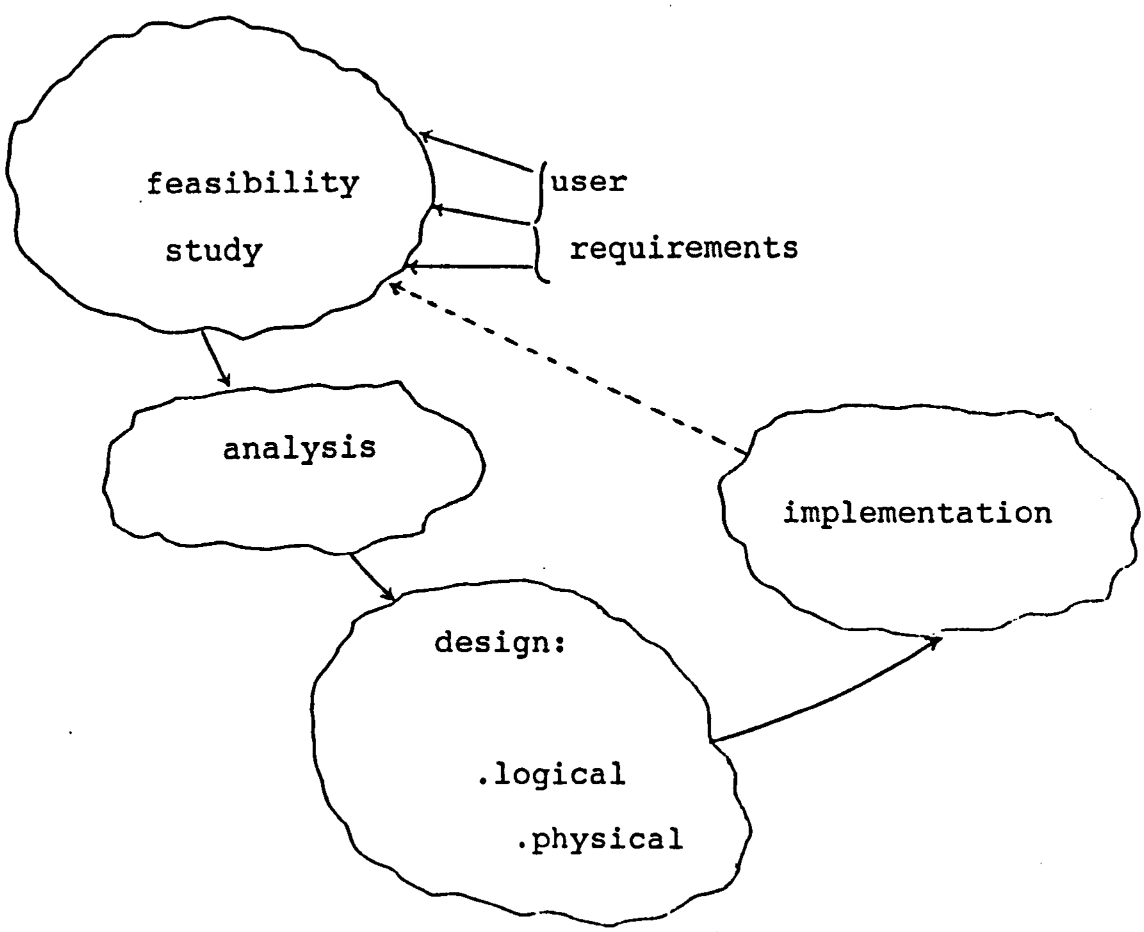

Fig.2.2. An information system life-cycle.

The conventional view, that the system's life-cycle has to go through the various phases shown above, is to some extent out of touch with the reality of the state of the art. This reality is characterised by the spectacular growth in computer engineering to meet the various needs of the organisation. This is particularly relevant for the small organisation, where the rapid growth and improvements of the relevant equipment, i.e. microcomputing, software, networking techniques, and the drop in the cost of these systems, have made it easier for organisations, instead of building computer systems in the sense described here, to select from a pool of available systems. The selection is becoming heavily influenced by the software component of the system. If the cost of hardware continues to drop owing to the technological advances, the same is not true of the accompanying software. Because of the labour intensive nature of the software industry, the evolution of prices of the software packages has not matched those of the hardware products.

However, for mainframe systems, the overall picture of the system's life-cycle remains valid, but improved to take into account the progress taking place in the computer industry. The change and the rate of change characterising the computer industry is on the increase, which means that the approach to information systems design and development should follow suit to keep in pace. That is to say the clear-cut separation between certain phases is disappearing, and the overlap between others is more apparent. This improved view of the information systems life-cycle can be seen from the diagram of fig.2.3 below [Antill and Wood-

Harper, 1985]. This view takes into account the stage beyond implementation which is maintaining the system.

As we can see, the system life-cycle methodology is a client-oriented methodology. As such it is dedicated to meet the requirements of the client. As we shall see in section IV, the requirements for information in an organisation follows a certain hierarchical order. The requirements for information of every level are almost unique. The underlying assumption of the methodology is that the systems designer should come up with an information system which meets the information needs of the decision makers at every level of the organisation. In other words, the operating structure of the organisation is a given fact and design efforts are directed towards producing an image (i.e. an information system) which fits the hierarchical structure. We cannot help but ask the question whether some of the failures of the system life-cycle methodology should be attributed to the pathology of the organisational structure itself.

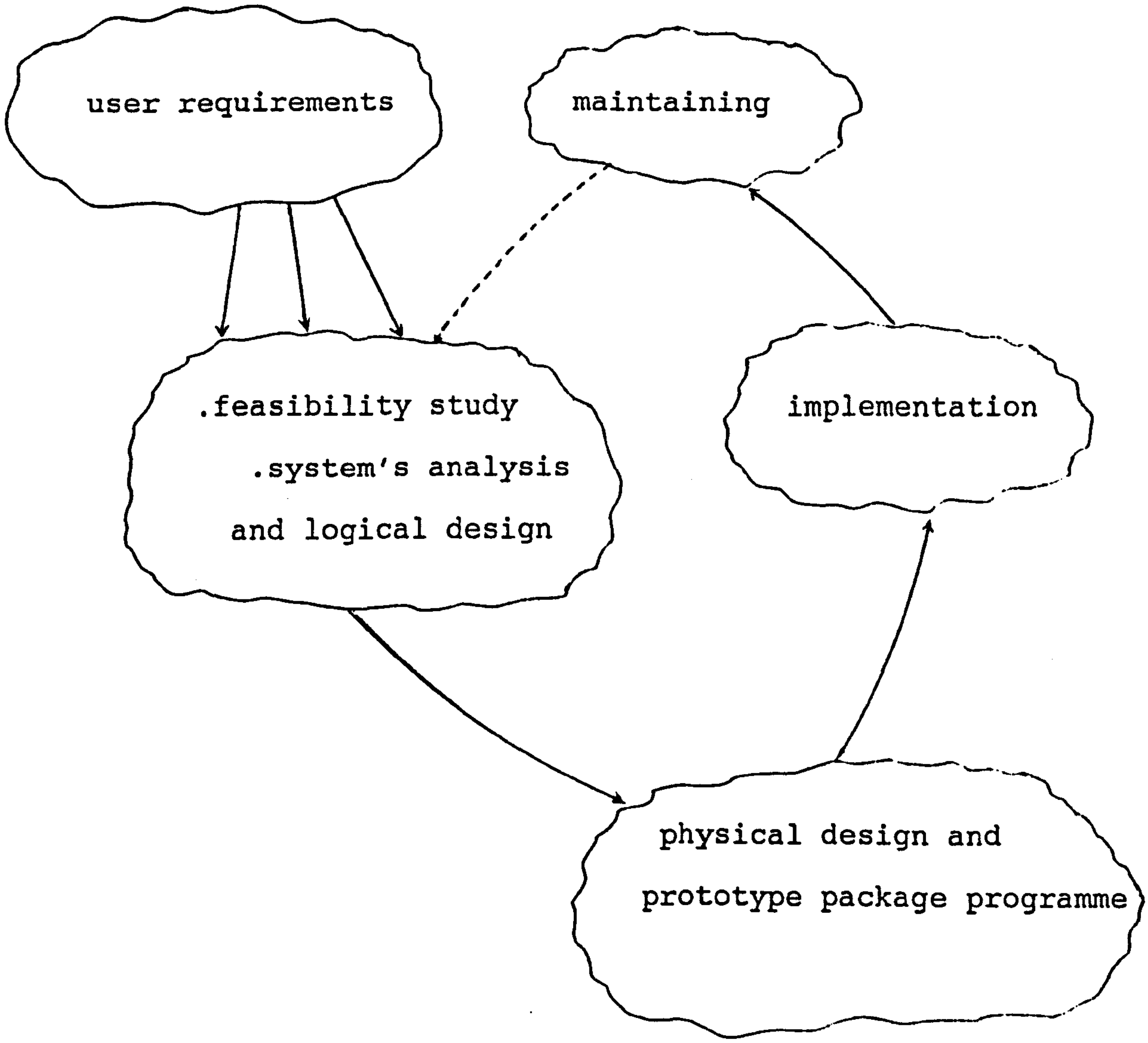

Fig.2.3 Improved view of the system life-cycle.

III.2 ALTERNATIVES TO THE SYSTEM LIFE-CYCLE

In addition to the conventional system life-cycle approach, there is another approach to system design and development referred to as the structured analysis and design approach [Page-Jones, 1980]. It is distinguished from the conventional approach (i.e. the life-cycle) in that it emphasises the notion of structure in the design of the system. Here the designer is "committed to the idea of a top-down organisation" [ibid: p.19]. He/ she starts by partitioning the system into modules or black boxes, i.e. manageable levels of detail. Each module or black box is to cover a well-defined part of the problem initially recognised by the analyst. The interfaces between the modules are a reflection of the overlap or the connections between the problem parts and these interfaces are rigorously specified. After that comes the organisation of the modules themselves, i.e. the internal processing of the modules.

As with the system life-cycle approach, design is preceded by analysis. The output of the structured analysis is the input to the structured design. The structured analysis output is expressed by certain tools, they are [ibid]:

.Data dictionary.

.Data flow diagrams.

.Decision tables.

.Decision trees.

.Structured English.

.Data access diagrams.

The tools employed in structured design (as opposed to structured analysis) are [ibid]:

.Structure chart. In the chart the designer makes explicit the partitioning of the system into modules (also known as black boxes), the connections between them, and their hierarchical organisation. The level of detail increases as we move from the top of the chart to the bottom.

.Pseudocode. This is a flexible language used to document the internal procedures of the individual modules. It is not intended to be executed on the computer, but it is essentially intended for the programmer to organise his work before coding.

One characteristic of this approach as compared to the conventional system life-cycle approach is that most of the work is carried out at the system analysis and system design stage. Also, it has certain advantages over the other approach in that the testing and implementation of the system is relatively easy, since it can be done module by module. The fact that it is partitioned makes understanding and maintaining the system easier than in the conventional method.

Information systems developed by the system life-cycle and structured analysis and design methodologies have not been problem-free [Lyytinen, 1988]. The frequency of information systems failures is leading a number of researchers to shift emphasis from the conventional "formal - rational" framework to perspectives which take into account more explicitly the social character of the information system.

One such approach is the socio-technical design approach [Mumford, 1985; Land et al., 1980]. The basic feature of this approach is to focus on the interaction between the technical subsystem and the social system in which it is embedded. Attempts are made to facilitate effective interaction rather than concentrating on the technical aspects at the expense of the human operators. In other words, the information systems design, in addition to being a process of choosing the right hardware and development of the relevant software to go with it, also "requires the insertion of a set of new computer-based procedures into a surrounding organisational framework that includes a network of people carrying out a variety of tasks" [Land et al., 1980: p.239]. The roles taken by the various participants and the relationships between them during the analysis, design and implementation process of the information system are determined by the organisational framework. Agreement about what is to be considered a success for an information system may prove to be unattainable. However, if success is seen as what the information system accomplishes for the organisation [Swanson, 1987], then this success is largely determined by the way the relationships between the participants are made to operate.

Soft systems methodology [Checkland, 1981] although it addresses itself mainly to problems of wider context (those of organisational problem alleviation), also has its advocates as an appropriate framework through which to tackle the question of information systems design [Nelson, 1986; Wilson, 1980; Benyon, 1987]. The key characteristic of the methodology is the orchestration of a debate through which individual (or group) perspectives relevant to a problem - situation are made explicit. It does not claim, however, that at the last stage of the debating process an agreement is necessarily reached as to the design of the system in question, or even improvements to an existing system. What is important is the debate and the learning process itself, where different (or even conflicting) viewpoints are set out for examination.

From the various approaches to informations systems, Wood-Harper and Antill [Antill and Wood-Harper, 1985] derived their "multi-view" methodology. Within their framework, "the analyst and the user cannot be removed from the problem domain" [ibid: p.170]. The underlying assumption of the multi-view methodology is that, whatever the state of the art in the field of information systems, the framework for analysis and design is five-fold, namely [Antill and Wood-Harper, 1985; Wood-Harper, 1985]:

.Analysis of the human activity system.

.Construction of the information model.

.Analysis and design of the socio-technical system.

.Design of the human computer interface.

.Design of the technical subsystem.

This five-fold framework is mapped onto the two dimensional plan of fig.2.4 below. The horizontal axis is marked by people at the left end and technical matters at the right end. At the upper end of the vertical axis we have organisation, at the lower end is depicted the computer. The five components of the methodology are then fitted on the different quadrants of the plan.

An interesting feature of the multi-view methodology is its recognition of the partial validity of other approaches to information systems design [Wood-Harper and Fitzgerald, 1982]. In each of the quadrants of fig.2.4 below we apply the relevant approach, after which we put together the individual outcomes to come up with an integrated design. "It is possible to select the most suitable approaches to each of the five areas and then integrate the results of each into an analysis and design methodology" [Wood-Harper, 1985: p.171]. To analyse the human activity system, for example, we might turn to Checkland's soft systems methodology [Checkland, 1981], the essence of which is its emphasis on subjectivity and the iterative process of analysis and design. For the design of the socio-technical component, Mumford's ETHICS would be a suitable method [Mumford, 1985]; and so on; for every component of the multi-view model, it is possible to identify a suitable approach.

The Multi-view methodology has the merit of stressing the importance of the various aspects in the design of real life information systems, particularly the social context of the information system towards which the conventional methodology takes a neutral stance. Clearly it is demanding to apply this methodology, since it requires one to know all the other methodologies to be able to adapt each of them to the relevant quadrant. What is not clear, however, is how to put the results of all the methodologies together to come up with a coherent system. For the practitioner in the field of information systems, the multi-view methodology may be confused with a methodological pluralism, and as has been argued, "if we look at the situation of the practicing analyst we find that methodological pluralism could create serious existential dilemmas for responsible practitioners" [Klein and Hirschheim, 1987(b): p.295].

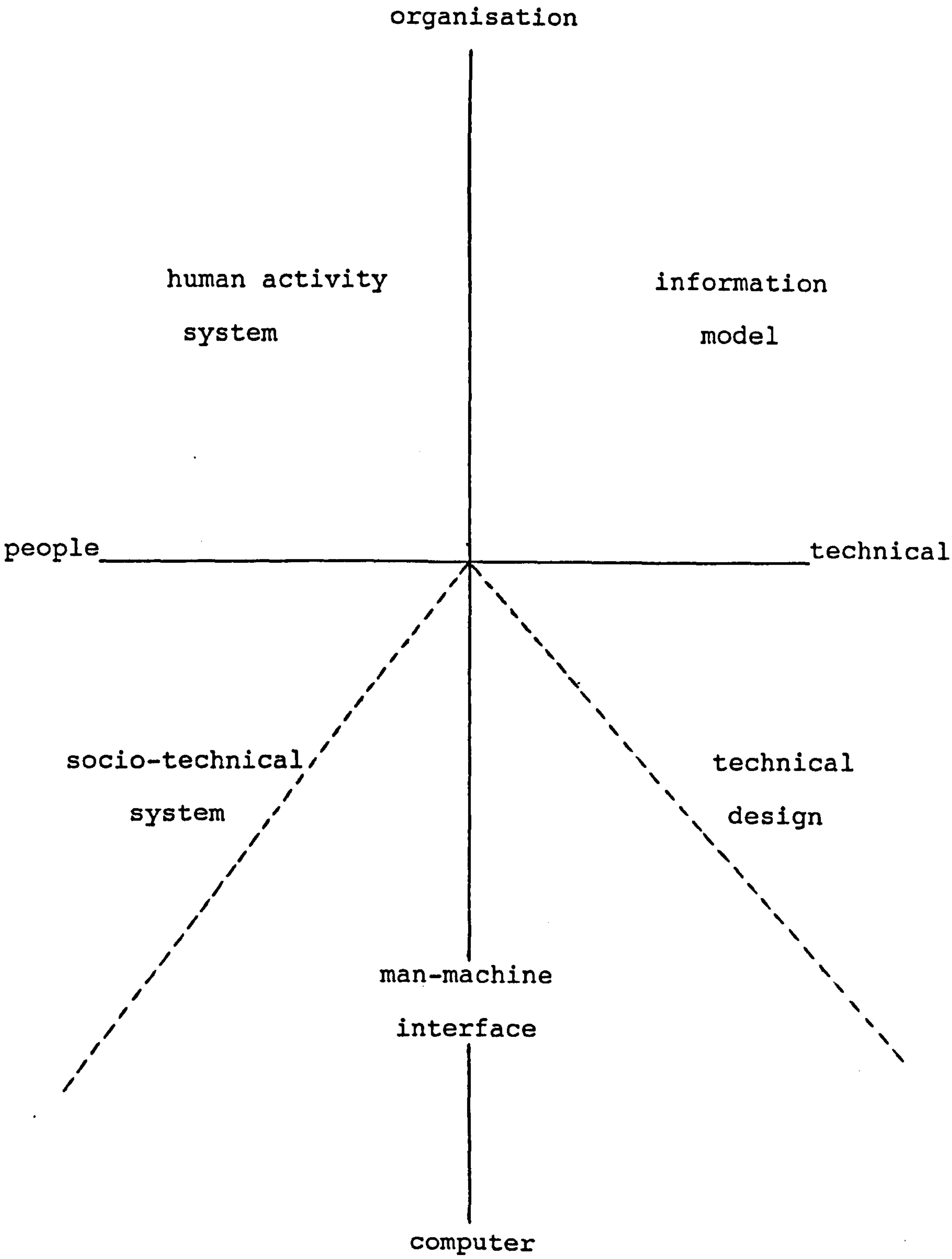

Fig.2.4. The multi-view model.

As we can see, some of the shortfalls of the system life-cycle are dealt with by the other methodologies. For example, there has been a shift towards taking more interest in the human component in the design of information systems. This was a response to the failures of the system life-cycle. Without implying a rejection of the importance of the human element in the organisation, we can, nevertheless, argue that information systems failures may (also) be a consequence of the faulty design of the organisation. It is obvious that none of the information systems design methodologies deal with this issue in any way. All the methodologies take the hierarchical structure of the organisation as a "matter of fact" framework within which to design an information system.

We have seen in section I above how an information system is intimately coupled to the organisation. Designing the image system (i.e. the information system) must take into account the shape of the organisation (i.e. the real system) for which it is intended. In other words, information systems design methodologies must be equipped to face up to the possibility of dealing with a pathologically designed organisation. The above-mentioned methodologies lack this capability; the only type of organisation they deal with is invariably an hierarchical organisation. In the following section we seek to gain more understanding of the organisational framework within which information systems are, today, made to operate.

IV. THE STRUCTURAL REQUIREMENTS OF AN INFORMATION SYSTEM

The ability to effectively coordinate the various functions of an organisation depends on the number and variety of the functions involved in carrying out the organisational task and the communication channels available between the functions.

With the increase of organisational size and task complexity, the number and variety of functions necessarily increases, which makes direct communication as a means of coordination impractical. One way to overcome the difficulty and facilitate coordination, is to "specify the necessary behaviours in advance of their execution in the form of rules and programmes" [Galbraith, 1973: p.10]. Programmable decisions are the type of decisions for which guidelines for action already exist. They arise in well-structured situations, frequently they are found at Anthony's operational level of control in the organisation [Anthony, 1965]. The obvious advantage of having rules and procedures is to limit the amount of information flowing in the hierarchy, but this kind of arrangement is not applicable at all hierarchical levels. The application of rules and procedures is feasible only for structured problems, where decision making can be programmed in advance, for example inventory control situations. As such they are limited to the operational level of the organisation (refer to ch.13).

The organisation's need for information would not be such an important issue if the problems it faced were limited to those at its operational level. However, there are quite a number of situations and problems of management which the modern organisation has to face which are not structured to allow the application of programmed decision making. Management of unstructured situations or, in the words of Ackoff, "messes" [Ackoff, 1981(b)] requires a different approach and different information needs. The managerial activity dealing with non-programmable decision making is associated with the higher levels of the hierarchy. These levels are commonly referred to (following Anthony) as management control (or tactical management) and strategic planning.

Ever since it was formulated by Anthony, this framework has dominated as the guiding principle for the discussion and determination of information requirements for management at the various levels of the organisation [Kast and Rosenzweig, 1985; Rahman and Halladay, 1988], where "the objective is development of better information decision systems for management" [Kast and Rosenzweig, 1985: p.431].

Temporally, the concerns of operational control are with the daily operations of the organisation; management control deals with short term planning; and strategic management tackles the long range planning issues of the organisation [Hartman et al., 1986]. In addition, some authors distinguish or identify within the operational control level the so-called transaction or data processing level [Davies, 1984; Hicks Jr., 1984], where the inputs to operational control are the outputs from the transaction processing level. Graphically, according to this model the managerial layers to be served by the organisation's information system appear as in the pyramid of fig.2.5 below. The vertical dimension of the pyramid can be conceived as made up of the various functional subsystems of the organisation, i.e. personnel, marketing, finance, etc. Each of these subsystems may have its own files and applications with its own software (see ch.11 and ch.14), at the same time all the subsystems (functions) are served by a general database.

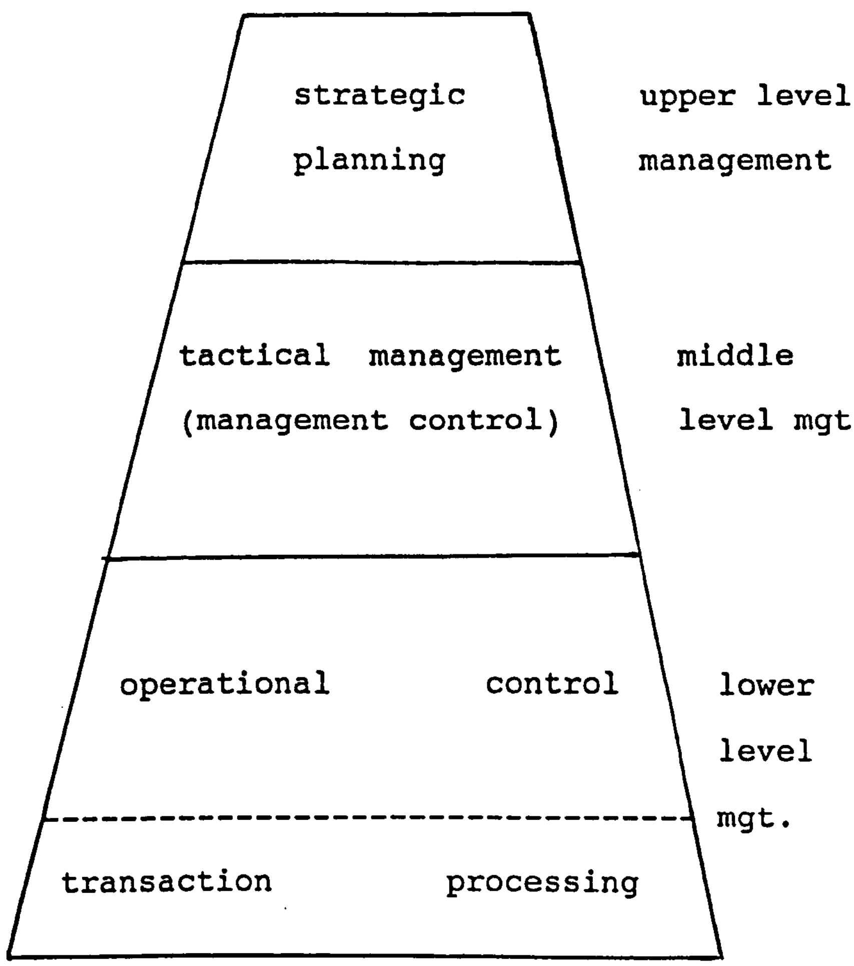

Fig.2.5. The pyramid of information requirements of an organisation.

The following subsection will concentrate on the lower level of the hierarchy, namely the operational level.

IV.1 INFORMATION REQUIREMENTS OF OPERATIONAL CONTROL

The activity of operational control is about ensuring that specific tasks are carried out effectively and efficiently. In other words, ensuring the right tasks are executed and in the right way. From a temporal stand point, the decisions made at the operational control level depend mostly on real time information. For example a depot foreman of a distribution company would be interested in the number of orders shipped to customers, the stock level, etc., whereas management control and strategic planning deal with information which has greater time delays.

Decision makers at the operational level of the organisation are closely associated with the physical system, that is the collection of activities by which the inputs are converted into outputs. This physical system and the corresponding information system make up the operational control level. Consider fig.2.6 below. This figure depicts the flow of information in support of management running the operation of converting the inputs into outputs. This information subsystem is designed to meet the requirements of the decision process at the operational level.

As we mentioned above, management at this level deals, basically, with well defined and well structured problem situations, that is to say decisions are programmed in advance to speed up the operations.

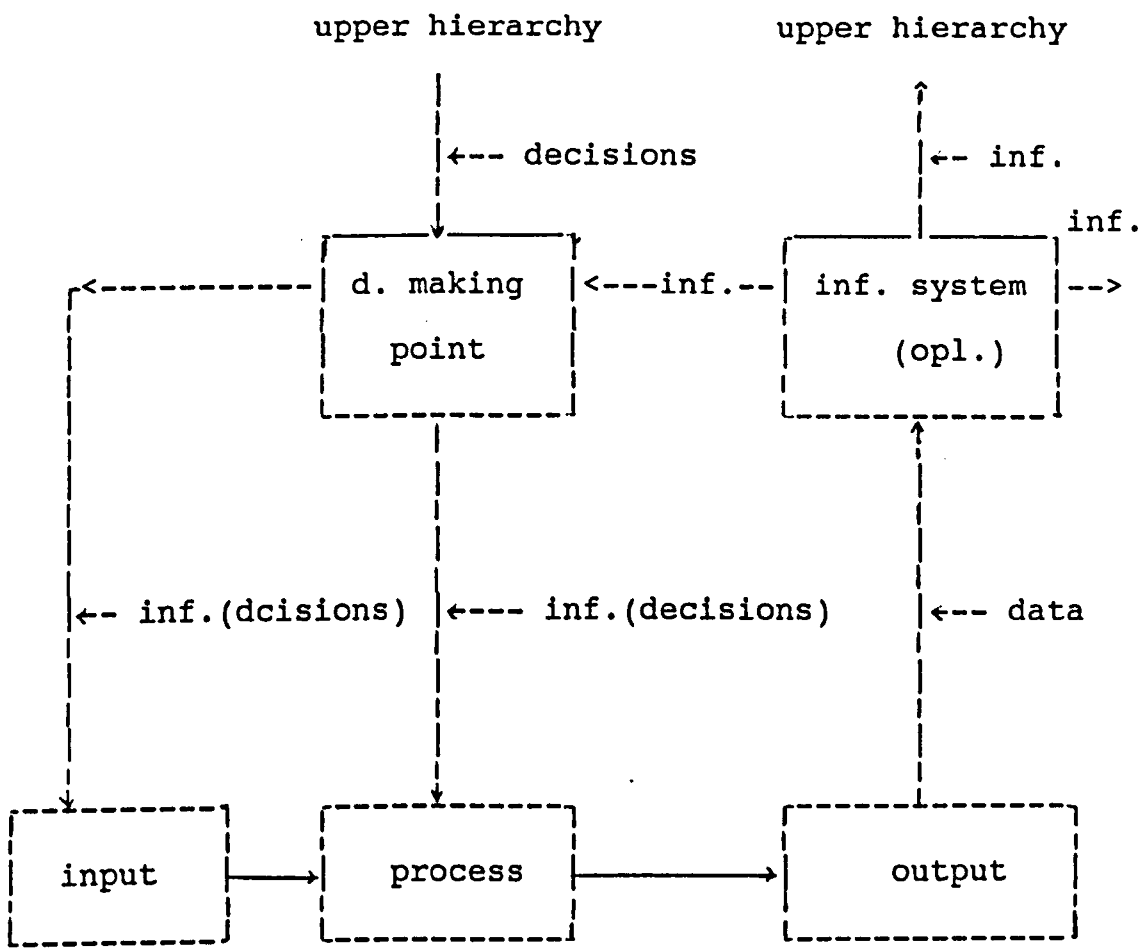

Fig.2.6. Operational control information system

Conceptualisation of the operational control level in terms of input --> process --> output is particularly useful. It is general enough to cover a wide range organisations, profit and non-profit making, manufacturing and service organisations. The concern of the decision makers is to find the best combination of inputs to produce the optimal output. In production situations, for example, programming techniques (linear programming, etc.) are readily available for application to help achieve optimum outcomes. Similarly, in service organisations, elaborate techniques are available to facilitate the programming of decisions at the operational level. Consider for example an inventory control situation.

If the decision variables such as demand for a product, cost of stocking and ordering the item and cost of stock-out are known or can be estimated (case of stochastic demand) with reasonable accuracy [Lewis, 1982], then the optimum stock level can be determined following well defined rules and procedures [Lewis, 1981].

The system depicted in fig.2.6 above is basically a rational system, meaning that the actions taken in the process of converting the inputs into outputs follow logical rules. These rules can readily be translated, if desired, into a computer programme for automatic operation and such computerisation can be extremely beneficial [Lingarage and Balasubramanian, 1983].

The impressive growth in information technology and the accompanying drop in the cost of acquiring and introducing it into the organisation [Nixon, 1986], and the arrival of new techniques to support decision making (such as decision support systems for example), all helped to enlarge the scope of operational control to encompass areas which where, not long ago, considered the exclusive domain of factory production and job scheduling. The newly conquered areas include, for example, financial modelling, control of cash transactions, purchasing, control of sales, etc. [Rahman and Halladay, 1988].

The data requirements of operational control are distinct from those of management control and strategic planning. Operational control uses exact real time data, often not of a financial character. Management control, on the other hand, is less interested in the details of customer orders (for example) or the number of items being shipped for the day. It is more interested in the overall performance of the operations under its control, and the financial aspects reflecting that performance.

As fig.2.6 above indicates, the information generated by the operational control information subsystem is not confined to the operational level. It provides the upper echelons of management with information necessary for control and planning. Part of the information flows are also destined for the environment, for example (in the case of inventory control), invoices and payment requests sent to customers.

IV.2 STRATEGIC PLANNING INFORMATION REQUIREMENTS

Top level decision makers in the organisation deal with "strategic" issues [Dutton and Duncan, 1987]. These issues are seen as the events, developments and the trends in the external environment which have a potential impact on the performance of the organisation [King, 1982]. The effectiveness of the organisation depends on how it can adapt to the changes taking place in the environment. The strategic planning process includes such major elements as the choice of goals of the organisation, the choice of resources required to achieve them, and eventual modification and changes to these goals [Kono, 1984], also the policies to adopt for the acquisition of the resources [Anthony et al., 1972; Sethi, 1982]. These authors argue that the strategic planning process as a normative model is a valid concept for all organisations, but the process by which it is undertaken in a particular organisation is determined by the characteristics of the relevant organisation [Hax and Majluf, 1988].

In general terms, the strategic planning process can be seen as producing the long-range plans that will affect the nature and the direction of the organisation. This kind of planning is characterised by its irregularity. A strategic plan can be the outcome of an opportunity presented to the organisation. The appropriate model to adopt depends on the issue or the situation being faced. If quantifiable models are readily available for the structured problems of operational control, at the strategic level the problem situations which face management are mostly unstructured. Therefore, no mathematical model can be made available (given the present state of the art).

We have seen from fig.2.6 above that strategic management obtains part of its information from operational control and from management control (see below). The huge quantities of information emanating from these two levels need to be recast to answer the questions posed by the "messy" problems faced by strategic planning. This recasting has to take into consideration the fact that "the human decision maker is seen as limited in his or her ability to process information" [Hartman et al., 1986: p.467].

Decision support systems are increasingly gaining acceptance by management as tools useful in helping with decision making at tactical and strategic levels [Rahman and Halladay, 1988]. This acceptance is made possible by advances in computer technology, which "are now opening new horizons for the application of information technology to serve middle and senior management in many organisations" [Collins, 1984: p.36]. A decision support system (DSS) is distinguished from the conventional management information system (MIS) in that it allows the use of models by management [Goslar et al., 1986]. A computer-based DSS can be seen as made up of three components [Boncezek, et al., 1981; Keys, 1985]: Language system, knowledge system and problem processing system. Through the language subsystem the decision maker or the user is connected to the problem processing system. The latter is the main part of a DSS. It carries out the tasks of problem recognition, model formulation, information collection and analysis. The data interfaces are provided by the knowledge subsystem. It contains the database file and the knowledge pertaining to the problem. The modelling languages used in DSS's tend to be higher than the existing high level languages employed to communicate with the computer (for example Fortran, Pascal, etc.) in that the modelling languages of DSS are more English-like, with limited and simple mathematical manipulations. However, we should bear in mind that DSS does not provide solutions, it rather provides a "methodology to enable solutions to be generated " [Keys, 1985: p.510].

There are a number of applications which advocate the adoption of computerised tools for strategic planning [Bielefeld et al., 1986], but it is too early to know whether they can be successfully applied. Owing to the type of unstructured problems and "messy" situations management is faced with beyond the operational level, the full scale introduction of computerised information support systems is risky and is unlikely to gain the full confidence of the decision makers [Aldag and Power, 1986].

IV.3 INFORMATION REQUIREMENTS OF TACTICAL MANAGEMENT

Along the spectrum from well structured problems to messy ones, and somewhere between operational control and strategic planning, lies tactical management or management control. It is difficult to find clear cut boundaries between the levels of management. It may be argued that recent developments in information technology (the software as well as the hardware side) as manifested, for example, in the development of DSS, have brought tactical management nearer to operational control in the sense that more attempts are made to structure problems hitherto considered as messy. Nevertheless, tactical management remains more akin to, and overlaps with, the strategic level, in that the problems it confronts remain largely messy and unstructured. It operates within the framework established by top management. It does not decide on the objectives of the organisation but it has the responsibility to make sure that resources are obtained to achieve the objectives.

Unlike operational control, tactical management is usually built around the financial structure of the organisation [Rahman and Halladay, 1988]. In other words, the inputs to the information subsystem serving tactical management are expressed in monetary terms. It is an agreed convention that monetary values are the units by which performance or outputs of the different subparts or functions of the organisation can be compared and evaluated. However, this is not to say that tactical management needs to be exclusively dedicated to monetary measures to evaluate performance.

We can conclude from this section that traditionally an information system is required to fit structurally the organisation for which it is designed. Since the latter is of an hierarchical character, the information system (which is its mirror image) also takes an hierarchical form.

V. INFORMATION SYSTEMS AND USER PARTICIPATION

In this section we try to deal with the question of user participation in the design of information systems. The contention here is that this participation is itself subject to the operating structure of the organisation. As we shall see, the methodologies which argue for user participation overlook the fact that the hierarchical nature of an organisation is an important aspect that cannot be taken for granted without seriously undermining the case for user participation.

The conventional methodologies which were developed around the concept of the system life-cycle (above) are built on the premises of the objectivist position. This position is characterised by realism, i.e. the system under consideration is "objectively" given, independent of the system's analyst and designer. Also, from an epistemological stand point, the designer follows a positivist approach, where the observed situation is explained in terms of cause-effect relationships [Klein and Hirshheim, 1987(a); Hirshheim, 1985]. In this objectivist position, different view points about the system under consideration are not allowed for and are seen as a reflection of human error:

"Inconsistencies between different views are unwarranted and a threat to data integrity" [Klein and Hirshheim, 1987(a): p.9]. Scientific method is considered as the appropriate method of analysis and can lead to a correct appreciation of the system of concern.

One of the beneficial consequences of following this path of reasoning is to encourage researchers to improve the tools and the techniques which help to "safeguard against the fallibility of the human mind in coping with the technical complexity of information systems development" [Klein and Lyytinen, 1985: p.137]. However, rigorous analysis characterising the scientific method is attainable "at the expense of relevance and the question 'relevant to whom?' is not accessible to the rigorous methods espoused" [ibid: p.138]. To take up the latter point, a "scientifically" designed information system can be a means by which to perpetuate the status-quo and maintain the position of those who already hold power in the organisation [Klein and Hirshheim, 1987(b)]. This remains the dominant trend in technically oriented information systems design. In other words, the information system is designed so as to match the operating (hierarchical) structure of the organisation, without taking the step of questioning that structure. Information systems design has, as its main objective, the satisfaction of key decision makers.

The other side of the argument, i.e. the subjectivist position, implies that reality has no existence independent of observers. It is what individuals perceive it to be. This means that the inconsistencies, which the scientific method strives to eliminate, are not considered as errors, but rather as a sign of the existence of the many ways of constructing an image of "reality" [Checkland, 1981]. According to this way of thinking, information systems are social systems with technical ingredients [Land and Hirshheim, 1983]. This, of course, differs from the conventional wisdom which considers information systems as mainly technical systems with behavioural aspects. One important conclusion of the subjectivist argument is that information system design and implementation must be "dealt with in some participative fashion" [ibid: p.92].

It would seem that the subjectivist position is enhanced by the apparent failures of the information systems designed within the framework of the dominant "objectivist" stance. The problems of such information systems are wide ranging [Lyytinen, 1988]. For example, it is clear that having an elegantly designed and competent technical system does not ensure complete success and "numerous failures of technically competent systems have been attributed to 'people problems' " [Symons and Walsham, 1988: p.110]. The frequency of unfulfilled expectations from information systems is leading a number of researchers to shift from the conventional "formal - rational" framework to perspectives with more emphasis on the social component of the information system, especially the promotion of user commitment and participation [Land and Hirschheim, 1983; Wood-Harper, 1985; Mumford, 1985].

In her ETHICS (Effective Technical and Human Implementation of Computer-based Systems) methodology (see section III above), E.Mumford has developed a way to help non-technical people "to identify their efficiency, effectiveness and job satisfaction needs and problems" [Mumford, 1985: p.99]. It is claimed that within the ETHICS's framework it is possible to specify accurately the user's needs and requirements for information. The claim of this methodology is that people working in systems designed within the ETHICS framework will have a higher commitment to their work than those who are not in such a system. What is significant with ETHICS is that it does not give so much attention to the technical aspects of the design. This is entirely left in the hands of the computer professionals and database experts. This may give rise to problems of interface which cannot be removed easily, especially when the software documentation is of poor quality. Also noticeable is the fact that the ETHICS method fails to deal with the constraints which may be imposed on participation from having hierarchical relationships in the organisation.

Soft systems methodology [Checkland, 1981] is mainly associated with the design of the "object" system, i.e. the organisation. However, it has its advocates as an appropriate methodology within which to address the question of user participation in information systems design [Nelson, 1986; Wilson, 1980; Benyon and Skidmore, 1987]. Its main feature is the orchestration of debate through which individual "world - views" and appreciations relevant to problem - situations can be made explicit.

The question to ask, however, is: does the methodology ensure equal opportunity for all the participants? Can it really ensure paticipation? Jackson argues that this is not the case [Jackson, 1982]. His argument is that the participants are not on the same standing in the organisation, and do not always possess the same economic and/ or intellectual resources, the result of which is that "the existing social order, from which power is drawn, is reproduced... The methodology, therefore, merely facilitates a social process in which the essential elements of the status-quo are reproduced" [ibid: p.25]. In addition to the unequal opportunity regarding intellectual resources and access to information pertinent to the situation, there is the question of the operating structure of social organisations. The structure of an organisation can prove to be a considerable constraint on the perceptions of the participants and can be a limiting factor to their degree of participation. "Disregard of the structure-in-use... makes it unlikely that any one viewpoint will be able to question this systemic constraint" [Espejo, 1987: p.13].

We can hardly have a genuine debate about participative information system design if we have, within the organisation, actors with power, actors without, actors who are informed and those who are less informed. Concentrating on the latter point, access to information is constrained by the available communication channels and the capacity of these channels to transmit the required information, and these are determined by the structure of the organisation. It is better to think of creating the conditions for genuine participation before participation is encouraged. This amounts to saying that we need to consider the organisation structure first and, for example, open up the communication channels in the organisation. As we have seen above, the information system is determined by the organisational context; put differently it is an image of the organisation for which it is the information system. The logical conclusion which follows is that genuine user participation in information system design requires a non-hierarchical form of organisation structure. This is not recognised by either "objectivist" or "subjectivist" approaches to information system design.

VI. COCNCLUSION

This chapter has explored the question of information system design. In the first section it was argued that an information system is no more than the image of the organisation of which it is an information system; this organisation is referred to as "the object system".

In the second section, a brief account of frameworks for the design of information systems in organisations was presented. It was seen that these models give an image of an hierarchical organisation. In the discussion of the methodologies for the design of information systems, it emerged that the system life-cycle methodology still dominates the scene. However, despite the fact that it is a well established methodology, it falls short of user expectations. In addition to this drawback (i.e. not meeting the expectations of the user), the life-cycle methodology is not equipped to deal with the anomalies that might be associated with the organisational design. This amounts to saying that the life-cycle methodology (and the other alternative methodologies) must take the hierarchical structure of the organisation as a given fact and build an information system to match the structure.

In the subsequent section it was made apparent how information systems are constructed to meet the requirements of the three-layer hierarchical structure of the organisation. In other words, being the image system of the organisation (refer to section I), the hierarchical structure of the latter is faithfully reflected by the information system.

Section V considered the subject of user participation. Here it was made apparent that user involvement is part and parcel of the organisational context. The degree of participation varies from one level of the organisation to another. The extent to which the participant can influence the outcome increases as we go up the hierarchy. The power structure as projected by the hierarchy can have an adverse effect on the perceptions of the participants and may prove to be a hindrance to effective paticipation. Neither "objectivist" or "subjectivist" approaches address this issue.

So, since an information system is the image of the organisation for which it is the information system, it is therefore necessary to consider the models of organisation as a prerequisite for providing a basis for information processing and transmission. Only by making the various models explicit and considering their strengths and weaknesses will we be able significantly to improve information system design. The remaining chapters of this part will be devoted to this task. The classical, the behavioural, systems and cybernetic model are considered. To what extent do any of these provide suitable basis for information processing and transmission? More particularly do any of them succeed in breaking with the dominant hierarchical conception of organisation?

Chapter 3

THE CLASSICAL MODEL OF ORGANISATION

Classical theorists view the organisation as a rational system in the sense that it should be designed in a "detached spirit" [Urwick, 1947] like designing a piece of hardware. The model is built on certain fundamental premises [Scott, 1981]:

.Goal specification: although most contributors to the model, particularly early founders, have not explicitly mentioned the necessity of specifying organisational goals, it is implicit in their writings that organisations as rational systems do strive towards desired ends.

.Formalisation of structure: this is considered to be the cornerstone of the classical model. The efforts of the classical writers centred on the architecture of organisations and how to make their behaviour predictable through an apparatus of well specified rules and relationships between the various components of the organisational hierarchy, independent of any human consideraions.

The structure is of a mechanical character, where all the components (i.e. positions) are specified, regardless of the individuals occupying them. Also the relationships by which the parts relate to one another are explicitly determined. No room is left for individual improvisation.

Our detailed discussion of the classical model is organised into the following sections:

.The main contributions to the classical model.

.The classical model and information processing.

.Some means to tackle the deficiencies of the classical model.

I.THE MAIN CONTRIBUTIONS TO THE CLASSICAL MODEL

Three major schools can be identified within the classical model [Jackson, 1985]. Combined together they form what has come to be known as the classical theory of organisation.

I.1 ADMINISTRATIVE MANAGEMENT THEORY

In his famous "General and Industrial Management" [Fayol, 1949], Fayol laid the foundation of this school. His contribution had a profound impact on subsequent writers of this stream of management thinking. In his book he specified six distinct groups of activities which can be carried out in any industrial organisation:

.Technical activities: because of their very nature, they assume "the prime importance" in any industrial concern; they are related to the process of turning imputs into outputs.

.Commercial activities: in addition to buying inputs (raw materials) and selling outputs (finished goods) they also include knowledge of competitors and "long term foresight" of the marketing conditions.

.Financial activities: for Fayol these activities are essential in an organisation. They involve the search for and the optimum use of capital.

.Accounting activities: they are necessary to provide information regarding the economic position of the organisation.

.Managerial activities: this group of activities is seen to involve planning, organising, command, coordination and control in an organisation.

.Security: this involves the protection of the persons and property.

Fayol held the view that the most important ability for the worker is technical ability, the relative importance of the managerial ability increases as we go up the scalar chain, becoming the most important skill for the top level executive.

On the basis of this conclusion Fayol considered that there was a wide-spread need for principles of management to guide managers in their function. Here is a summary of these principles.

1.Division of work. This is a specialisation principle, seen as necessary for the efficient use of labour. "The object of the division of work is to produce more and better work with the same effort" [ibid: p.20].

2.Authority and responsibilty. These two are related, where the latter is a corollary of the former and arising from it. For Fayol, authority is a combination of the official authority deriving from the official position of the manager and personal qualities of the latter.

3.Discipline. Fayol considered that discipline is "essential for the smooth running of business and that without discipline no enterprise could prosper" [ibid: p.22].

4.Unity of command. This principle implies that an employee should receive orders from one superior only.

5.Unity of direction. For Fayol this principle means that any group of activities having the same objective must have one head and one plan.

6.Subordination of individual interest to general interest. This implies that the interest of the individual or a group comes second to that of the concern.

7.Remuneration of personnel. According to Fayol remuneration of personnel should be fair and satisfactory to both employee and employer.

8.Centralisation. This refers to the degree of centralisation (or dispersion) of authority in an organisation. For Fayol the degree of centralisation is determined by the circumstances of the organisation.

9.Scalar chain. This refers to the line of authority from the highest to the lowest rank. This line of authority should be respected by subordinates. However, it can be short-circuited if the need arises.

10.Order. This concerns the arrangement of people and things, i.e. each person and each thing must be in its proper place. In turn, each person and each thing must be appointed a place.

11.Equity. This principle means eliciting devotion and loyalty on the part of personnel.

12.Stability of tenure of personnel. Fayol emphasised that high personnel turnover is a sign of bad management.

13.Initiative. This implies thinking-out and execution of plans. Fayol recommended that managers "sacrifice personal vanity" and allow their subordinates to exercise initiative.

14.Esprit de corps. In this principle Fayol highlighted the importance of team work and considered that "union among the personnel of a concern is a great strength in that concern" [ibid: p.40].

Fayol emphasised that the number of these principles could be extended to cope with different and new situations: "There is no limit to the number of principles of management" [ibid: p.19].

There are those who consider that Fayol's principles of management are no more than general guidelines at a broad level of generality. Others such as Simon are more critical and state that in addition to being "proverbs", they are in essence contradictory and their application leads to false expectations: "For almost every principle one can find an equally plausible and acceptable contradictory principle" [Simon, 1947: p.20]. Simon goes on to argue that they should not be elevated to the rank of principles. However, he does not insist on their total irrelevance. He advocated that these management principles should be considered only as "criteria for describing and diagnosing administrative situations" [ibid: p.36].

In spite of the criticisms, some if not all, of the principles of management are still in use, and there are many companies still organised along lines recommended by the administrative management principles.

I.1.1 BASIC ELEMENTS OF MANAGEMENT

As mentioned earlier, administrative management theorists, (like other classicists) rely heavily on structure and formal relationships inside the organisation as basic for the attainment of the organisational goals. The process by which to ensure the working of the whole machinery is through the elements of:

.Planning

.Organising

.Controlling

I.1.1.1 THE PLANNING FUNCTION

Planning constitutes an important part of the management activity. For Fayol: "The preparation of the plan of action is the most difficult and most important matter of every business" [Fayol, 1949: p.43]. Keeping in line with the conventions of this school, planning presupposes the setting up of goals. However, Fayol is only implicit about goal specification, in that his "plan of action" cannot be other than a means for achieving the organisational goal(s). Later writers, however, were more explicit and elaborate about goal setting as a first phase of planning [Urwick, 1947]. In their work, goals are set according to priorities and structured into subgoals, so that different parts of the organisation are responsible for the pursuit of particular and specified goals.

After goal setting comes forecasting: following through the implementation of "the line of conduct" as defined by the plan of action. At this stage we distinguish three types of forecasts:

.Short-term forecasts; they are defined as some sort of anticipatory summary of activities of the concern, and they should be flexible so as to take into account changes occuring within the organisation and outside it.

.Long-term forecasts: they are not different from short-term forecasts in any fundamental way. In fact they are a kind of a build-up of the latter in order to allow a longer vision to management, further ahead into the future.

.Special forecasts: these are intended as a back-up tool designed to encompass the type of activities which escape the cycles of other forecasts. However, their findings should be consistent with the other types of forecasts.

I.1.1.2 THE ORGANISING FUNCTION

Just as planning should be administered within the framework of the principles of management, the same is true of the organising function. It is basically a rational process, where management (given the objectives) coordinates the utilisation of the organisational resources, through the design and implementation of the management principles, namely, scalar chain, span of control and specialisation and departmentalisation [Gulick, 1937]:

.Scalar chain: this principle implies that organisational structure is considered as a pyramid and a continuous series of superior-subordinate relationships, starting from the top of the pyramid down to the shop floor. It is this chain which determines the line of communication inside an organisation . However, it is recognised by Fayol that there exist circumstances where there is "a need for swift action", whereby subordinates can communicate laterally and by-pass their superiors [Fayol, 1949].

.Span of control: is related to the number of subordinates a particular superior can directly supervise. It is argued by administrative management theorists that this number should be kept to a minimum; "a superior's authority should extend over no more than six subordinates, whose work interlocks" [Urwick, 1956: p.45].

Graicunas considered the total number of relationships a manager is required to supervise and found that this number progresses geometrically as the number of subordinates increases arithmetically. This could be calculated as follows [Graicunas, 1937]:

$$R = N*[2^N/2+N-1] \quad \text{where:}$$

R = number of relationships.

N = number of subordinates.

The above mentioned theorists only stress the need to keep the span of control at a low level. They are not clear about the optimum number of subordinates to a supervisor. Gulick argued that span of control is determined by factors such as the size of the organisation and the nature of the work performed, "...the limits of the span of control obviously differs in different kinds of work and in organisations of different sizes" [Gulick, 1937: p.7].

.Specialisation and departmentalisation: in Urwick's terms, "specialisation is the way of progress in human organisations" [Urwick, 1947: p.48]. Specialisation in this context implies assignment of tasks to individual specialists or groups of them, in order to increase (and improve) output. On the other hand departmentalisation is the grouping of organisational tasks, while taking into account the specialised nature of these tasks.

There is more than one way in which tasks and "work units" are grouped [Gulick, 1937]:

.by purpose,

.by process,

.by clientele,

.by place or geographical area.

In fact: "There is apparently no one most effective system of departmentalism" [ibid: p.31]. In most cases , it is carried out through a combination of the above mentioned methods. For example, geographical departmentalisation at the first level of the hierarchy , then by a process at the area level (or the second level)and so on.

Persistent preoccupation with the question of departmentalisation led (in more recent years) to the rise of what is known in operational research as assignment problem techniques [di Roccaferrera, 1964; Starr, 1971]. However, mathematical treatments of the assignment problem tend to rely on simplified assumptions and, therefore, they lack the usefulness of becoming guidelines in designing practical situations.

I.1.1.3 THE CONTROL FUNCTION

Control is understood to be the activities management undertakes to ensure that actual performance conforms to the planned, for all the activities carried out in the organisation. More recently, the control function has been elaborated further to include [Donnelly Jr., et al., 1971]:

.Preliminary control: which overlaps considerably with the planning function. It deals with setting up the right policies to carry out the plan.

.Concurrent control: like preliminary control it covers all organisational resources. It deals with the actual execution of the plan, through the whole apparatus of the organisational structure.

.Feedback control: this is a cybernetic concept (refer to ch.6). It operates on the basis of the information received (past data), in order to correct future courses of action.

From the literature of the administrative management school, conflicting views emerge as to by whom (and how) the control function is to be exercised. On the one hand it is widely argued that control is basically a management function. On the other hand (according to Fayol) the control function is to be carried out by a body independent of management: "a further danger to avoid is infiltration of control into management and departmental running" [Fayol, 1949: p.109].

I.2 SCIENTIFIC MANAGEMENT

This strand of management thinking is historically associated with F.Taylor. It was his contribution that gave the impetus to scientific management [Taylor, 1919, 1923; Pearson, 1929]. Fayol and his followers had considered the organisation from the point of view of top management looking down the line to the shop floor. Taylor was more pragmatic. He looked at the organisation from the opposite angle, i.e. from down at the shop floor up to the top level of the hierarchy. In fact his main concern was the functioning of the organisation at the operational level. His research was concerned with how to get the maximum production out of the work force for given periods of time. He believed that the adoption of scientific management would "readily in the future double the productivity of the average man engaged in industrial work" [Taylor, 1923: p.142].

Taylor's work centred around the notion of measurement of time and the amount of work that could be accomplished in that time, with the intention of coming up with a standard output for every type of work: "There is no question that the average individual accomplishes the most when either he gives himself or someone else assigns him a definite task, namely, a given amount of work which he must do within a given time" [Taylor, 1919: p.69]. In this respect he was the first to initiate the idea of time and motion studies at the worker level. Intellectually, however, Taylor's scientific management started (and remained) limited in scope. It was of empirical character, and dealt only with manufacturing organisations. In other words, scientific management contributed more to management practice than to management theory: "Taylor did not develop a broad general theory of management" [Kast and Rosenzweig, 1985: p.59].

I.2.1 BASIC FEATURES OF SCIENTIFIC MANAGEMENT

In analysing the performance of the worker, advocates of scientific management take the behavioural dimension out of the human being. He or she is looked at as a mere physiological organism: "The work of scientific management is more relevant to mechanisation and automation than to the broader psychological aspects of human behaviour in organisation" [March and Simon, 1965: p.13]. The work analysed is the kind of work that can be routinised and then standardised: "Taylor and his associates studied primarily the use of men as adjuncts to machines in the performance of routine productive tasks" [ibid: p.13].

In the context of scientific management, the main attribute of a worker's activity is that it is highly routinised and, therefore, can be subdivided into individual regularised movements. Consequently, the best way to improve performance is to standardise the activities to the last detail. Here enters the management. It is its task to provide ways and methods, and carry out the process of standardisation of workers' tasks, i.e. in terms of the time necessary to perform the tasks and the movements needed to carry them out.

Motion study, due mainly to the Gilbreths [Gilbreth, 1911; Gilbreth and Gilbreth, 1917], requires that a task is broken down into its subtasks and detailed movements connected with each subtask in conjunction with the machine and the tools used (motion is measured in what the Gilbreths called "therbligs"). Having done so, the specialist "recombines" the movements and the subtasks, eliminates the redundant movements and determines the best way to perform the task. The next stage is to calculate the time necessary for each subtask, to arrive at the duration needed for the completion of the whole task. This time and motion study will provide the basis on which the worker's wage is determined.

The underlying assumption of scientific management is that of the classical economic theory of the time which stipulates that people are motivated only by economic considerations. This dubious assumption about worker motivation is, very possibly, one of the reasons which led to its failure to become the dominant approach to management its founders had predicted it would be.

I.3 THE BUREAUCRATIC APPROACH

Being of a sociological background, Weber's bureaucratic model of organisation is better viewed and appreciated as part of his vision of the modern industrial society. The model was developed in the same historical era as the other streams of classical thinking on organisations, which is why they all tend to be mechanistic in nature and highly formalised. The fact that he was an academic (as compared to the practioners Fayol and Taylor) probably explains why Weber's model tends to be more descriptive as compared with the prescriptive nature of the other models.

The bureaucratic model is highly structured. It is meant to be the rational and most efficient solution to the complexities of modern large scale organisations. It was an alternative (and increasingly influential one) to the charismatic and traditional ways of leading and governing organisations.

People obey a charismatic leader, "because of faith in their personally extraordinary qualities" [Gerth and Milles, 1948: p.52]. In the case of traditional authority, obedience is owed to those who hold power because of personal loyalty and long "accustomed traditions". In a bureaucratic organisation, individuals owe their obedience to an impersonal order , to an office: "it extends to the persons exercising the authority of office under it only by virtue of the formal legality of their commands and only within the scope of authority of the office" [Weber, 1984: p.15].

I.3.1 BASIC FEATURES OF BUREAUCRACY

In his description of the model, Weber relied mainly on his theoretical reasoning in the construction of an "ideal type", rather than empirical evidence. The "ideal type" consists of the following basic features [Gerth and Milles, 1948]:

.Well specialised duties for the members of the organisation. In the modern context this amounts to division of labour.

.Offices of authority follow a hierarchical order.

.Personnel should have a "thorough and expert training".

.Total separation of public from private property, or avtivity.

.Complete devotion to the office from the person who holds it; "official activity demands the full working capacity of the official" [ibid: p.196].

.Participants' employment is on a permanent basis and their loyalty is devoted to "impersonal and functional" purposes [ibid].

The emphasis on the impersonal order, which in turn breeds rigidity of behaviour from the members of the organisation, and blind obedience to bureaucratic rules, may produce the desired internal stability of the system. However, those very rules and the inherent structural rigidity will resist change when it is manifestly necessary to change.

To recapitulate, the classical model treats organisations as closed rational systems. It does not recognise the environment as having influence on the internal structure of the organisation: "the model assumes that resources enter the organisation at a constant rate as it needs them and that the environment does not intrude into the organisation" [Jackson and Morgan, 1978: p.85]. However, organisations are open systems (refer to ch.5 and ch.6) since they import inputs from and export outputs to the environment. These contacts with the environment "necessarily influence the structure and internal operations of an organisation" [ibid: p.85].

In addition to being a closed model, the classical model is a "machine model" in that it fails to recognise the interdependencies of the parts making up the organisation. The problem with this is that: "the parts of an organisation cannot be viewed as operating independently but must be understood as parts of a system which interact closely together" [Jackson, 1985: p.28]. Another apparent deficiency of the classical model is its emphasis on the pursuit of the declared goal(s) of the leaders of the organisation without taking into account other groups in the organisation. These may have different rationalities and may pursue goals other than the goal(s) declared by the leaders of the organisation: "At the very least the social needs of people working in the organisation will affect the way goals are pursued" [ibid: p.28].

As it stands, the classical model is incomplete "because it looks at organisations in a mechanistic way. It is not particularly interested either in creating an adaptive organism or in fostering humanism" [Butler, 1986: p.289].

The intention of presenting the model in such detail is to make the circulation of information through the structure more transparent and make it possible to pinpoint any deficiencies of the model in its capacity to handle the flow of information inside an organisation. To this issue we now turn.

II. THE CLASSICAL MODEL AND INFORMATION PROCESSING

From the mechanistic nature and the pyramidal structure of the classical model, it is possible to distinguish different aspects of information handling inside the organisation. We shall do this in terms of operational and higher levels in the hierarchy.

II.1 THE OPERATIONAL LEVEL

At this lower level in the organisation's hierarchy (which as we have seen was the focus of scientific management), the nature of activities performed are repetitive and "standardized", requiring only limited knowledge. They are programmed in advance. The information requirement relevant to the task, and the resources necessary for its completion, are provided in the form of detailed programmes, in line with the objectives to be achieved specified at a higher level of the hierarchy [Simon, 1960]. Given the assumed stability of the activity level, all the information needs at the "shop floor" level are satisfied.

This state of affairs, and the need to push further task programming to higher efficiency have, no doubt, given rise to some of the mathematical techniques of operational research. One of these techniques which became standard practice for operational activities in many organisations, is linear programming. Its programming logic takes the following form:

$$\text{Optimize } Z = \sum Cj\ Xj,$$

subject to the constraints:

$$\sum Aij\ Xj\ \{ =<,\ =,\ >= \}bi$$

$$Xj >= 0\ ;\ i=1,\ldots,m\ \ j=1,\ldots,n$$

Z, is the objective function to be maximised (or minimised), depending on the situation under consideration. It is obvious from the formulation that (Z), is a linear function of the dependent variables Xj.

Xj, is the level of the activity j (output of activity).

bi, is the availability of the resource i.

Cj, is the financial contribution of Xj to the objective to be optimised.

Aij, is the technological coefficient, i.e. the amount of the resource i, necessary to perform the activity j, within the specifications of the technology in use for a given cycle of production.

In this kind of arrangement, the programme takes care of the changes that occur. For example a drop (or rise) in the number of production man-hours (or machines), or the reallocation of resources that are translated into the availability of raw materials, warehouse space, etc. These modifications are implemented by the (LP) model through injecting new values for (b's) at the right-hand side of the constraints. In the event of introducing new technology for improving productivity of workers (or machines), the programming logic of (LP) is constructed so as to cope with these additions by manipulating the technological coefficients (Aij). It can also be manipulated to accommodate new activities or dispose of some of the existing ones.

However, despite its successes in improving planning and implementation of operations at the shop floor level, mathematical programming is just that: mathematical abstracts for highly formalised situations, with many implied assumptions (linearity, additivity, etc.). It is (at best) an approximation of operational reality, (or mathematically, it is a limiting case of operational reality).

II.2 HIGHER LEVELS IN THE HIERARCHY

As organisations grow larger, "the number of levels of hierarchy increases" [Ouchi, 1977: p.99]. The increase in the hierarchical levels compounds the control problems in the organisation [Evans, 1975; Williamson, 1971]. The information flowing upward in the hierarchy concerns necessarily the exceptions which arise at any given level, that is the eventualities which cannot be predicted and programmed in advance by the organisation: "The non-programmed events place the greatest communication load on the organisation" [Galbraith, 1980: p.106]. The exceptions are channelled upward through the layers of management until (eventually) the top is reached.

The task of the individual manager is specified by the formal structure, and so is the scope of the authority within which he or she can act without reference to his or her superiors: "The information necessary for task completion is contained in rules" [Ouchi, 1979: p.835]. In other words, task specification relates to information regarding the manager's role as integrator of the tasks of his subordinates, and channelling down (the information received) in the form of instructions for further action, or in the form of feedback relating to each subordinate's performance. Decisions outside those limits are considered exceptions, and should be passed upwards to the next level in the hierarchy. The filtration of exceptions continues with the same logic at every layer to the top level. That is to say the classical (machine) model of organisation defines the instructions (information) that can be issued at every position, and what kind of information is to be passed upwards, and what is to be processed locally [Katz and Kahn, 1971].

If the validity of the premises of the model are adopted without question, then it might seem that the vertical flow of information, as described, is quite feasible and straightforward as long as the number of exceptions generated inside the structure is kept to a minimum. However, there are inherent features of the model that suggest otherwise, i.e. the validity of the model's assumptions cannot be taken for granted in the pyramidal structure described above. The number of exceptions an individual manager is likely to have to handle is a function of his span of control, i.e. the number of exceptions increases with the number of subordinates supervised. Reduced span of control will, necessarily, lead to the increase of the number of management levels, and widens the distance between senior and junior management. This will lead to the creation of time lags between the moment of generating the information and receiving a response in the form of a decision at the point of action.

Another consequence of the multiplication of management levels (in addition to time lags) is, again, the likely increase of the number of exceptions, as every layer in the managerial hierarchy generates its own exceptions, to add to the stream flowing upwards. The net result would inevitably be to overload top management with information that, otherwise, could have been dealt with at the operational level, if those in charge had the discretion to act.

To this structural rigidity, there is the behavioural aspect that should not be overlooked. The authoritarian character of the system leads to "...great constraints on free upward communication. The boss is not likely to be given information by his subordinates which will lead to decisions affecting them adversely" [ibid: p.51]. Another point related to the behavioural aspect is the downward flow. A considerable amount of information emanating from superiors is not always relevant, and not necessarily what subordinates expect or need from superiors. A subordinate receives instructions concerning his job and also information regarding his other obligations and priviliges: "Feedback to the individual about how well he is doing his job is often neglected or poorly handled" [ibid: p.44].

As organisations become larger, the more the need for horizontal differentiation is felt, i.e. more departments or divisions are created with specialised tasks [Ouchi, 1977].

It has been observed [Galbraith, 1973, 1980] that in large organisations individual departments or functional divisions tend to develop their individual jargons (refer also to ch.11 and ch.13). They do so because the specific jargon they develop provides them with the symbols relevant to their task needs. The multiplication of specific jargons may lead to the overloading of the information carrying capacity of the organisation.

It can hardly be said that the classical model of organisation fails to provide information for management- that it certainly does. The truth of the matter is, in fact, that it overloads management with information. Whether or not this is relevant, managers do not have the means or time to find out [Ackoff, 1967].

We conclude this section about information handling in the classical model with the remark that the classical model with its pyramidal structure is ineffective. It tends to produce valid information for the unimportant and programmed problems and invalid information for the important and non-programmed problems [Argyris, 1971].

III. SOME MEANS TO TACKLE THE DEFICIENCIES OF THE MODEL

This section is in no way a comprehensive review of the literature on the various attempts aimed at improving on the deficiencies of the classical model of organisation. We shall look at only two strategies which are considered (within the framework of this exposition) as especially relevant in the sense that they do not constitute complete and independent alternatives to the model. They are concerned, as we shall see, with the question of the flow of information inside an organisation.

III.1 THE CONTINGENCY APPROACH

This term is used here to refer to the strategies put forward by Galbraith [Galbraith, 1973, 1980], as possible courses of action open to an organisation in the face of mounting pressures from the environment. His propositions stem from the fact that organisations exist in a dynamic and changing (with an ever accelerating rate) environment. The faster the rate of change the more complex is the organisational task. Consequently, it is no longer possible for the organisation's hierarchy, to cope with the growing number of exceptions generated by the prevailing uncertainty. To counter such a state of affairs, and enable the organisation to improve its capacity to handle information regarding its activities, Galbraith advocates a strategy of two distinct (if not mutually exclusive) alternatives, each with a number of contingencies: active organisational response and passive organisational response.

III.1.1 ACTIVE ORGANISATIONAL RESPONSE

This strategy involves increasing the capacity of the organisation to process information in the face of the proliferating variety of the environment, in order to achieve the required level of performance. This takes the form of:

.Extending the existing and creating new channels (vertical) of communication, by making use of electronic data processing facilities. This contingency (supposedly) reduces the time lags between the origin of information and the moment of decision. With the extra speed in data processing, the organisation can increase the frequency of planning and replanning, therefore reducing the number of exceptions which are passed upwards in the hierarchy.

.Create and encourage lateral relations, which are "to selectively employ lateral decision processes which cut across lines of authority" [Galbraith, 1973: p.18]. In essence, this contingency aims at bringing down the decision making process to the point of action, by allowing direct and frequent contacts between line managers at the same level in the hierarchy who share the same problem. Lateral relations may take various forms, depending on the "volume" and time duration of the contacts involved. They could range from a quick communication between two individuals, to a lengthy meeting between groups of people belonging to different subtasks.

Creation of lateral relations as a contingency for action is not particularly appealing in the case where the organisation is subdivided functionally. Instead of facilitating communication, practical considerations relating to the formalised language used by subtasks (engineering design, production, marketing, etc.) would tend to create problems of interpretation and render efforts at improving communication fruitless [Burns and Stalker, 1961]. This is not to mention the fact that the very nature and composition of the groups, or "task forces", tends to make or render the outcome of group contacts less fruitful than might be hoped for. Also the individuals spared by their respective units for such contacts are, usually, the least competent.

III.1.2 PASSIVE ORGANISATIONAL RESPONSE

These strategies reduce the need of the organisation for information. This, in fact, amounts to reducing organisational performance. They take the form of bringing down the number of interdependencies between the subtasks, for example allocating new resources in cases where there is competition between the subunits for the same resource, or lengthening the duration of time for the completion of a task, if the degree of uncertainty of it meeting the target date is initially high. Although these particular courses of action may prove effective in reducing information overload on management, the cost of implementation and the difficulties of switching away from them, when it becomes necessary, makes them an ineffective choice.

The responses advocated here, whether active or passive, are relevant to the operational level of the organisation (production lines scheduling, stock holding, etc.) and possibly to the next level in the management hierarchy, where advances in programming techniques have made it possible to extend programmable decision making [Simon, 1960]. At these levels, we can assume that management has control over its operations. It can manipulate its courses of action with a reasonable degree of confidence. However, problems arising for organisations in dealing with information overload are manifestly most acute in the upper echelons of the management hierarchy. It is to this level that design strategies for information handling should address themselves.

Galbraith's contingency approach no doubt answers some of the criticisms directed to the classical model regarding its limited capacity to handle information flows. However, the basic hierarchical character of the model is taken for granted. As we shall see later (part II and part III) optimal flow of information in the organisation lies in the redesigning of its hierarchical structure.

III.2 MANAGEMENT BY OBJECTIVES (MBO)

It is hard to associate Drucker's work with any of the streams of management thought making up the classical model of organisation. Yet, it is equally difficult to put MBO outside the classical model's perspective. It is better seen as an extension of the classical approach to organisation with more recognition of the human content of the manager's job. To claim that MBO can constitute an alternative that can stand on its own, is a proposition very hard to substantiate. The key terms in Drucker's approach are "management by objectives" and "self control" [Drucker, 1968]. The first (and foremost) step of management is the definition and setting up of objectives. The enterprise is then organised accordingly. In this respect, Drucker is in total conformity with the classical approach to organisation.

The point of departure of MBO is the formalisation of the structure as the sole vehicle towards attainment of objectives (which is not different from the classical thinking). However, instead of considering the organisation in terms of span of control, one should look at it from the point of view of "span of responsibility", where there is no constraint to the number a manager can supervise, or "assist" to attain their objectives. Another important area in which MBO departs from the classical mode is its attitude towards specialisation of work (the manager's). Formalisation of structure is not the distinguishing feature of MBO. What sets it apart from the classical approach is the relative weight given to the manner in which objectives are set and elaborated. We shall now show how this is so in the following subsection.

III.2.1 SETTING THE OBJECTIVES

The idea of hierarchy is implicit in MBO. Managers "down the line" are supposed to set their own objectives, with the approval and help of their superiors. While setting his/ her objectives, the manager does so within the constraints of the objectives of the unit of which he/ she is part, those of the organisation as a whole, and in the light of the objectives of other components of his/ her unit. That is to say, a manager can set his/ her objectives only after getting to know the objectives of the next levels up in the hierarchy and concurrently with his/ her own peers. It is through these defined objectives that the manager's relationships and communications are defined:

.to the organisation as a whole,

.to his/ her superiors,

.and to his/ her subordinates.

A distinguishing feature of MBO from the conventional approach is that it puts the downward relationships of a manager in terms of "guidance rather than supervision or command. It derives from knowledge rather than from rank" [Drucker, 1968: p.170]. This implies that the activities of a superior are, to some extent, derived from those of his subordinates.

It is the case that MBO takes away some of the rigidity of the classical model, and allows more flexibility for the flow of information inside the organisation. This is because part of the information is processed locally. At junior levels, managers are relatively free to act in the face of new situations. However, continuously to monitor objectives, including necessarily those of the rest, the manager finds himself/ herself processing an amount of information which is more than he/ she can possibly cope with. He/ she is required to process information at his/ her own level, also process information pertaining to the objectives of his/ her peers, his/ her superiors and his/ her subordinates.

From an information processing point of view, MBO does not successfully tackle the problem of management being overloaded with information. With its arrangements, it simply transfers the problem from senior to junior levels. MBO does not provide an explicit arrangement to take care of information processing and transmission necessary for setting objectives and for ensuring that performance is in line with the objectives.

There is, however, a more fundamental objection to MBO as a self contained theory of organisation. This objection is mainly concerned with the whole attitude towards objectives themselves, as if they are real objects to be shaped and manipulated. Making objectives explicit, as implied by MBO, appears to be the privilege of "hard" or engineering systems. When dealing with social organisations or "soft" systems "objectives seem to be very elusive"

[Espejo and Watt, 1978: p.10]. Formal and specified objectives are in fact something of a hindrance to an organisation's adaptability. Such formalisation "is bound to be outdated soon by the natural processes of adaptation to environmental disturbances" [ibid: p.14]. A more constructive attitude towards organisations' objectives would be to start at the environment in which they operate. There are two fundamental factors management of social systems (organisations) should consider if they seek their effective control [Beer, 1979, 1981]:

.The degree of complexity and the rate of change of the system's environment.

.While striving for continued viability, a system obeys natural processes of self-regulation and self-organisation. This should be appreciated by management and made use of.

If these processes appear not to be accessible to our comprehension, it is only that they are lost in the uncertainty and extreme complexity characterising the system under observation (refer to ch.6). They are the mechanisms which enable organisations to continue to be viable. The more complex is the environment and the faster is the rate of change, the more imperative it is that management should allow flexibility for adaptation and facilitate the processes of self-regulation and self-organisation [ibid].

IV. CONCLUSION

In this chapter we have attempted to present the classical model of the organisation. It is believed that three strands of thought make up this model: Fayol's administrative management, Taylor's scientific management and Weber's bureaucracy theory. According to this model the organisation is like a machine built to achieve the desired goal(s) of those who control it. The organisation is a closed system in the sense that the environment in which it operates has no influence on its internal processes. Also, the classical model presents the organisation with a rigid hierarchical structure of a pyramidal shape, where the base of the pyramid corresponds to the operational level of the organisation.

This hierarchical structure presents difficulties for information flows. Owing to the well structured nature of problems tackled at the operational level, decision making can be programmed in advance. However, as we move up the hierarchy the number of exceptions increases and management becomes overloaded with more information than it can handle. In other words, from the data processing and information transmission point of view, the hierarchical structure is not the perfect answer and the classical model needs reconsideration.

Some attempts have been made to remedy some of the deficiencies of the classical model. However, these attempts show problems they fall short of providing a definite answer for patching up the model. Since the classical model is inadequate as a basis for information processing, it is necessary for us to move on and look for a more suitable model, i.e. a model which can provide a basis for information processing. The next stop in our quest is the behavioural model of the organisation.

Chapter 4

THE BEHAVIOURAL MODEL OF ORGANISATION

After the classical model, the next step in our quest for a consistent and comprehensive information processing model of an organisation is the behavioural model. Before we begin the exposition of the model it is desirable to explain, briefly, what is meant by the behavioural model, as a distinct body of management thinking. The origins of the behavioural model (BM) of the organisation can be traced back in time to the research on human relations in the early 1920's. This research flourished in the 1930's, during and after the Hawthorne studies to be taken over during the 1950's (and onwards) by what is known in modern management thinking as the behavioural science approach. Researchers are mainly interested in developing an account of the human element in the organisation, in order that management can take a proper approach towards individual (and group) motivation and attitudes towards work.

The Hawthorne experiments were (and still are in many quarters) considered as a major event in the human relations approach. Historically, however, interest in workers as more than economic units, and the impact of work environment on workers' performance was well in progress long before the Hawthorne studies [Rose, 1975].

Researchers in Britain [Rowntree, 1938] during the 1920's had come to disagree with the scientific management view of men, and reject the psychological assumptions of

Taylorism. What led these early reaserchers to disavow the classical thinking about the management of men, is partly that the business community in Britain at the time was better equipped intellectually, and more open to new social ideas concerning organised labour, and their implications for the necessary change of attitudes of management towards the workforce [Child, 1969]. The more "progressive" employers thought it advisable to consider, in addition to the primary material needs, the idea of giving "some attention to the question of 'secondary' social needs as these might be satisfied by new ways of managerial leadership" [Ibid: p.49].

The leadership of the human relations movement was, however, soon taken over by the much publicised work of Mayo and his Harvard colleagues at the Hawthorne plant in Chicago [Mayo, 1960]. The outcome of their experiments was the conclusion that the social element is the most important factor in an organisation's performance.

In this exposition of the behavioural model we attempt to pinpoint the social elements not taken care of by the classical model. Also, we try to show how informal relationships can enhance the flow of information inside an organisation. The chapter will contain the following sections:

.Group dynamics in an organisation.

.Individual needs and motivation.

.Communication patterns in the BM.

.The behavioural vs the classical model.

I. GROUP DYNAMICS IN AN ORGANISATION

The experimental studies on human relations at the Western Electric Company at the Hawthorne plant in Chicago began as an attempt to establish a relationship between work conditions and worker productivity [Mayo, 1960; Roethlisberger and Dickson, 1939]. It was believed by the experimenters that exact knowledge can be obtained, for example, on the relationship between the light intensity on a job and the output. As the experiments continued the results which emerged were unexpected, and the whole inquiry took an unexpected turn. The researchers were expecting definite answers within a year, but they discovered that they were dealing with social phenomena which could not be explained by the methods and tools of analysis of the time: "old methods had to be modified, and quite frequently new methods had to be introduced" [Roethlisberger and Dickson, 1939: p.3]. As a result of the unexpected turn of the inquiry, the experiments continued for five years [ibid].

The outcome of the five-year research at Hawthorne emphasised that an organisation is more than a formal arrangement of relationships, it is a social system. In other words, an organisation is a system of "cliques, grapevines, informal status systems,..." [Scott, 1967: p.34].

Although in this section we have restricted ourselves to working groups in organisations, we try not to limit our definition of a group. We keep the notion general enough to encompass other gatherings (not necessarily working together) that may evolve in a working environment which could have side effects on the performance of the organisation. A group is defined as "any manifold of persons, identifiable over a period of time, and sufficiently integrated so that its actions and objectives are identifiable" [Churchman, 1961: p.299].

I.1 THE FORMATION OF INFORMAL GROUPS

The phenomenon of small groups is ubiquitous in all organisations. Their formation is inevitable whenever people find themselves working together [Applewhite, 1965]. This inevitable formation is due to various factors:

.Common interest. By joining together, the members of a group are in a stronger position than as individuals, for example to pressure management, in order to gain certain financial ends.

.An ideal medium to satisfy higher order needs (see below). The need to socialise is strong in most individuals. Closely related to sociability is the need for belonging to a group. Through this belonging, group members can gratify their needs for self-esteem and self-actualisation. The group also provides security at work for its members, against reprisals from management, in cases where a member finds the need to protest against certain aspects of his work.

.Location. Another important factor which leads to the spontaneous formation of social groups in organisations, is working together at the same location. By meeting regularly at the same place, individuals tend to communicate, interact and establish relationships that may transcend their normal working concerns.

I.1.1 COHESIVENESS OF INFORMAL GROUPS

One important characteristic of the group is that it seeks to maintain itself as a group. Consequently, groups develop norms to which individual members should conform as a price for their belonging to the group. Pressure on members to conform can be beneficial. It helps the individual member (as mentioned earlier) to satisfy his social needs, confirm and validate his opinions, and define his relationship to his working environment. Pressure to induce conformity is found to be higher in homogeneous groups (for example group members having the same skill) than in heterogeneous ones.

However, group norms can have meaning only when there is a minimum degree of cohesiveness in the group. A group is said to be cohesive, when it holds certain attraction to its members, and when these, in turn, develop positive mutual attitudes towards each other. The following (not in any way exhaustive) are the factors which determine group cohesiveness:

.The frequency of goal attainment. Being successful enhances the status of the group, and that makes it more attractive for the individual to belong to such a group. Its success reflects the degree of mutual understanding and cooperation between the members of the group.

.Size of the group. It is less likely that in large groups all members know each other, which logically means that the degree of interaction and communication in small groups is expected to be higher. Contact and intercommunication are prerequisites for cohesiveness in informal groups.

.External pressure. Outside threat to the group's well being, in the form (for example) of supervisors or management's demands for an increase in the rate of production beyond which the group had settled for, would lead to reaction and a "closing of ranks" among the members of the group. This is even more so when outside pressure is more frequent. Not resisting the pressure and accepting management's demands requires modification of the internal working and behavioural patterns of the group. For management to succeed in implementing changes, and to persuade workers to accept the unknown is not an easy task, particularly with a highly cohesive group. Nevertheless, this is not to imply that changes are never acceptable to working groups. They meet with less resistance when they are introduced through the internal mechanisms of the group (the leader for example), and are compatible with the long term objectives of the group.

I.2 AN APPROACH TO THE STUDY OF WORKING GROUPS

Although the Hawthorne experiments are seen as the cornerstone of the human relations movement, over the years a number of other conceptual tools have been suggested by behavioural scientists to study working groups in organisations. These various approaches centre around variables like: group structure, members' activities and interactions and the influence of the group on its members.

As an example, we will cite Moreno's sociometric method [Moreno, 1947]. According to Moreno, this method is based on "a law of social gravity", which "seems to be valid for every kind of grouping irrespective of the membership" [ibid: p.288]. Sosciometry is the study of the tendencies that emerge in the group. These tendencies can appear in the form of attraction or repulsion of members towards one another, or towards their leader. Fig.4.1 below shows a sociogram pattern of attraction in a group. In a similar fashion, a sociogram can be constructed to represent the degree of repulsion inside a group. From this simple sociogram we can deduce the manner by which members informally choose their leader. The sociogram can be extended to show the degree of "fringe" belonging of some members in relation to others [Scott, 1967], and also how an individual can belong to more than one informal group (fig.4.2 below).

According to Scott, there are three categories of individual relating to informal groups [ibid]:

.The primary group category, i.e. the informal group in the strict sense (GI or GII in fig.4.2).

.The fringe status category, including those individuals who are not strongly attached to the group. This is shown (in fig.4.2) by the position of the elements (e) and (f) vis-a-vis both groups. Fig.4.2 also shows how element (i) is a member of GI and at the same time entertains a fringe status in relation to GII.

.Outside status category, which is made up of the rest of the workforce, i.e. all the individuals who do not belong to the group in one form or another.

Sociometry can be of practical use to management when it is dealing with small informal groups. It can help identify the leader and establish the degree of cohesiveness of the group, which can be a determinant factor in resisting management's proposed changes.

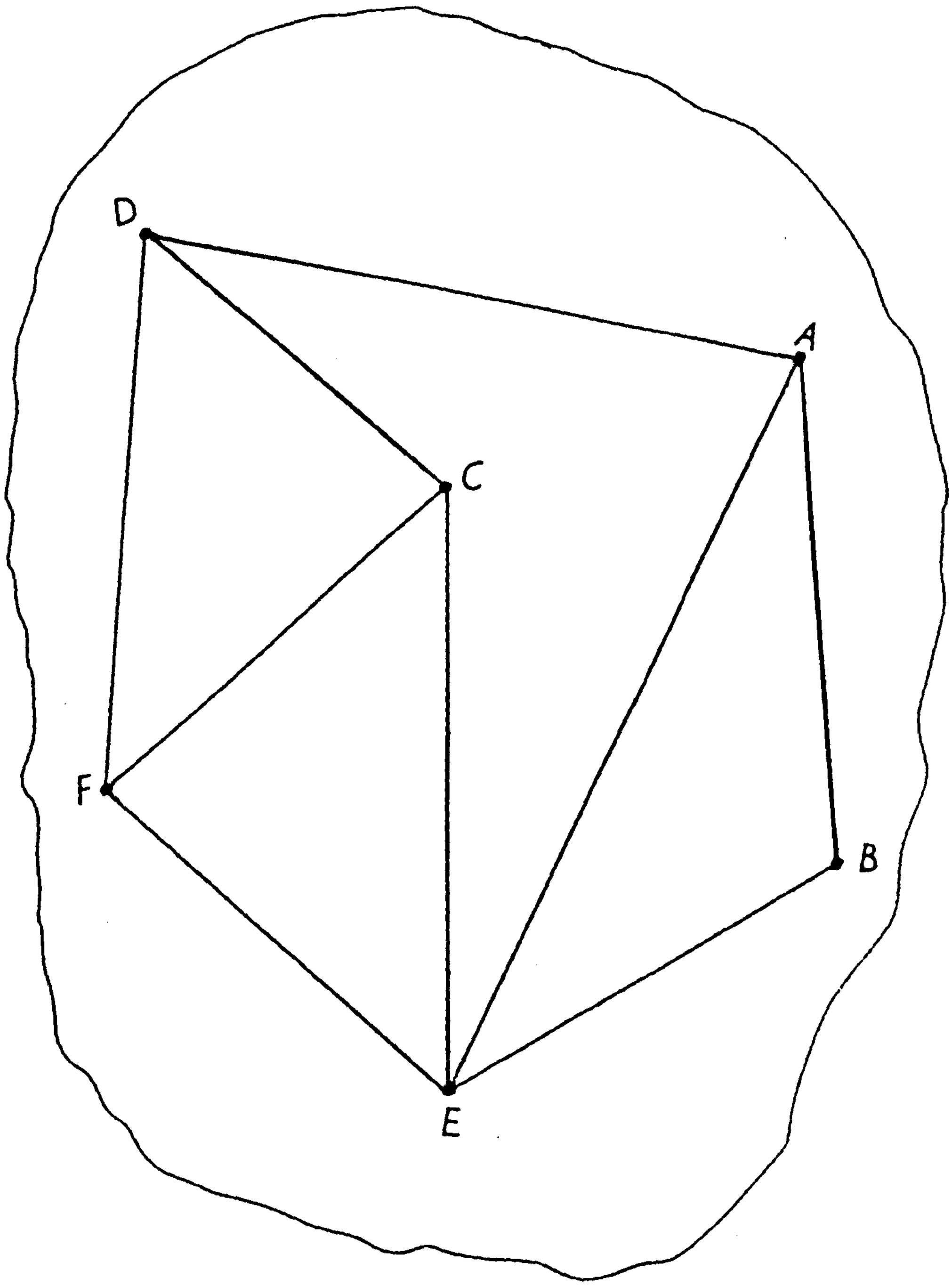

Fig.4.1. A sociogram pattern of attraction in a working group.

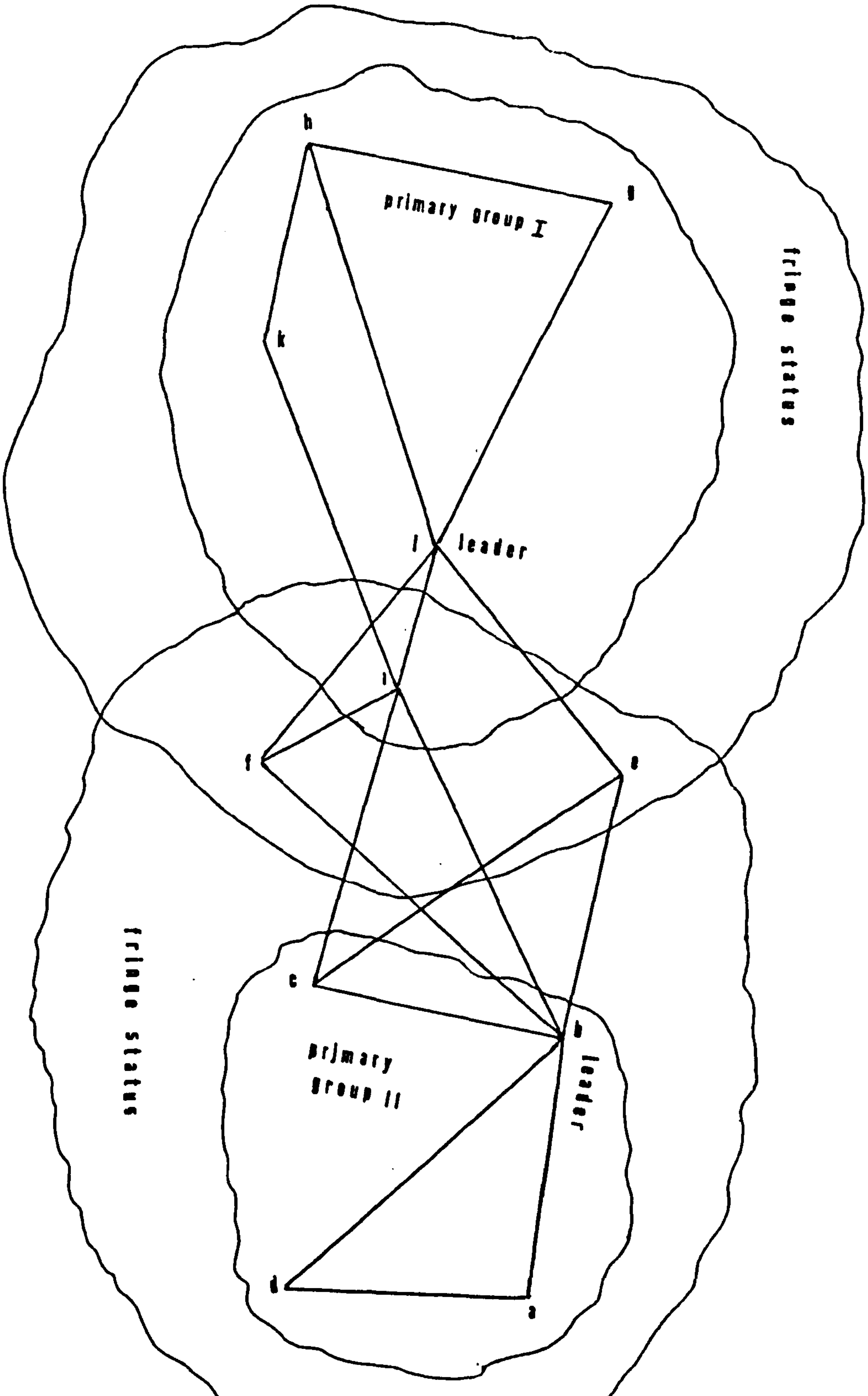

Fig.4.2. The different ways in which members can belong to a group (s).

I.3 GROUPS AND ORGANISATIONAL PERFORMANCE

Having dealt with the main and most relevant aspects of groups, it is important to look into ways by which this knowledge can be put into practice to improve organisational performance. In this respect, we cannot pretend to provide an exhaustive account of the many possible ways by which an organisation can be improved. We attempt here to provide some illustrations of how behavioural science findings can be put into practice.

I.3.1 SUPERVISORY ROLES AND INFORMAL GROUPS

Attempts have been made to take advantage of the strategic importance and power of small informal groups. It seems justifiable to integrate the formal supervisory role and the informal position of the group leader. This can be achieved by manipulation of supervisory styles. Likert advocates that supervisors should be encouraged to adopt an open and democratic style, or a down-to-earth attitude towards the workforce [Likert, 1961]. This is done by having direct contact with individual members and holding meetings with them to discuss work-related problems whenever the need arises. Members can also be allowed to participate in setting the objectives of the group (for example production rate), while keeping in line with the goal(s) of the organisation. In that way group members feel committed to those goal(s). On the other hand, rigid and autocratic supervision may lead group members (particularly if they are a cohesive group) to establish their own goals and reject those of the organisation, needless to say leading to adverse effects on production.

Generally speaking the open supervisory style, as advocated in the behavioural model, should not be limited to the operational level in the organisation. As an approach to improve performance, it transcends hierarchy levels, i.e. in theory it can be applied just as effectively by superiors at the intermediate level of the management hierarchy [ibid]. However, it is also argued that organisational leaders should have an open mind as to the appropriate style to adopt. It is not impossible to find cases of successful heavy handed leadership [Tannenbaum and Schmidt, 1969; Argyris, 1969].

Not all supervisors have the same need hierarchy structure (i.e. beyond the physical and security needs). Some of them are affiliation-oriented, and others are more achievement-oriented [Golembiewski, 1965]. Thus, it can be argued that supervisors who are motivated more by the need for achievement would be less inclined (than those who feel strongly for affiliation) to adopt democratic styles towards their subordinates [Forsyth, 1983].

Having said that, there are other factors in the organisation to be taken into account in judging supervisory styles, for example the technology in use and the organisation's prevailing culture. This amounts to saying that supervisory style as a tool for ameliorating organisational performance, cannot be isolated from other variables. Although considerable progress has been made in understanding individual behaviour, one should not be over confident about what motivates individuals. That, to some extent, remains situational [Robbins, 1976].

I.3.2. COMMITTEES: A CASE OF GROUP PARTICIPATION

Committees are an outstanding example of a working group in modern organisations. A committee stands out as a special case of group dynamics in the organisation, in that it is not a spontaneous creation. Its existence and its working protocol are a function of the specific objective(s) for which it is created. The committee, as a device for integrated decision making, is widely adopted at the middle and executive levels rather than at the operational level of the organisation. It is an effective tool for planning the implementation of changes in the organisation [Kast and Rosenzweig, 1985]. For example, by involving all departmental heads in the planning process for a particular change, committee members can gain a better understanding and contribute individually to the plan. If the functioning protocol of the committee is so designed that the success or failure of the operation is the responsibility of the committee as a whole, the divisional executive (committee chairman) can ensure commitment to the success of the planned change, not only of his direct subordinates, but also possibly of their subordinates.

In addition to their functional importance for implementing certain organisational plans, committees are a worthwhile medium for satisfying members needs for affiliation and self-expression. Belonging to a committee is sometimes a prestigeous affair and a boost for the social standing of the member in the organisation.

I.4 LEADERSHIP IN GROUPS

After the initial period of a group's formation, during which members get to know each other, individual roles start to emerge. The most important of these roles is that of the group's leader. In formal groups the role of the leader, and those of other members, are defined by the organisational chart. In informal groups the leader emerges from within [Donnelly Jr., et al., 1971]. The leader constitutes the focal point for any concerted action. He ensures cohesiveness of the group. Without him, every member pulls in his own direction and eventually the group will fall apart.

Some argue that leadership is difficult to identify and there is hardly an agreed working definition of leadership [Bryman, 1986]. Early research on leadership focused on the possibility of finding the personality traits that could differentiate leaders from non-leaders [Stogdill, 1948; Gibb, 1969]. However, there was no conclusive evidence to support this "personality-profile" approach to leadership.

In these early studies of leadership there was no clear distinction between management and leadership [Stogdill and Shartle, 1948]. More recently, however, some researchers have disagreed with early research and emphasised the distinction between managers and leaders. Zaleznik states that "managers and leaders are very different kinds of people" [Zalaznick, 1977: p.70]. They have a different outlook in the way they view things and in the way they act. If managers adopt impersonal attitudes towards goals and objectives, leaders strive to change the way people think and establish what is desirable. However, this view of distinguishing leadership from management is not held among all writers on the subject of leadership. As mentioned above there is no agreed definition of leadership [Forsyth, 1983; Bryman, 1986].

I.4.1 THE CONTINGENCY MODEL OF LEADERSHIP

According to Fiedler the success of leadership is contingent on two sets of factors. These are the leader's personal attributes and the nature of the group situation [Fiedler, 1978]. He built his model on two basic sets of variables: the leader's motivational structure, and the leader's situational control. To assess the motivational structure of leaders Fiedler designed his Least Preferred Co-worker (LPC) scale. He considers that there are two motivational styles of leadership. In other words, there is a type of leader who is relationship oriented or motivated. This type of leader usually sees his LPC in relatively more positive terms [ibid]. The other type of leader is a task motivated individual who usually has a low LPC score.

In relation to the second set of variables of his model (situational control), Fiedler assumes that an important feature of any leadership situation is the degree of influence or control exerted by the leader on the situation: "A high degree of control and influence implies that the leader has correspondingly high certainty that his decisions and actions will have predictable results and that they will achieve the desired goals..." [ibid: p.62]. The degree of control and influence is assessed by three variables [ibid]:

.Leader-member relation. This measures the degree to which the leader enjoys the support of his fellow group members. If the group members are loyal to their leader, then the latter can be confident that his suggestions can be carried out.

.Task structure. Fiedler considers this as the second most important dimension of situational control after the leader-member relation. The more structured are the situations, the easier it is for the leader to ensure the support of "the organisation in directing the job" [ibid: p.63].

.Position power. This refers to the degree of power of the leader over the group members, i.e.: "the degree to which leaders are able to reward and punish" [ibid: p.62].

No doubt Fiedler's model of leadership has its strengths [Forsyth, 1983]. Some empirical research seems to support the predictions of the model [Strobe and Garcia, 1981]. However, there are authors who disagree with the interpretations of the correlation findings of the model on the basis that they do not reach the conventional levels of statistical significance [McMahon, 1972].

I.4.2 PARTICIPATION AND LEADERSHIP

An experimental study of group-member participation was first attempted by Kurt Lewin and colleagues in 1939 [Lewin et al., 1939]. They carried out a study on a group of school boys which they divided into three groups, each led by an adult male. With the first group, a democratic style of leadership was adopted; the second group was led by an authoritarian leader, the third by a laissez-faire leader. Lewin and his colleagues concluded from their findings that the democratic style of leadership is to be recommended over the other two alternatives.

Following their lead, other authors have researched the participation issue in organisational settings [Likert, 1961; Coch and French, 1948]. Coch and French carried out an experimental study on a group of females in a garment factory [Coch and French, 1948]. Their findings also seem to support worker participation and democratic leadership style. However, there are those researchers who argue that we cannot generalise about group effectiveness and member satisfaction from participation in decision making. Vroom and Yetton consider that participative style leadership improves or enhances satisfaction and group effectiveness in certain situations only [Vroom and Yetton, 1973; Vroom and Jago, 1988]. In a sense their normative model of leadership is to some extent a contingency model, where no one single leadership style is relevant to all situations. However, it is important not to confuse their model with Fiedler's contingency model.

With this exposition of informal groups it is hoped that some insight is gained regarding the social nature of people at work. Understanding the social control informal groups exert on their members and the communication networks operating inside these informal groups can be of immense help to management for achieving organisational goals. However, an understanding of the individual as part of a group will probably not be sufficient to explain fully the behavioural aspects of people at work. In the following section we attempt to complement the social nature of people at work by the study of an individual motivation and needs.

II. INDIVIDUAL NEEDS AND MOTIVATION

The underlying assumption here is that individuals are similar enough to make possible an abstraction of the notion of need and motivation, and how they relate to behaviour. The basic model of human behaviour can be construed as follows [Herzberg et al., 1959; Herzberg, 1968; Maslow, 1970]:

.It subscribes to the natural science view of individuals, i.e. human behaviour is caused by stimuli, just like any other physical object.

.Human behaviour is goal-directed.

.Human behaviour is motivated.

This somewhat oversimplified model can make a starting point for analysis of human behaviour. However, for it to have any practical use, we need to include another, non-physical, dimension in the basic model, namely, the individual's personality.

For the sake of developing an argument we will accept that individuals are similar. We shall present the motivational needs in the way they affect the individual in his working environment and look at the extent to which management can provide ways, or favourable conditions, to satisfy them.

II.1 THE HIERARCHY OF NEEDS.

According to Maslow, human needs are patterned in hierarchical order [Maslow, 1970]. Certain needs surface only after an individual has satisfied other more basic needs. In Maslow's hierarchy, these basic needs constitute the base of the pyramid. We consider needs working up from the base of the pyramid.

II.1.1 PHYSIOLOGICAL NEEDS

This class consists of the primary needs of the human being. They pertain to the survival and maintenance of the body. There is no way by which we can make an exclusive list of all the physical needs: "It seems impossible as well as useless to make any list of fundamental physiological needs" [ibid: p.36]. The category, however, includes: food, water, rest, and sex. They are "the most prepotent" of all needs [ibid]. Until they are satisfied, they constitute the driving motivational force of the individual. Other (higher order) needs appear as simply non-existent, and are pushed into the background while the individual is seeking to satisfy his bodily needs.

For the working individual in an organisation, most of these are, at least, partially (if not fully) satisfied most of the time. This satisfaction is mainly derived through the salary the worker receives, and the working conditions (resting periods, air conditioning, for example) introduced in most modern organisations.

II.1.2 SAFETY NEEDS

Once the physiological needs are satisfied, they cease to be the dominating force over the individual. The next set of needs to assume command over the employee's behaviour are those relevant to his safety (physical or economic) needs.

Regarding physical safety, employees like to work in an environment which is accident free. As to economic safety, the more stable the employment prospects are for the individual, the more motivated and committed he or she becomes to his/ her work. Another form of the need for safety (i.e. economic) appears in the provisions for old age.

II.1.3 BELONGING AND LOVE NEEDS

This class of needs surfaces in the individual once physiological and safety needs "are fairly well gratified" [ibid: p.43]. They are closely related to man's requirement for companionship, friends and family. In addition to this more or less universal need the worker needs to feel that he or she is part of a group, with whose members he or she shares whatever the group may have to offer, for example, information, plans, fun, etc.

At this level in the hierarchy of needs enters into play the psychological (in addition to the purely anatomical and physiological) dimension. From this stage we have to consider what Herzberg calls the "psychological growth" of the worker [Herzberg, 1968]. This category of needs (and the next higher up in the hierarchy) have meaning only when the individual is part of the group. They cannot be abstracted out of the worker's social milieu.

II.1.4 ESTEEM NEEDS

According to Maslow [Maslow, 1970], these can be subdivided into two subsets:

.The need for self-awareness of one's competence, and self-confidece in one's ability to face the world.

.The need to feel the esteem accorded by others.

Satisfaction of esteem needs leads to the worker feeling self-confident "and of being useful in the world"; their suppression, however, leads to feelings "of inferiority... and of helplessness" [ibid: p.45].

II.1.5 SELF-ACTUALISATION NEEDS

The need of the human being to self-actualise refers to "man's desire for self-fulfillment, namely, to the tendency for him to become actualised in what he is potentially" [ibid: p.46]. The mode of acquiring this sense of achievement varies from one person to another, rests upon personal differences and relies on the psychological maturity of individuals.

Self-actualisation, is to a large extent, independent of the acclaim one may get from one's surroundings. In other words, self-actualisation needs derive heavily from the individual's inner sense of accomplishment, whether the employee be a manual worker, product designer or a manager. The emergence of this need "usually rests upon prior satisfaction of the physiological, safety, love and esteem needs" [ibid: p.47].

More support for the idea of a hierarchy of needs comes from Herzberg's motivation and hygiene theory [Herzberg et al., 1959]. In a study carried out on a sample of 200 employees (other than shop floor workers), Herzberg and his associates came to the conclusion that the factors which strongly determine job satisfaction are: achievement, recognition, work itself, responsibility and advancement [Herzberg, 1968]. On the other hand, the major factors that determine job dissatisfaction are: the type of supervision, company policy, salary, interpersonal relations and poor working conditions [ibid]. The important distinction to draw between the two sets of factors, is that the set of "satisfiers" relates directly to the task or the job itself, they are the motivators. The second set of factors is more concerned with the context in which the work is carried out, they are what Herzberg calls the "hygiene factors".

A positive employee attitude towards his or her job, requires that we should recognise explicitly the dual characteristic of human needs. An individual should have available, favourable "hygiene" conditions, which correspond to satisfying his "animal-like" needs; and be provided with the opportunity to attain psychological growth, i.e. satisfy his human needs (those which distinguish him from the rest of the animal kingdom).

II.2 SATISFACTION OF BASIC NEEDS AND THE ORGANISATION

Most of the literature of economists and the classical approach (as we have noted earlier) stresses the financial reward, and the various satisfactions the worker derives from the use of his or her pay, basically outside his working hours.

The contribution of the behavioural scientists, on the other hand, is to insist on the importance of the direct satisfactions the individual derives while at his or her work [Herzberg et al., 1959; Herzberg, 1968]. In modern industrial society, most of the physiological needs of people are satisfied most of the time. Thus, these lower level needs become no longer the prime motivator of behaviour [McGregor, 1960]. Management should turn its attention to the other needs up the hierarchy. One of the highly praised approaches to directing employee behaviour towards achieving organisational goals is through integration of the individual's goals and those of the organisation [McGregor, 1960].

It is the management's task to create a working environment such that the individual can perform his task satisfactorily and is encouraged to achieve his own objective and fulfil his high level needs, while at the same time, doing his best to attain the goals of the organisation. This integrative process can be carried out only if management discard its conventional view of workers (McGregor's theory X [McGregor, 1984]). The effective way by which organisations can influence positively employees' behaviour, is by making them the centre around which the organisation revolves. It has been argued by Argyris that people seek employment not only to earn a salary and satisfy their basic needs. They seek employment situations in which they are treated as adults and situations which offer opportunities for self actualisation [Argyris, 1964]. Job design theory has evolved as an important attempt to suggest how higher order needs can be met at work.

II.2.1 JOB DESIGN

Instead of tying workers to limited jobs, the tasks they do should be designed in a way that leaves scope for creativity. They should allow the worker to realise his potential and make his individual contribution to task improvement for which he can, eventually, assume responsibility. In this fashion management can provide the conditions in which the employee or worker is given a sense of achievement [Herzberg, 1987].

Herzberg states that a good job design implies job enrichment which "provides the opportunity for the employee's psychological growth" [ibid: p.114]. His argument is that it is essential that management adopts a more constructive attitude to job design and moves away from the traditional industrial engineering approach. He provides some of the following general principles for job enrichment [ibid]:

.Remove some control over the job while maintaining accountability.

.Increase the employee's accountability for his or her own work.

.Provide the individual with a natural unit of work.

.Grant additional authority to employees in their activity; give them freedom in their jobs.

.Make periodic reports on progress to workers rather than the supervisors only.

.Provide employees with the opportunity for learning by giving them more difficult tasks.

.Assign individuals specific or specialised tasks to enable them to increase their expertise.

Herzberg considers that job enrichment is a continuous management function rather than being a one off exercise. Job enrichment addresses (or targets) the individual motivators (as opposed to the hygiene factors). The nature of the motivators, he argues, is that "they have a much longer term effect on employees' attitudes" [ibid: p.117]. This implies that the initial changes in job design, in order to enrich employees jobs, must last a considerable length of time [ibid]. Herzberg maintains that not all jobs need necessarily be enriched. Nevertheless, job enrichment "remains the key to designing work that motivates employees" [ibid: p.120].

However, for some authors, job enrichment cannot be justified in advance [Reif and Luthans, 1977; Winpisinger, 1977]. It may not motivate certain types of people. There are workers "who are not necessarily alienated from work but are alienated from the middle class values expressed by the job enrichment concept" [Reif and Luthans, 1977: p.206].

II.2.2 THE NECESSITY OF DELEGATION

Another important recommendation of the BM is the encouragement of delegation. Delegation, here, refers to the effort to free middle and line management from the bonds of conventional organisation in order that they can satisfy their "egoistic needs". So it is carried out for these managers' benefit and not only because senior management is overwhelmed by the complexities of the organisation's task.

Giving divisional managers autonomy of decision making is an "unusual chance" to help individual managers to satisfy their needs for self-esteem. According to McGregor, it is in the interests of the organisation that management moves away from the traditional assumption that only the exercise of authority over individuals will ensure the attainment of organisational goals [McGregor, 1984]. He states that it is perfectly possible to integrate the goals and needs of the individual with the organisation's goals and requirements (if the member is seen in the light of theory Y). Perfect integration may not be attainable. Nevertheless, much can be done if the individual is encouraged to develop his or her knowledge and skills, and sufficient freedom of action is given to him or her to further the goals of the organisation, while at the same time satisfying his or her own needs.

In addition to it being an opportunity for subordinates to achieve their psychological growth, delegation of decision making can bring about various benefits to the organisation [Dale, 1969]. For example, freeing top management to dedicate itself to more important decisions.

We understand from the behavioural model that people and their needs and motivations should be the main focus of attention. Jobs and organisations should be designed to conform to members' needs and motivations. Members of an organisation can be motivated to achieve their own objectives while at the same time contributing to the achievement of the organisational goal.

Up to this point we have considered the importance accorded by the behavioural model to people, their needs and motivations and as active members of informal working groups. It is now time to consider the way communication in the organisation is treated by the behavioural model.

III.COMMUNICATION PATTERNS IN THE BEHAVIOURAL MODEL

The underlying assumptions of the behavioural model (regarding the structure of the organisation) are basically the same as those of the classical model. These assumptions do not seriously challenge the traditional pyramidal structure of the organisation. Nevertheless, emphasis on human relations in organisations brings into light dysfunctional consequences of a strict adherence to bureaucratic rules. Suppression of human needs and motivations drives organisation members outside the formal system, in order to satisfy their needs, and this may impede organisational performance and goal accomplishment.

In this section we limit discussion to the contribution of the behavioural model to the communication patterns in organisations. This is mainly confined to the informal group level. The rest of the discussion of information processing according to the model is deferred to the next section.

Sociometric analysis of small groups has revealed interesting communication patterns at the micro level. Generally speaking, the communication network in a group is affected by a number of different factors. Without pretending to make a full list of these, we mention for example the nature of the task performed by the group (whether this requires high technical skill and expertise), leadership, the cohesiveness of the group, its size, etc.

From research findings regarding communication in small groups [Shaw, 1954, 1958; Glanzer and Glazer, 1961], it is possible to narrow down the various patterns to the following:

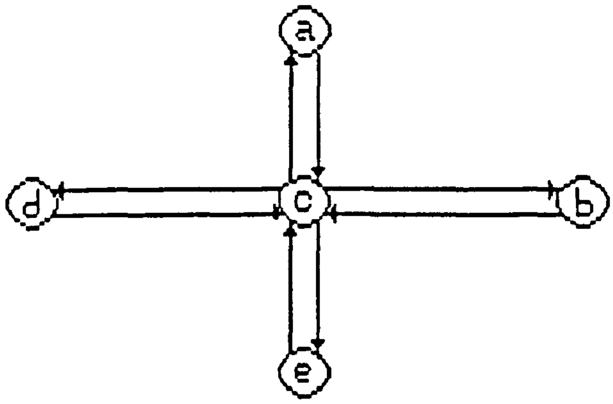

Fig.4.3 A wheel pattern of communication.

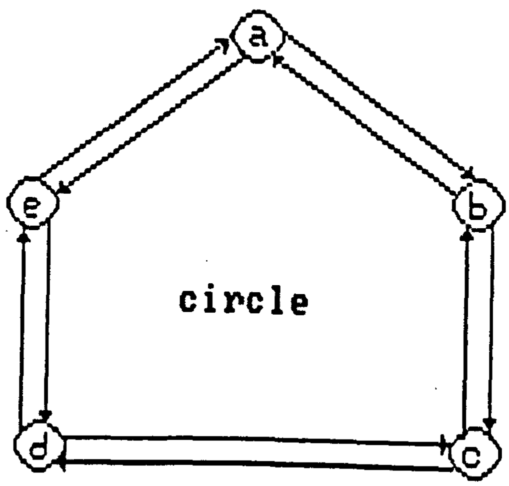

Fig.4.4. Circle pattern of communication.

.The wheel pattern of communication (refer to fig.4.3 above). We find a central processor of information to whom every member of the group communicates and receives feedback concerning his or her performance. The central processor coincides with the group leader. This pattern is particularly efficient in groups where tasks are relatively simple. The wheel (net) is the fastest of all nets, as the members are not required to know all the information flowing in the net. However, as the group gets bigger and the task becomes more complex, more skills are needed, and the network tends to become more decentralised.

.The circle communication patterns (refer to fig.4.4). As the task increases in complexity, the restrictions on communications placed on group members affect their performance; i.e. constraining their capacity to organise themselves (as a group) for an optimal performance. The circle arrangement is characterised by a relay system in which information is passed sequentially among members. In the circle group, interaction and exchange of information between individual members are important for the completion of the task: in this group there is no relay system by which the members are related to one another.

From an organisational standpoint, the wheel group is easier to fit in the formal organisation. The arrangement produces less redundant back and forth information and efficiency can be kept high. However, this may sometimes be at the expense of high morale and satisfaction.

The research findings from which the above classifications derived are the outcome of experiments carried out under controlled conditions, and depart from real life working conditions. In such situations the group task is unquestionably far more complex.

III.1 THE MICRO LEVEL AND ORGANISATIONAL COMMUNICATION

Although fundamendally, the behavioural model takes for granted the traditional structure of the organisation, there have been attempts to integrate the individual and the small group (i.e. the micro level) in the macro communication network of the organisation. This contribution takes the form of pinpointing the inadequacies of the conventional channels, and also suggesting the opening-up of informal (parallel) channels and new channels on the horizontal level to reduce the burden off the existing ones.

III.1.1 THE INADEQUACIES OF THE EXISTING CONVENTIONS

In classical organisations, communication is often of a downward type. There is little scope for horizontal and upward flow of information. This is due to faulty design and unsuitable climate (from a human relations point of view): "Subordinates tend to screen, withhold, and, in general, distort in various ways the communication directed upward... Such upward distortion is need motivated and goal-oriented, that it is related to the subordinate's security and ascendency needs" [Athannasiades, 1974: p.208].

Human frustration resulting from the prevailing climate in the bureaucratically-managed organisations is an outstanding drawback in traditional management. It can only lead to dysfunctional consequences: "Results of the laboratory experiments confirmed a tendency for senders to level or suppress unfavourable-important items sent to superiors" [O'Reilly, 1978: p.189]. Better upward communication is to be expected in a system designed to take into account the human relations aspects. These include developing trust between the subordinates and superior.

The absence of these considerations will increase the probability of superiors receiving information less relevant to achieving organisational tasks. One may assume that increasing the volume of information flowing on the vertical domain, besides the fact that it may lead to an overload of the system [Ackoff, 1967], does not necessarily lead to higher level managers in the organisation improving their performance: "As organisations have more and more of a sharp status pyramid, upward communication tends to be considerably inhibited, just as it is when the power is concentrated in the hands of a small elite" [Hage et al., 1980: p.313].

III.1.2 LATERAL COMMUNICATION

Within the framework of the conventional structure of organisation, lateral flow of information is restricted. Fayol accepts lateral contacts among peers, but only on an exceptional basis [Fayol, 1949]. From the BM's perspective this needs reconsideration. A case for the importance of lateral communication can be made from the need for "socio-emotional" support among peers [Katz and Kahn, 1971]. This compensates for the frustration subordinates encounter in their contacts with superiors. Direct contact among peers concerning certain aspects of their relevant tasks, if not provided for by the formal organisation, takes place anyway, simply because of the force of the need of individuals to socialise, in which case the informal contacts between subordinates outside the laid down procedures may not involve questions relating to their tasks.

It is suggested that as organisations become more diversified and based more on personal specialisation (as opposed to task specialisation), they have to rely less on the laid down procedures and programmed interactions to attain and maintain the necessary linkages between parts of the organisation. Instead, they rely on "a system of reciprocal information flows to achieve coordination" [Hage et al., 1980: p.313]. In such organisations the conventional method of sanctions as a mechanism of social control must be substituted by socialisation.

As a corollary to the increased discretion at the lower levels in the hierarchy, is the need to interrelate different departments (or units) and provide them with a common direction; since the exercise of discretion on the part of the organisational components may lead to conflicting objectives. To keep them on the same common ground and within the overall strategy of the organisation, they need to be informed about each other's operations adequately and faster than the conventional channels can allow. These horizontal communications are particularly necessary when the tasks involved are complex.

III.2 THE GRAPEVINE AS AN INFORMAL COMMUNICATION CHANNEL

A grapevine is a common characteristic of modern organisations. As a channel of communication it transcends the formal communication network as defined by the organisation chart. The existence of the grapevine as a parallel channel is probably a consequence of the inadequacies of the formally instituted channels of communication; "many administrators rely on it almost exclusively" [Davis, 1960: p.289]. Grapevine communication, is usually of an oral type. It is faster than the formal channel. However, it is not unusual for the information to be accompanied by personal interpretation and speculation. The likelihood is that the information gets distorted as it is passed along from one person to another, with each adding his or her own version and interpretation.

Attempts have been made to quantify the spread of rumours in an organisation [Allport and Postman, 1947; Chorus, 1960]. It is postulated that the transmission of information through this invisible channel depends on three factors [Chorus, 1960]:

.The importance of the rumour. The more important the rumour the faster is its transmission, for example speculation about the resignation of an executive or rumours about the closing down of a plant.

.The degree of ambiguity of the rumour. According to the rumour law (below), the greater the ambiguity of the rumour the greater the likelihood that it will be spread quickly [ibid].

.There is also a pure psychological element which stems from the "critical sense" of the rumour transmitter [ibid]. This critical sense implies the degree of resistance of a particular person to rumour. It is inversely related to the rate of rumour transmission. The relation that joins the three factors together appears as follows [ibid]:

$$R \sim I * a/c$$

where:

I = The importance factor of the rumour.

a = The degree of ambiguity of the rumour.

c = The critical sense factor.

It is obvious from the relation above that the absence of any of the factors (i.e. any one of them = 0) for a person in the chain will lead the rumour to stop. In other words, the relationship between the factors is multiplicative and not additive. The greater is I and/ or the faster is the spread of the rumour. The speed of rumour transmission is totally determined by I and a for an average person where (arbitrarily) c=1.

The greater is the resistence c of a person (for various reasons, for example, high moral standards, intelligence, knowledge of this basic law itself), the less chance there is that the rumour will spread. Clearly, the speed of rumour transmission is not constant throughout; it could increase, slow down or even stop, as it undergoes transduction at every node (person) along the chain.

In an empirical study [Davis, 1960], K. Davis found that the predominant type of grapevine chain of communication is that of a "cluster chain", in which only a few of those who have the information transmit it to others. These are the active receivers or the "liaison individuals". Those who do not transmit the information received are seen as passive receivers.

From the findings of his study he recommends that if management wants more communication and circulation of information, it should increase the number and/ or effectiveness of its liaison individuals. He also recommends a more conscious use of staff personnel as communicators and information transmitters. Equally, he found that socialisation plays an important part in the process of grapevine communication. As an informal channel of information transmission, the grapevine is a factor which management needs to take into account in the conduct of its affairs. Davis gives an example of one company of which he states: "Indeed the chain of command was seldom used in this company except for very formal communication" [ibid: p.295].

IV.THE BEHAVIOURAL VS. THE CLASSICAL MODEL

It is argued that the behavioural and the classical models of the organisation belong to the same (but more general) field of research, which might be called organisational behaviour. The classical model emphasises the formal aspect of organisation. It is built around the pyramidal structure, where the different relationships are devoid of any explicit human element. The total ignorance of individuals in organisations had generated a kind of reaction, which took seriously human involvement and influence on the functioning of organisations. However, even in the reaction, the hierarchical structure of the organisation is accepted as a given fact.

The Hawthorne experiments, and subsequent studies on the individual and group behaviour in organisations, embodied the hypothesis that a healthy organisation is one which is built around human relations and employee-centred participative leadership. The conclusion that was drawn by the Hawthorne reaserchers is the need to enlarge the framework of the existing scientific management methods to encompass the individual and his or her social and other needs that appeared to be "irrational" (i.e. non-economic needs).

As has been suggested above, the behavioural approach to organisations emerged as a reaction to the classical model. It does not deal directly (or explicitly) with such important variables as the organisational structure and organisational environment and its influence. Human relations researchers carried on with the closed system tradition of the classical model. They can be criticised for "viewing human relations in a closed system and for not considering economic, political and other environmental forces" [Kast and Rosenzweig, 1985: p.83].

The bulk of the behavioural model's concepts centre around the informal organisation, where the building block is the individual and the small informal group. A direct consequence of this emphasis is that the behavioural approach deals mainly with the implementation aspects rather than concerning itself with evaluation or planning of organisational performance.

Human relations theory makes an unwarranted abstraction of the model within which basic human needs are discussed. The individual is abstracted out of his social environment outside the organisation. Some of the basic needs (for example, the self-actualisation need) are very much the result of the continuous conditioning of the individual by outside social forces [Perrow, 1979]. Some of the behaviourists' cries, which are pointed at management, for improving and creating better working conditions, and providing participation and "psychological growth" would, in fact, be more meaningful if directed at the wider system, i.e. the economic and socio-political systems in which the organisation is embedded.

Many of the findings of the sociometric analysis of the informal groups are based on empirical studies carried out in laboratory-controlled conditions. Real-life organisations are far more complex, and uncertain; a fact which justifies a hesitant adoption of sociometric findings by organisations.

Also, the Hawthorne studies (which are the cornerstone of the behavioural model) leave much to be desired from a scientific standpoint. They have been described as pro management and scientifically naive [Carey, 1967]. The experiments cannot be validated statistically; "the limitations of the Hawthorne studies clearly render them incapable of yielding serious support for any sort of generalisations whatever" [ibid: p.416].

Other general criticisms of the BM could be made, but we shall concentrate now on those directly stemming from its failure to rethink the fundamental assumptions of the classical model.

The behavioural model greatly emphasises participation and discretion as a means of improving the managing of organisations. However, this insistence alone is incomplete. It could lead to redundant networks in organisational communication, as a result of the incompatibility between the working protocol, i.e. organisation chart (which the behavioural model accepts as a matter of fact) and the call for participation in decision making. Openness and extensive participation in decision making implies that information is made available to those who are supposed to participate; in other words, the information loops should be large enough to cover all the members in the organisation. This will lead to redundancies in the sense that some of the members are to receive and be overloaded with information which is not relevant to their tasks [Katz and Kahn, 1971].

The organisation chart is an outcome of a certain mode of thinking about how organisations should be run. It is logical to assume that, to modify such an approach to management, the apparatus around which the organisation evolves (i.e. organisation chart) must be made compatible with the new (open) outlook. The power of discretion advocated by the behavioural model is not assured of successful implementation within the framework of the existing convention. The exercise of discretion by localised management will very likely lead to each pulling in its own direction, for example, competition for available resources. Assuming that localised managements learn about each other's situation, they will try to bring themselves into line by adjusting to one another, and in the end oscillation will inevitably set in [Beer, 1985]. In other words, the system as a whole (the organisation) will be plagued by instability. It is not apparent how the behavioural model's protocol will have the capacity to damp such oscillation without redesigning the organisational structure.

Horizontal interaction is a necessity and a need in the BM's protocol. It is found that organisations with wide participation in decision making tend to have a greater degree of interdepartmental communications [Hage et al., 1980]. However, no explicit provision is provided for how lateral communication is to be channelled. The mechanical organisational structure (adopted by the behavioural model) is highly "restrictive". In the absence of consciously designed channels to carry the flow of (lateral) information, there is no way of knowing how informal channels can carry the load. A loss is incurred whenever information crosses a boundary from one department (unit) to another, since it undergoes a decoding then a coding process (what is known in cybernetics as transduction). For the lateral transmission of information to work, it must also be accompanied with the necessary mechanisms for transduction at the boundaries.

Committees have been advanced as a medium for interdepartmental (inter-unit) communication. True, they serve as a means for satisfying the need for self-esteem, but as information channels, they manifestly lack capacity [Beer, 1979]. Members of a committee come from different organisational origins, where everyone "speaks" a different language. The inherent heterogeneity of the committee is itself a qualification and a recipe for failure as a forum for information processing.

As we have been emphasising, the traditional hierarchical structure of the organisation is left intact by the behavioural model. One of the criticisms directed at Mayo's early research is that he was "bent on the maintenance of the hierarchical structure but with the manager giving greater consideration to human factors in order to maintain the traditional system" [Kast and Rosenzweig, 1985: p.83]. This is to say that, for the behavioural model, the formal arrangement of information processing and transmission of the classical model is maintained. It is supplemented by the opening up of the informal network at the group level, mainly at the operational level. The encouragement of informal contacts may help in the processing of information at the lower level of the organisation, and possibly reduce potential information overload at this (i.e. operational) level. However, the most significant problems encountered in information processing and transmission in an organisation are generally those at the upper levels of the organisational hierarchy. It was mentioned in chapter two that problems arising at the operational level are of a routine type. As such, the formal structure with its rules, procedures and programmes may be adequate to meet the information needs of the organisation at the operational level. However, the formal structure, and its processing arrangement, has not proved of great help to the manager above that level [Ackoff, 1967]. It is in this area where help will be most appreciated (i.e. in relation to information processing and transmission). In this regard the behavioural model offers little useful advice.

Chapter 5

THE SYSTEMS MODEL OF ORGANISATION

We consider now the systems model as a possible basis for the construction of adequate information handling procedures. The systems model of organisation, as we have come to know it, is a product of various insights and intellectual effort by researchers working in various fields. As a framework of thought, it is generally attributed to the biologist Ludwig von Bertalanffy [von Bertlanffy, 1968]. However, Burrell and Morgan, in their discussion of the development of systems theory [Burrell and Morgan, 1979], trace its origins to the work of early sociologists, like Durkheim [Giddens, 1972], and the economist turned sociologist Vilfredo Pareto [Pareto, 1968].

In order to make our treatment of the systems model as informative as possible, it is thought appropriate to make a distinction between the closed system perspective and the open system perspective. So, we begin this chapter with a brief section on the closed system perspective, followed by another section for the open systems perspective. The remaining sections will be as follows:

.The system, the environment and the boundaries.

.The integrative systems view of organisations.

.The dynamics of an organisation.

.Information handling in the systems model.

I. THE CLOSED SYSTEM PERSPECTIVE

One of the earliest attempts to apply systems ideas to the study of social phenomena can be found in the work of Pareto. Pareto employed the natural scientific analogy of the mechanical model to arrive at conclusions regarding social phenomena: "On peut employer par analogie d'autres termes de la mecanique, en economie et en sociologie" [Pareto, 1968: p.58]. Pareto's notion of equilibrium is built on the analogy of the mechanical model and relies on controlled experiments in which the subject of study undergoes various tests in isolation from the environment. In this sense, for von Bertalanffy, systems thinking based on the mechanical model is of the closed type [von Bertalanffy, 1968].

This notion of equilibrium in the social system was taken further by researchers at Harvard, like Roethlisberger and Dickson [Roethlisberger and Dickson, 1966]. In their work on management and the worker, Roethlisberger and Dickson set out an experimental-like study to determine the relationships between the conditions of work and fatigue and monotony among workers. The analogy of the mechanical model in their experimental approach is quite obvious. They experimented on a system by isolating certain variables and measuring the effects these have on the performance of the system under investigation. Further, they emphasised the fact that an industrial organisation is a social system of interdependent parts, the driving force of which is to achieve an equilibrial state. The aim of their work was to consider: "...the parts of the social system of which account has to be taken in an industrial organisation, and to consider the state of equilibrium which obtains among the parts" [ibid: p.552].

Useful as it was in the early development of organisation theory, the closed system approach could not keep pace with the rapid change characterising modern organisations. It failed to recognise the necessary interactions between the organisation and its environment. According to Katz and Kahn the organisation is dependent on the environment for inputs of energy and material. Treating the environmental inputs as a constant leads to "much of the organisational behaviour becomes unexplainable" [Katz and Kahn, 1978: p.31]

II. THE OPEN SYSTEM PERSPECTIVE

In contrast to closed systems thinking based on the notion of equilibrium, the open system perspective stresses the close relationship of the system with its environment. In the words of von Bertalanffy a system is open "if there is import and export and, therefore, a change of the components" [von Bertalanffy, 1981: p.83]. In this respect a living organism is an outstanding example of an open system. In his work on general systems theory von Bertalanffy moved away from the concept of equilibrium which characterised the closed system model towards the "steady state" idea [ibid: p.83], which he considered as more adequate to reflect on the processes taking place in open systems. In the open systems perspective the emphasis is on the close interaction of the organisation with the environment, and "how the continued life or survival of an organisation is dependent upon an appropriate relationship being achieved" [Morgan, 1980: p.614].

There are various contributions to the open systems model of the organisation. Parsons treatment of the organisation [Parsons, 1956-57(a,b)] remains within the sociological tradition inherited from Pareto in the sense that, for him, equilibrium is the driving force of an organisation as a system: "Parsons does indeed postulate an equilibrium-seeking tendency as a property of systems of any sort" [Deverreux Jr., 1961: p.33]. However, he also makes use of the organismic analogy in his open system model of the social system [Parsons, 1951]. In this sense his work provides a bridge between the closed system model and later, clearly open systems approaches, such as that of Katz and Kahn [Katz and Kahn, 1978].

The organismic analogy of the open system is fully explicit in the work of Katz and Kahn [ibid]. They emphasise the social character of organisational relationships and the close interaction of the organisation with the environment. In their model the organisation is conceptualised as a process with input, throughput, and output; and a feedback loop connecting the output to the throughput and the input. This can be depicted as in fig.5.1 below.

The notion of equilibrium found in the closed system perspective is replaced by that of homeostasis. This is (in addition to other characteristics like equifinality, negative entropy, etc.) an important characteristic of an organisation as an open system. The organisation as a whole is geared towards attaining and maintaining the state of homeostasis.

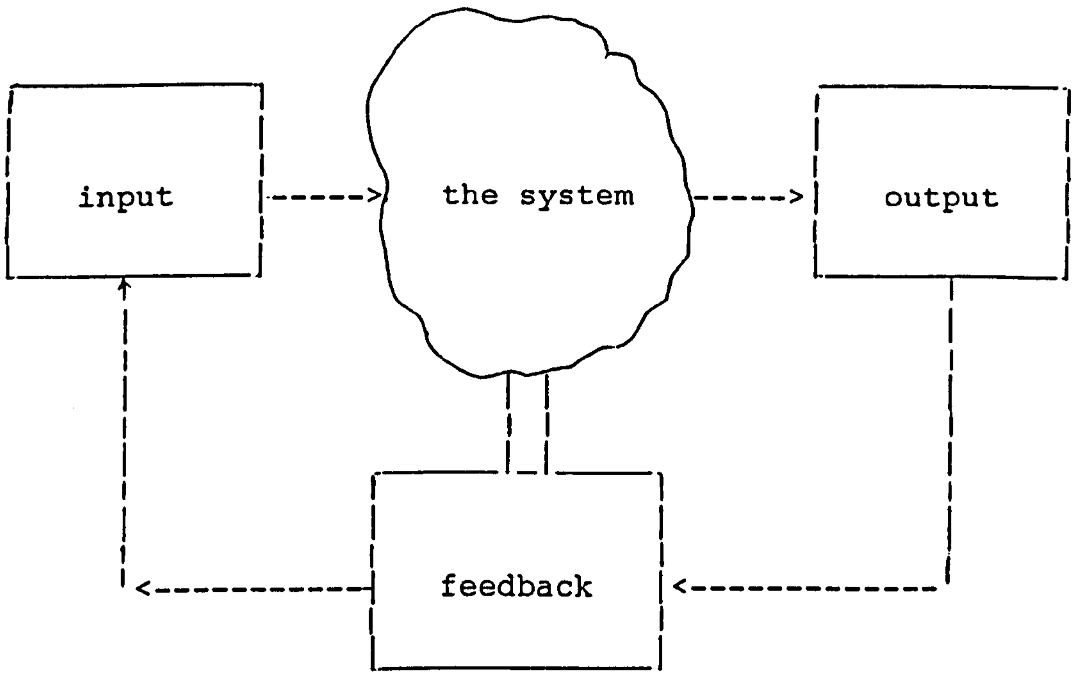

Fig.5.1. Katz and Kahn's conceptual model.

To this the organisation needs subsystems (identified by Katz and Kahn), the dynamics of which will satisfy the system's needs and ensure its continuity and survival.

There is another important body of research on the open systems approach to organisations, which adopts a socio-technical and contingency approach [Rice, 1963; Kast and Rosenzweig, 1985; Lawrence and Lorsch, 1969; Burns and Stalker, 1961; Trist et al., 1987]. This approach contends that considering organisations as "open socio-technical systems" allows a better understanding of "how they are both influenced by and able to act back on their environment" [Trist et al., 1987: p.6]. The model of the organisation dominating this approach remains processural, i.e. input, process and output, in the words of Rice "Import - conversion - export" [Rice, 1963: p.16], which is basically similar to the input - throughput - output model of Katz and Kahn [Katz and Kahn, 1978]. In this approach we find explicit recognition of the uniqueness of the structure of organisational subsystems and the interrelationships between them, as well as the uniqueness of the organisation's environment [Kast and Rosenzweig, 1985].

As we can see, there is no single view constituting the systems model of the organisation. It is hardly conceivable that one view can claim a monopoly of the model. In what follows we try to elaborate the systems model of the organisation by marrying together Katz and Kahn's approach [Katz and Kahn, 1978] with the socio-technical and contingency views, particularly those of Kast and Rosenzweig [Kast and Rosenzweig, 1985].

III. THE SYSTEM, THE ENVIRONMENT AND THE BOUNDARIES

Let us recapitulate. In broad terms, a system is defined as a "set of interrelated elements" [Ackoff, 1971: p.662]. The organisation as a system is seen as a functionally indivisible whole, that is to say it is not possible to make an abstraction of the effect of any one part on the working whole. The totality of the components and their multiple relationships, i.e. the system, will display properties none of the parts (or any subset of them) have. It is only in this sense that the organisation can be studied in its relationship to the environment. Otherwise, we would be talking of aggregates rather than of systems.

The environment of an organisation is considered to be "a set of elements and their relevant properties, which elements are not part of the system but a change in any of which can produce a change in the state of the system" [ibid: p.663]. These two formal definitions (of the system and its environment) are too general. They cover all types: physical, biological, social and even conceptual systems. However, our objective here is limited to social organisations and we try to understand them in order that they can be better managed. So how are we going to decide on the elements that will make up the system (or organisation) under consideration, and consequently, the relationships that tie up the elements? What are the criteria by which we determine that a particular element belongs (or not) to the system? These are difficulties which characterise open systems.

In open systems like business organisations, the number of elements, the way they are nested together, and the variety of relationships by which they are related to one another is so huge that no serious work on the system can be carried out without introducing the subjective assessment of those involved. This amounts to saying that, in the end, the final arbiter of what is a system is the observer himself. Deciding upon a system involves an act of selection, i.e. it is up to the researcher or observer to select the group of entities and relations which will make up his system. This conclusion is equally valid regarding the determination of the organisation's environment.

In order that our understanding of organisations, as systems, can have any practical relevance, we need to explore a little further the notion that an organisation is part of a larger system, namely the environment.

A system imports inputs (energy, material, men, etc.), and exports the transformed inputs, in the form of an output, to the environment. One way to delimit the boundaries of the system is through the establishment of the pattern of the flow of energy, materials and information, etc., from outside in the form of inputs to the system; and the pattern of the flow of the output to the environment.

However, this does not entirely settle the issue of the identification of the system's boundaries. The behavioural patterns at the areas of energic and informational exchange are not as easily identifiable as the behavioural patterns associated with the transformation of inputs into outputs, i.e. "the throughput" of the system. In the final analysis, the boundaries of the system remain a conceptual construction of the interested observer. They are determined by the purpose of the research to be undertaken on the observed system. Anything which is relevant, and satisfies the subjective criteria of the observer, is considered as part of the system and therefore lies within its boundaries. The rest is part of the environment.

A proposed guideline in helping the determination of the system's boundaries, is to observe carefully the links and relations between the entities of the system under study. The areas where relations of the system are less concentrated than other places are considered as boundary areas of the system [Kramer and de Smit, 1977]. Even so we cannot avoid the conclusion that boundary determination, like the system itself, is observer-dependent.

IV. THE INTEGRATIVE SYSTEMS VIEW OF ORGANISATIONS

Katz and Kahn's integrative model of the organisation as an open system is pictured in fig.5.2 below. The organisation receives its inputs (energy, information, materials, human labour, etc.), processes and transforms these inputs into outputs, in the form of a physical product(s) or a service(s), to be returned to the environment to regenerate further inputs and renew the cycle. The output is the result of the patterned activities of the interrelated or interdependent subsystems from the moment of introducing the inputs to the system to the point of disposing of the output (for a return) into the environment. For a business organisation, the environment provides an efficient way of converting outputs into new inputs through an almost universally accepted metric: money. For example, in a manufacturing firm, raw materials are bought and people employed to transform these raw materials, by the use of a relevant technology and the available production techniques, into the final product which is sold for a price. The price is again used to acquire new sources of inputs to renew the production cycle. We can imagine the cycle of activity:

Input ----> Transformation ----> Output ----> Input

as a loop of two parts. The internal part, basically consists of the subsystems which carry out the actual transformation of the energic inputs into outputs and produce the organisation. The external half of the loop makes up the rest of the organisation. In other words, the subsystems which manage the boundary regions of the organisation and

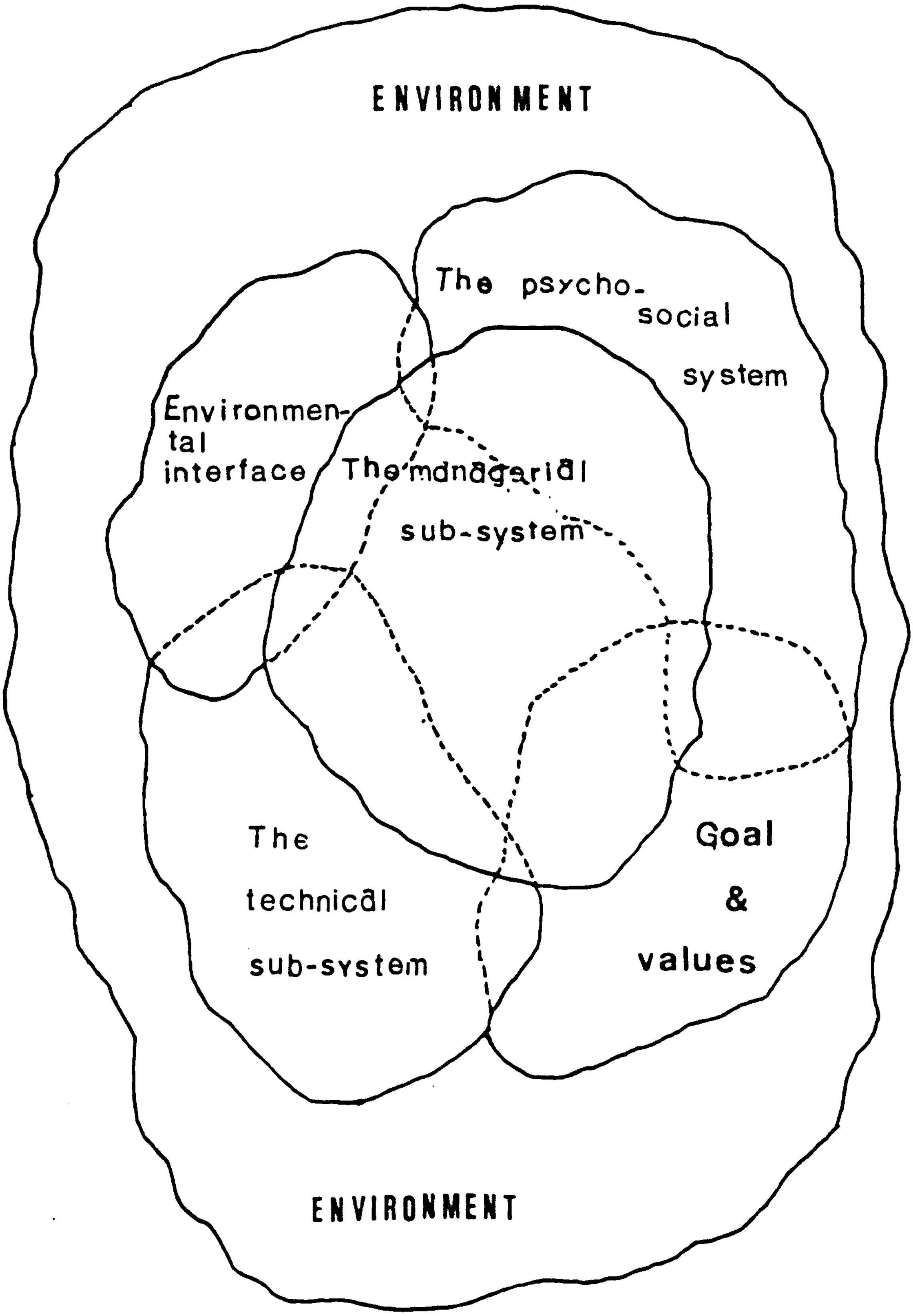

Fig.5.2. Katz and Kahn's integrative model of the organisation.

maintain it in a stable relationship vis-a-vis the environment.

In the following subsections, we shall be dealing with some different subsystems that make up the above mentioned loop, with particular reference to business organisations.

IV.1. THE TECHNICAL SUBSYSTEM

The term technical subsystem or production subsystem is not used here to refer simply to the production of physical goods. The technical subsystem is characteristic of any on-going organisation [Woodward, 1970]. It could imply the production of a physical product in a manufacturing company or the training of a teacher in a college of education.

There are two major aspects that characterise the technical subsystem: the organisational task, and the technology employed to perform this task. There is an intimate relationship between the two. Perrow [Perrow, 1967] has shown that there exists a direct connection between the technology and the task of the organisation, that is to say a task is the end result of applying a specific technology on inputs:

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 ----------       ------------       ------------
| Inputs  |----->| Technology |----->| org.task  |
 ----------       ------------       ------------
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The influence of technology on the working of organisations is accepted as a commonplace today. It is not only intimately related to the task to be accomplished

[ibid], it also affects other organisational characteristics, for example organisational structure [Harvey, 1968; Hickson et al., 1969]. One of the outstanding studies of the influence of technology on organisational functioning is the one carried out by J.Woodward [Woodward, 1970]. Her study included 100 formal organisations (of more than 100 employees). The noticeable differences observed in the performances between these organisations could not be explained in the traditional manner of the day, such as management structure, personality of the organisational leader, etc. They could however be explained in terms of technology-structure fit.

Woodward differentiated three categories of firms: unit and small batch, mass production and process oriented organisations. There is a certain kind of machinery associated with each category above. In the unit and small batch situation, we find general purpose machines. The degree of sophistication of the hardware involved increases moving along the Woodward scale of technological complexity, towards the process organisations, in which the technical subsystem (the plant) becomes an integrated total, rather than dispersed machines in a shop. Woodward found a direct link between technology and organisation structure. For example the span of control of a manager is dependent on the type of technology. It varies at different points along her scale: unit and small batch --> mass production --> process organisations.

On the basis of her findings, Woodward concluded that high performance firms succeeded in arriving at the right kind of structure for the technology they were using. Type of technology determined the sort of organisational structure a firm should adopt.

Since Woodward's work the generality of her conclusions have been challenged by others (especially as a result of the Aston studies). For example, according to Kast and Rosenzweig the impact of technology on the structure varies from one level of the organisation to another. "Technology is a prime determinant of the structure on the production line" [Kast and Rosenzweig, 1985: p.219]. It has less influence on the structure as we move upwards in the hierarchy. The structure of the strategic level for instance is more dependent on environmental factors than technology [ibid].

Recalling that technology, in general terms, refers to the means an organisation employs to accomplish its task, its effects on the production function (i.e. the technical subsystem) are not limited to industrial organisations, and cannot be equated solely with machine hardware. Its influence is ubiquitous.

In service organisations, Perrow [Perrow, 1967] makes the point that the modern hospital is a complex and technologically advanced organisation. The technical subsystem is changing as a result of advancing technology which leads to an increase in the number of professional specialists. These specialists require coordination for the achievement of the organisational task. This led to the rise of the administrator as a necessary ingredient in today's hospital.

Technology interacts with outside social conditions in a complex way. The organisation is influenced by the prevailing cultural and technical trends. It must continuously reshape its technical subsystem in order to accommodate new advances in the technical field. This necessarily leads to it having to change its other characteristics - just as influences from outside on those other characteristics may mean that it has to review its technical subsystem.

IV.2 THE MAINTENANCE SUBSYSTEM

Even if the technical subsystem is considered as the major component of the organisation, it cannot, obviously, exist without another fundamental element in every social organisation, namely, the human being. The raison d'etre of the maintenance subsystem is to provide the organisation with the necessary personnel, including those to operate the technical subsystem, allowing it to perpetuate its cycle of activity. The maintenance subsystem must also devise the means and motivations to maintain and keep these people in the system and arrange and organise the individual roles around the specific technology of the organisation.

It is imperative that harmony prevails between the technical subsystem and the maintenance subsystem, where the latter ensures the smooth operation of the former. In order to achieve this, the interrelationship between the two subsystems should, in fact, be mutual rather than one being a function of the other. The prevailing orthodoxy in organisations takes for granted that people are recruited, trained, and adapted to the mode of work in the organisation. They are then sanctioned or rewarded to ensure attainment of role performance, loyalty and adherence to the system's rules and practices. This approach to how organisations should function is rather simplistic. It encourages a very low opinion of the full potentialities of the individual human being. A more realistic attitude is to take into account the exigencies of the psycho-social dimension of the people making up the maintenance subsystem when designing the technical subsystem of the organisation.

The objective of the maintenance subsystem is the attainment of and "maintaining stability and predictability in the organisation" [Katz and Kahn, 1978: P.85]. To carry out such a task, various methods and structures need to be developed or designed, contingent on the technical subsystem to be serviced, and on the environmental constraints. Usually two strategies are employed [ibid]:

.Methods for recruiting new members to the organisation. New members are chosen on the basis of dependability and predictability of their task performance [Guion, 1981]. Ideally, the organisation must establish its own methods and procedures for recruiting personnel. However, most organisations do not possess the resources to carry out the necessary research to establish such methods. Generally they are of wide-ranging character and, therefore, it is appropriate to rely on other organisations' experiences [Schmidt and Hunter, 1977].

.Procedures for maintaining the existing personnel. By its very nature, the maintenance subsystem is internal and stability bound. It establishes rules and procedures in order to reduce the variability of behaviour so as to maintain the organisation in its steady (existing) state.

Any tendency to deviate from this course is considered as destabilising, therefore it should be sanctioned. This closed system orientation of the maintenance subsystem of the organisation risks creating conflict, and perpetuating a sense of dissatisfaction among organisational members [Dill, 1965].

IV.3 THE ORGANISATION-ENVIRONMENT INTERFACE

Regarding the question of the interface of the organisation with its environment, we can distinguish two substructures. One of these has for its task the "procurement" of the necessary resources for the functionning of the organisation. The second looks after the "disposal" of the organisation's product, whatever form it may take. It is important to distinguish between acquiring human resources (personnel), which is the task of the maintenance subsystem, and other physical resources, the objects of the transformation process, which is part of the task of the technical subsystem.

It is not an easy matter to deal with the management of the boundary regions of the organisation, given its social nature. The boundaries are hazy and difficult to define; organisations are not totally open; many things are filtered and kept out of the system, either because of their irrelevance, or because they are harmful to the system. In other words, not all the environment is relevant to the continued functioning of the organisation. The question which comes to mind, therefore, is: what kind of mechanisms does the organisation need to employ in order to dispose of the product to the right users at the right conditions? (place, price, etc.). Also what mechanisms and structures are needed to ensure the inflow of inputs, energy and information to renew the activity cycle of the organisation?

The organisational product is disposed of in the environment. The latter is considered as everything outside the boundaries of the organisation. It can be thought of as having general and specific (or task) elements. The task environment is more specific than the general. The latter "is the same for all organisations in a given society. The task environment is different for each organisation" [Kast and Rosenzweig, 1985: p.138]. In addition, the task environment of an organisation consists, to a large extent, of other organisations on which it must rely for the procurement of resources, growth and development. For a business organisation, the task environment may include: suppliers of raw materials, equipment, financial facilities, labour, customers, other organisations sharing the same sources of inputs and the same customers, regulatory groups for example labour unions, government agencies, etc.

The disposal structures employed by organisations can be thought of as those units which surround the technical subsystem. Their task is to smooth the flow of the product to the environment, for example the sales department and the distribution department in a manufacturing organisation.

These boundary posts must have the capacity to screen information and allow it to enter the organisation only selectively, so as to limit the interference with the working of the technical subsystem, and avoid information overload. The permeability of the boundary units determines the extent to which they are successful in monitoring the organisation's relevant environment, and filtering the information emanating from the nonrelevant environment. The processed information is screened out and passed on to the appropriate authority for decision.

The linkage of the boundary post to an authority centre in the organisation is meant to speed up and facilitate the transmission of information regarding the mission of the organisation. To ensure an efficient use of this information, the centre ought to have some kind of authority over some aspect of the working of the technical subsystem of the organisation. For example in a manufacturing organisation, information gathered by the purchasing department must be accessed directly to the unit or structure in charge of inventory control. Information regarding the state of the market, new customer needs, etc., compiled by the marketing unit must be input directly to those in charge of product development and the technical subsystem.

The information does not come to the organisation, it has to be collected and selected. It is a common feature of modern organisations to have sensors operating in the environment. They are the points of contact with the outside, together they form the boundary network of the organisation. Coming back to the manufacturing organisation cited above, an example of such sensors would be market researchers, sales agents on the disposal side, and purchasing agents on the procurement side.

IV.4 THE ADAPTIVE SUBSYSTEM

So far, we have dealt with subsystems which are basically concerned with the internal regulation (in varying degrees) of the organisation, and ensure the continuation of the cycle of activities as they are in their current state. We have also considered the organisation - environment interface in very general terms. It is now necessary to recognise that "...the environmental contexts in which organisations exist are themselves changing, at an increasing rate and towards an increasing complexity" [Emery and Trist, 1965: p.21]. To survive in the ever changing environment, organisations need to develop mechanisms by which they can keep pace with the change. If the regulatory subsystem, namely, the maintenance subsystem "faces inward on the organisation" [Katz and Kahn, 1978: p.88], the mechanisms for adaptation and survival strive outward. In other words, there are two forces in the organisation which pull in two different and opposing directions: one towards maintaining the status-quo, the other, which is future bound, towards change and innovation. We have mentioned above that organisations are in constant interaction with their task environment through a network of sensors. For long term survival and adaptation purposes, this network of sensors is extended beyond the task environment to the general (or macro) environment.

The information flowing to the adaptive subsystem from the environment (specific and general), may come from its own sensors or from those of the disposal and procurement substructures. The focus of attention here is directed towards managing the uncertainty element picked up by these sensors. A major source of this uncertainty is determined by the degree of dependence of the organisation on external resources for its continued operations [Pfeffer, 1972]. It can be viewed on a two-dimensional continuum: from static-dynamic and from simple to complex [Emery and Trist, 1965]. The more dynamic and complex is the environment, the more uncertain it becomes.

To adapt to environmental exigencies, the organisation can choose two possible strategies [Katz and Kahn, 1978]. Following one of them does not necessarily exclude the other, i.e. the organisation could opt for a combination of both of them. The first of these strategies is to do with the development of structures and programmes which allow it to predict the state of the environment and respond as quickly as possible to changes in that state. The essence of this strategy is that the organisation must exhibit some degree of flexibility (as well as internal stability) in its functioning in order that it can modify its internal practices to meet the requirements of new situations as they arise in the environment.

The organisation may be facing an unstable environment, but the apparent instability may have a pattern that can be predicted. Or the organisation may be able to approximately determine the range of variation and move accordingly with least cost to meet the desired change. Market research is an example of such a strategy. The organisation assesses the market conditions, then adapts its products and production process to meet the requirements of the marketplace. One important factor which affects the readiness of an organisation to opt for such strategy is its own structure and the degree to which the different subsystems are interrelated. Loosely coupled structures are capable of absorbing environmental change with least modification to their internal functioning [Pfeffer, 1978]. In this case new structures are added to the organisation to meet the new needs, while the rest of the subsystems go on without modification, or with minor structural changes.

Adopting this strategy is not an easy way out for the organisation. Restructuring itself in response to every change in the environment, particularly when the change in the latter is taking place at an increasing rate, is a monumental task, however necessary it may be. According to Pfeffer [ibid] organisational redesign, the making of major structural modifications, can be damaging and may lead to organisational dislocation.

The second strategy or alternative for the organisation is to induce necessary changes in the environment rather than changing itself. One of the options open to it is to extend its boundaries "so that it incorporates more of the external world...to control external forces so that they lose their independence as external forces" [Katz and Kahn, 1978: p.89]. In this respect the relative power of the organisation in its environment is an important factor in determining its success in influencing outside agents. As economic theory clearly states, an organisation having the monopoly of the market, has favourable exchange conditions over others.

The extent to which an organisation can go in implementing this strategy is contingent on various factors. On the input side the organisation can build relationships with its suppliers. On the disposal side, it can offer incentives to customers, and negotiate long term contracts to ensure the continued sales of its product(s). A more adequate measure and one with lasting effect is to control the sources of dependence themselves by absorption, i.e. through mergers and acquisitions [Pfeffer, and Salancik, 1978]. This strategy does not limit (or eliminate) the vulnerability of the organisation, but it increases its relative power in the environment.

V. THE DYNAMICS OF THE ORGANISATION

In the previous section, we explained the role of some possible subsystems within organisations. However, the systems view stipulates that an organisation is a collection of interrelated parts or subsystems. Thus, these subsystems must be coordinated for the organisation to function as an integrated whole. The task of coordinating the internal subsystems, and relating the overall organisation to its environment is carried out by management. Anthony, and others after him [Anthony, 1965; Brown, 1969; Gorry and Scott Morton, 1971], conceive of the management of an organisation as made up of three ascending layers. This idea, indeed, dates back to the work of Parsons [Kast and Rosenzweig, 1985]. Diagrammatically, it can be represented by the pyramid of fig.5.3 below.

Simon also views the organisation as made up of three layers. For each layer there corresponds a certain type of decision making. At the bottom we find "the basic work processes". At the middle layer we have the programmed decision making processes; and at the top layer we have "the non-programmed decision making processes" [Dickson et al., 1969: p.98].

We have already encountered this categorisation of managerial decision making in the organisation in the context of information processing in chapter 2. However, this is not a repetition. In order to understand the dynamics of an organisation in the context of the systems model, it is appropriate to present this dynamics through its, the organisation's control structure as presented in the pyramid of fig.5.3 below. By doing so we hope to highlight the hierarchical structure characterising the organisation as vieweded by the systems model.

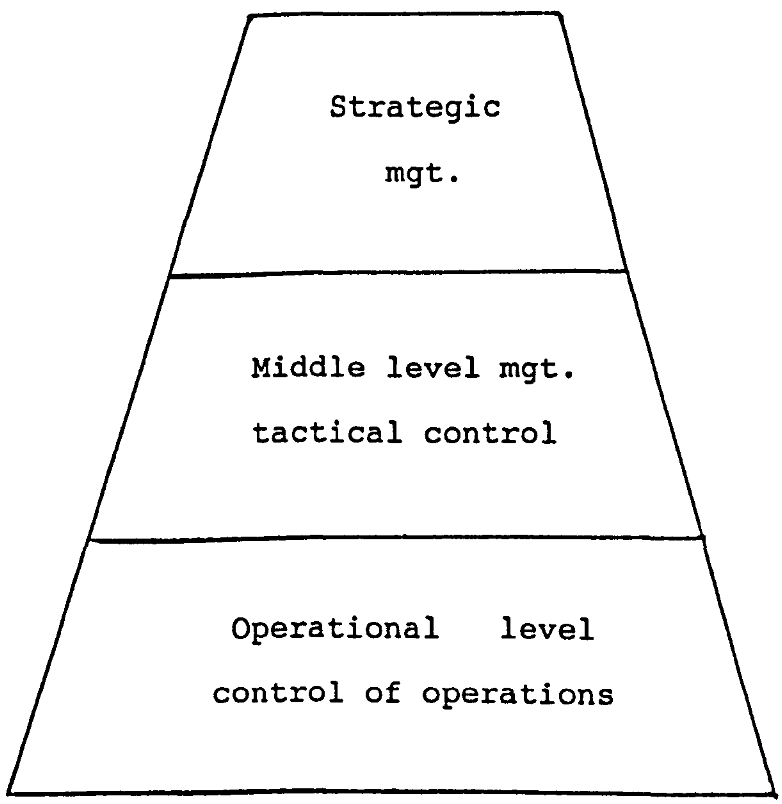


Fig.5.3. Control structure of the organisation.

At the base of the pyramid is the operational level, i.e. where the task of producing the organisation's output is actually carried out. Examples of management control at this level are production scheduling and control of inventories. At the middle is the "management level", or the tactical control of the organisation (as compared to the strategic function of top management). Its job is to facilitate and coordinate the tasks of the operational level. The strategic management of the organisation is at the top of the pyramid [Boyle, 1967]. This subsystem of management is future-bound. It is designed to look out for the overall development of the organisation. Its function consists basically of planning and setting the policies of the system as an integrated whole. Let us take each of these levels in turn.

V.1 THE OPERATIONAL CONTROL OF AN ORGANISATION

This type of management control is exercised at the technical level of the organisation, where the organisational output is produced, whether it is a service or a physical commodity. Operational control is the process by which detailed activities and specific tasks are performed with maximum possible effeciency. Efficiency in task performance, here, implies striving towards an optimum use of the input in turning out the output.

Advances in modern technology have pushed task performance on the shop floor to the optimum. Technical supervisors and managers have become capable of determining in advance the optimum input-output relationship, and this makes the programming of tasks and activities at this level a common practice. This can be considered as a distinguishing characteristic of operational control vis-a-vis the coordinating activity of management at the intermediate level [ibid]. Common examples of operational control are the productive operations of most manufacturing organisations, like the automated processes in the automobile industry, electricity generating stations, or oil refineries.

However, there are areas susceptible to operational control where the optimum input-output relationship is not fully deterministic, nor can it be determined in advance, for example, an inventory system in a manufacturing organisation, where the demand for an item is stochastic. The economic order quantity (EOQ) for the item, the inventory level, and the production schedule are calculated in probabilistic terms according to well defined mathematical rules. These rules are reasonably elaborate and make stock control susceptible to, at least, partial programming.

Operational control is a rational process in the sense that it is governed by a logical set of rules. The set of rules can, in principle, be translated into computer software to be executed by a machine, for example, translating the formulas for the calculation of the EOQ into a computer programme, and letting the computer decide automatically on the order necessary to replenish the stock, just by feeding it with the values of the relevant parameters (lead time, the cost of rnnning out of stock, etc.).

Operational control, as opposed to tactical control, deals mainly with real time and exact data, i.e. individual events as they occur, whereas tactical control deals with summaries and aggregates. Management at the intermediate level cannot possibly cope with all the details; it relies more on approximations where human judgement is the rule rather than the exception. Nevertheless the possibility of applying programming techniques in areas of traditionally non-programmable decision making is steadily on the increase [Simon, 1965]. For example, marketing and salesmanship are becoming part of mathematical programming, as with placing the calls of the travelling salesman.

Operational control is carried out within the set of procedures set down by the level above in the management hierarchy (i.e. the tactical level). In fact, its techniques are an integral part of the battery of procedures available to the managerial system to achieve the stability of the internal organisation.

V.2 TACTICAL CONTROL OF AN ORGANISATION

In broad terms, tactical control or management coordination is the process by which management strives to keep the organisation on course towards achieving its objectives. It ensures the disposal of the organisational product for a return (usually monetary), and also makes sure that resources (inputs) are obtained and used effectively in the transformation process to operationalise the cycle: Input ---> Transformation ---> Output. Just as operational control takes place within the guidelines of the tactical control of management, so managerial coordination operates within the framework set by the top or the strategic management.

The types of problem dealt with by management at this level are not reducible to mathematical forms. A vast number, perhaps most of the problems tackled by middle and high levels in management have not been made amenable to mathematical treatment, and probably never will be [ibid].

Tactical control must be conceptualized as a total system. It embraces all the operations organisation-wide. Part of its task is to ensure the internal stability and harmonious functioning of the organisation's subsystems. For it to do so, it needs information about all the subsystems. The financial language is almost ubiquitous and, with few exceptions, most of the information is expressed in monetary terms. Money is the common denominator for expressing the heterogenous nature of the inputs (raw materials, labour force, etc.), and outputs (types of products, quantities, etc.), and to compare the efficiency of the components of the technical subsystem.

Tactical control is more subtle and more difficult than operational control, in the sense that it lacks scientific standards by which performance can be evaluated. It relies heavily on subjective considerations and the personal abilities and active skills of the manager.

V.3 STRATEGIC PLANNING OF AN ORGANISATION

The management's task at this level is about tackling the strategic issues [Dutton and Duncan, 1987]. Strategic planning involves deciding on the objectives and laying down the general principles on the basis of which the organisation will operate. It also involves deciding on the resources to employ for the attainment of objectives [Kono, 1984]. Laying down principles for organisational functioning implies the definition of an organisational structure to govern how the different subsystems interrelate with one another, and also providing the framework within which the managerial process (down the pyramid) is carried out. Strategic planning is basically of an irregular nature, and there is no determinate approach to tackling strategic problems, or to evaluating opportunities arising in the changing environment. It is future-bound, oriented towards relating the organisation with the outside.

The type of information processed at the strategic level is mainly probabilistic and external to the organisation; for example the general trends in the economy and the state of the market. However, diffusion of information is not organisation-wide as with the case of middle-level management (i.e. tactical control). The channels of communication are much simpler and do not involve large numbers of participants.

VI. INFORMATION HANDLING IN THE SYSTEMS MODEL

The framework for understanding organisations presented in the previous sections suggests that the organisation resembles the flow of a cycle of events: Inputs ---> Transformation of these inputs (i.e. the throughput) ---> Output (through an exchange with the environment). The cycle closes in on itself and starts anew. However, the flow of inputs into the organisation is informational as well as energic, "the physical and energy flows are paralleled by an equally indispensable flow of words and symbols" [Simon, 1982: P.112].

The inflow of information deals with knowledge about the environment, customer needs and demands, opportunities for organisational expansion, etc. In addition, the organisation also produces information in the form of records, accounts, orders, and plans to be transmitted to various organisational subsystems. Without a systematic treatment and handling of information in the organisation, no management planning, coordination and control of operations is possible. In other words, the organisation must be provided with an overall integrated system that receives, processes, and stores data and directs information to the functional subsystems of the organisation, where and whenever it is needed.

The parallel flow of information to the cycle of energic input ---> transformation ---> output can be depicted diagammatically as follows:

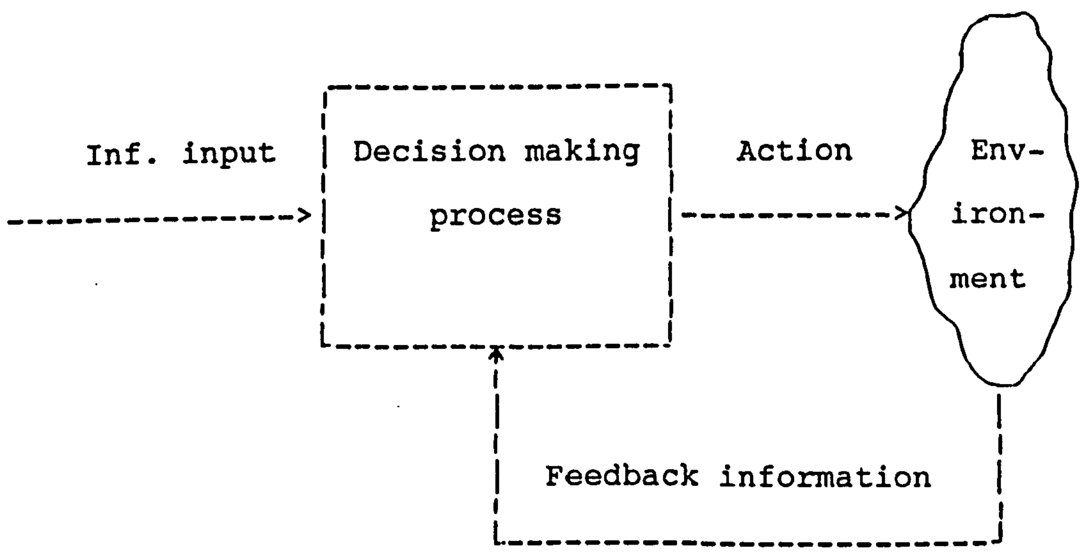


Fig.5.4. Parallel information flow.

The input information is that provided by the boundary spanning units of the organisation, for example information relating to economic trends, officially published statistics about the labour force, raw material prices and availability, market conditions for the organisational product(s), etc. This information is essential for evaluating decisions and taking action. On the other hand, feedback information is valuable to the decision maker for the evaluation of the impact of his decisions on the environment. It allows the necessary revision of plans and predictions when the action taken does not bring results up to expectations.

Since information is the essence of management [Katz and Kahn, 1978], an information system is built in the organisation to match the control structure of the latter. The information system can be thought of as an assemblage of people, machines and activities that gather and process data to meet the informational requirements of the organisation. In other words, it provides the information which meets the accounting, marketing and operational needs at all levels of management.

As indicated in the previous section the systems model views the organisation as a pyramid of three layers of managerial decision making: strategic, tactical, and operational. As would be expected, the lines at which these levels interface are not clearly defined. They tend to overlap. Nevertheless, the design of the information system of the organisation must take into consideration the distinct requirements for information of the different levels of managerial decision making: "information subsystems should exist only to support decisions..." [Gorry and Scott Morton, 1971: p.56].

At the operational level, management is task oriented, its information requirements are largely well defined, and generally the information is generated internally. Decision making is repetitive and there is high usage of the same items of information. This leads to highly structured and formalised information transmission procedures which enhance the scope for programmed decision making. Advances in modern data processing, and communication technology, have made on-line processing a frequent and most effective method for providing information for operational control purposes. The speed and accuracy with which operating information can be generated can, in turn, enhance the efficiency of the decision making process at the tactical control level as far as it is concerned with the short term future of the organisation.

The decision making process at the tactical management level is characterized by coordination of the efforts of the organisational parts at the lower level. The method chosen for coordination is positively correlated with the pattern of flow of information in the organisation. Vertical communication is the dominant mode when coordination is achieved through the application of the chain of command principle. On the other hand, the greater the intensity of the interdependence between the organisational components, the greater is the required effort for coordination. In such a case, the tendency for lateral communication to occur is intensified to supplement the formal, vertical communication.

Apart from the dimensional aspect of the flow of information, the types of problem tackled at the tactical level are also dissimilar to those at the operational control level. As a consequence, its information requirements will differ. The vast majority of situations faced by tactical management are messy, and no routine procedure is available to deal with them. To come to the aid of management, the information systems designer "can seek to improve the quality of the information inputs or to change the decision process, or both" [ibid: p.64]. The tendency however, is to treat the unstructured problems at this level in the same way as those of operational control, and to emphasise the need to improve the information inputs by providing more up-to-date, more accurate, and more detailed information: "Systems analysts and designers seem preoccupied with running everything on the computer... and seem to be not interested in what happens to data and information before or after the computer except in computer terms..." [Carter, 1983: p.45]. Managers need new ways and methods of understanding and processing the information presented to them. While the quality and volume of information has noticeably increased, the methods managers use to handle this information remain relatively primitive.

The process of decision making at the strategic level of the organisation must concern itself with setting long term objectives. Design scenarios for the future of the organisation must be worked out as well as alternative strategies by which to steer the organisation towards the desired future.

In the context of information requirements, the management information system must be capable of gathering, processing, storing, and disseminating the information to the appropriate users. As mentioned above, information concerning the environment is gathered through the boundary spanners of the organisation-environment interface subsystems. This information exists in natural language forms and texts: government statistics, technical and trade journals, etc. Before it can be stored, this information must be translated into the organisational language, checked and screened for validity. The information must then be stored. Although the problems dealt with at this level are unstructured and nonrecurrent, there is still a need for the storage of processed information for future use, particularly in situations of preactive planning. Next is the diffusion of information to users. When the information is not transmitted on a regular basis, the system must have a query capability to allow interested users to retrieve relevant information. This query mechanism has the advantage of not overloading managers with irrelevant infomation.

The limited extent to which information systems are successfully implementated and used in organisations, suggests that most of development effort is made without prior and proper understanding of the managerial decision making process. This is particularly true at the tactical and strategic levels, where management deals with messy and unstructured problems.

The integration of the information system is understood by designers as a task of creating an organisation-wide information system. The output of one level is to serve as an input to the next, so that the whole system is built on the detailed database collected at the level of operational control. This assumption fails to grasp the fact that the information requirements of management at higher levels are not mere aggregations of operational control data. The requirement of information systems design at the operational control level involve implementation of a general decision making model (such as provided by operational research) in a given organisational context; for example production scheduling and inventory control. Outside the operational control area, however, the task of the information systems designer would be better understood as to educate the manager in the modelling process itself, since problems are necessarily nonrecurrent.

We conclude this chapter with a brief reflection on what has been said about the systems model. The most important question which concerns us is whether the systems model can provide a basis for information processing and transmission. Looked at from this perspective, the systems model is not very promising. It recognises the openness of the organisation to the environment and emphasises that an organisation is made up of a number of parts with interconnections between the parts. However, it maintains an adherence to the hierarchical nature of control in the organisation. An image system (i.e. the information system, refer to ch.2) of an hierarchical organisation is often subject to time lags and tends to overload the upper levels in the hierarchy. Further, the systems model makes room for lateral communication between the parts of the organisation, but does not really say how to deal with this. It is essential that lateral transmission of information is accompanied by a conscious design of the necessary channels. If we do not cater for the channel capacity and the transduction capacity at the cross-over points between the organisational subunits, the information will be lost.

We may state briefly that the systems model, since it maintains the hierarchical structure of the organisation, does not provide a sound enough basis for information processing and transmission. This being the case, we need to move on and consider the cybernetic model of the organisation. This is the subject of the following chapter.

Chapter 6

THE CYBERNETIC MODEL OF ORGANISATION

Cybernetics can be considered as a constituent part of the wider framework of systems thinking [Jackson, 1987(a); Flood and Carson, 1988]. Although it was formally established as a separate discipline towards the end of the 1940's by Wiener [Wiener, 1948], it has been in existence, under some form or another, ever since Ancient Greece. The word cybernetics itself is derived from the word "kybernetes" meaning steersmanship [Wiener, 1968]. Ampere, in his writings on the philosophy of science, used the word "cybernetique" (which is today's French translation of the word cybernetics) to denote what he referred to as the science of civil government [Ampere, 1834]. With the publication of his book, however, Wiener "formalised much of the thinking up to that time and suggested potentially fruitful areas for further inquiry" [Dechert, 1969: p.107].

Early developments of the new discipline of cybernetics were dominated by the emphasis on applications to physical systems or engineering systems. However, Wiener, although aware of the limitations of the quantified language of mathematics in formalising social problems, did not exclude the possibility of extending the scope of cybernetics to societal problems [Wiener, 1964].

In an attempt to understand the subsequent development of the new discipline in the West, it has been suggested that cybernetics has progressed along two (for some three [ibid]) main axes [Otley, 1983]. First is the theoretical cybernetics, which groups under its banner the mathematical theory of communication, control engineering, artificial intelligence, etc. The second stream is that of practical cybernetics which has direct relevance to the human being as a biological system or as part of a larger human activity system. Later developments in the field of practical cybernetics show how the concepts of neuro- cybernetics can be used in shaping the cybernetics of organisations [Beer, 1981].

Outside the developments that have taken place in the West, cybernetic thinking in the Soviet Union appeared before Wiener and can be traced back to the early years of this century [Gorelik, 1987]. In his essays on Tektology, Bogdanov [Bogdanov, 1984] attempted to initiate or create what he considered the universal science of organisation. Although the terms he employed may differ, the fundamental concepts of cybernetics such as feedback, variety and regulation find their place in Bogdanov's Tektology [Gorelik, 1987]. His work remained unknown owing to official censorship by the Soviet authorities. Towards the end of the fifties, however, cybernetics was formally established in the Soviet Union "as a legitimate natural science" [Holloway, 1976: p.114], being officially endorsed in 1958 [Graham, 1967]. There remained the question of the applicability of the new science. The debate during the early years of formation of cybernetics converged on a consensus that cybernetics is applicable only to the control of complex mechanisms; the broadest laws of nature, society and thought being the domain of dialectical materialism [ibid]. This subordinate position of cybernetics vis-a-vis Marxism did not, however, gain universal acceptance among scientists. Not long after the official endorsement of the new science, there were some willing to call for the recognition of a cybernetic approach to all phenomena [ibid]. Newly-emerging research interests brought with them the possibility of applying the ideas of cybernetics in the area of human activity systems, not only in the Soviet Union but also in other countries of Eastern Europe [Lange, 1970].

After this introduction we can proceed to deal, in section I of this chapter, with some of the important concepts of cybernetics which have direct relevance to later analysis. The second section will present a discussion of organisational control in a cybernetic context.

I. SOME RELEVANT CYBERNETIC CONCEPTS

Cybernetics, as formally defined by Wiener, is the science of control and communication in the animate and the inanimate [Wiener, 1948]. However, it was not long before practical cybernetics began to find its way into the field of management (in the East as well as in the West) as a means to control organisations and economic systems [Holloway, 1976; Lange, 1970; Beer, 1959]. Before we tackle the question of cybernetic control of social organisations, it is appropriate to describe some of the cybernetic concepts relevant to the management of organisations.

I.1 THE CYBERNETIC SYSTEM

Generally speaking, a system can be described in many different ways: verbally, by using everyday language; by a physically simulated model, or by relying on a more abstract language, for example a set of linear equations, like the mathematical formulation of a transportation system, where quantities of goods are shipped from a number of sources to a set of destinations. However, before we begin any actual description, we must first specify the object of our description, i.e. what we understand by the concept system.

Here is an attempt to formally define a system. Let (S) be a collection of the elements e1,e2,...,en. (S) itself is contained in a wider environment, E ; where E = {eo, e1, e2,...,en}. We also consider that every element in E is characterized by input and output qualities. We introduce a set P = {e1,e2,...,en}. Let Rij denote the set of relationships by which elements of E are related to one another. For example, r23 shows how the output of e3 depends on the direct input of e2 in the set E. Formally then, the system is defined as follows:

S = { P, R }, i.e. as a set of interrelated elements.

The question now is: in order that our treatment of the system may have any practical use, can we consider the above definition as sufficient? What are these elements? What are the relationships (and how many of them) between these elements?

Let us put these questions in a more practical context. Consider a system in the form of a distribution company with a certain range of products. It operates over a given geographical area. We can describe this company in different ways. What is to count as an element? It could be a functional department, it could be a regional outlet, or better still we can consider every individual employee of the company as a separate element. The relationships between the elements could be the physical flow of goods between the outlets or the possible social relationships between the individual employees, or groups of them. Or, instead, the relevant relationships might be the flow of information between the functional components of the firm.

This example is intended to show that there is no one (objective) definition of a system (refer to ch. 5). The facts about the system are observer - dependent [Beer, 1979]. An important feature of a social organisation is that it belongs to a "sphere of existence" [Beer, 1985] of multiple dimensions. Choosing one particular dimension along which to view the organisation depends on the modelling purposes of the observer (refer to ch. 12). Social organisations "are characterised by possessing a closed structure of communications which defines them as wholes..." [Espejo, 1987: p.58]. This outlook implies that what matters about organisations, as systems, is the mode of the relationships that bind the different parts, and the pattern those relationships may assume over time: "The relation is more important than the things related" [Beer, 1966: p.245].

The multi-dimensionality of an organisation as a cybernetic system (i.e. exceedingly complex and probabilistic [Beer, 1959]) implies that many of its aspects escape the perception of any one individual at any time. Put differently, this means that the organisation is so complex that it cannot possibly be assimilated by one observer.

To clarify this idea, let us go back to our attempt at definition of a system and elaborate on it a little further. We have a system (S) made up of five elements: e1,e2,...,e5. R denotes the flow of information inside (S). For the moment we ignore the influence of the environment E, and concentrate only on the internal relationships of (S). This is shown graphically in fig.6.1 below. The number of possible relationships in the system are:

$$n(n-1)/2 = [5(5-1)]/2 = 10$$

However, it is not enough to know about the existence of the relationships. It is also important to find out the way elements are related one to another. The flow of information between the elements of the system may operate in two ways. In this case the number of these relationships becomes:

$$n(n-1) = 5(5-1) = 20.$$

This number will be more than doubled if we add just two more elements to the system.

However, this is only a snapshot picture. The system's elements are dynamically related. The flow of information ei--->ej has 2 states, on or not on. The same applies to ej--->ei. The number of possible relationships between ei and ej (taken together) over time is 2*2 = 4. In other words, the number of distinguishable states of the system (in operation) increases exponentially as elements are added to the picture.

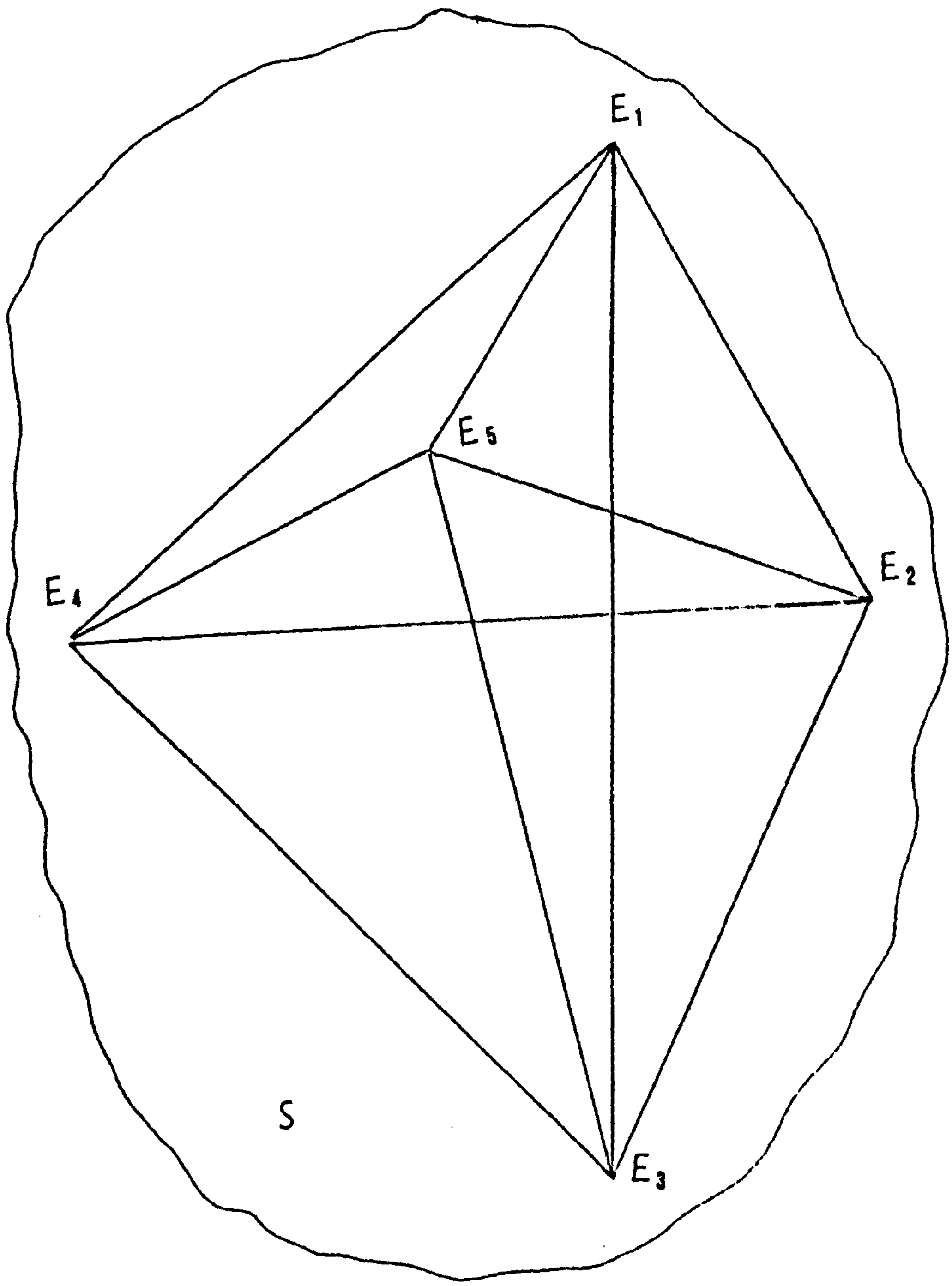


Fig.6.1. The dynamic relationships between the elements of a system

Before we can seriously account for the complexity of an organisation, we must make clear that this cannot be done without, first, stating the purpose of the organisation as conceived. It is the purpose ascribed to the named organisation which determines the perceived level of its complexity [Espejo, 1987]. For example, with reference to the system of figure 6.1 above, it could be that the system contains more than five elements, but because we concentrate on those elements which entertain two-way relationships with other elements, this limits our concern exclusively to those which have only such a relationship. So, just like the naming of the system itself, its complexity is also observer dependent. The measure of complexity in cybernetics is called variety [Ashby, 1964], which is defined as the number of distinguishable states of a system [ibid]. It follows from this definition that the concept of variety as a measure is also subjective: "The observer is always part of the system: he determines its nature, its purpose, its variety" [Beer, 1979: p.36].

I.2 THE LAW OF REQUISITE VARIETY

Owing to its great importance for the cybernetic model of organisation (refer to part II), it would be appropriate to deal, if only briefly, with Ashby's law of requisite variety. Ashby's formulation of the law of requisite variety implies that it is applicable to all types of system [Ashby, 1964]. Thus, organisations as themselves cybernetic systems are also subject to this law [Beer, 1979; Buckley, 1968]. The law states that "the variety within a system must be at least as great as the environmental variety against which it is attempting to regulate itself" [Buckley, 1968: p.495].

For the purpose of illustration, we recast the proposition of the law above in terms of an example using the idea of a black box. A black is box referred to here as a system which is completely opaque; none of its states can be observed. All we can do with a black box is manipulate its inputs to determine the pattern of its outputs [Ashby, 1964; Beer, 1979]. Using Ashby's own notation, the variety of the system (i.e. the black box) is denoted by R and it is defined as the number of action states or responses available to the system.

D denotes the variety of the environment, and it is the number of action states or disturbances the environment can assume vis-a-vis the system.

O is the set of outcomes of the black box. An outcome O(d,r) is the result of the operation of the black box, when a disturbance d is applied on the black box and met by a response r.

The law of requisite variety states that the variety in the set of outcomes O cannot be less than the ratio of environmental variety to the black box variety, i.e.:

$$\text{variety O} > \frac{\text{variety of D}}{\text{variety of R}}$$

If the varieties are measured logarithmetially then:

$$VO > VD - VR$$

Let T be the target set (a subset of O) which defines the stable behaviour of the black box. To reduce or limit the variety of the outcomes VO to that of the target set VT (i.e. the variety of the stable behaviour), the only option open is to increase the variety of the black box VR: "Only variety in R can force down the variety due to D, only variety can destroy variety" [Ashby, 1964: p.207].

One of the difficulties standing in the way of fully appreciating the law of requisite variety is the ability to count the number of possible environmental disturbances and the number of responses of the black box. Without such counting it is difficult to interpret the ratio:

$$\text{variety O} > \frac{\text{variety of D}}{\text{variety of R}}$$

Another significant criticism of the law of requisite variety comes from Espejo and Howard [Espejo and Howard, 1982]. This criticism is directly related to "the coefficient representing the capacity of a single response r to absorb the "variety" of the set of the environment disturbance d" [ibid: p.5]. This coefficient (k) is the number of times a particular response r may be repeated in Ashby's outcome matrix (d,r). The criticism directed to the law is to do with the assumption that k=1 (that is why it does not appear in the formulation above). This assumption is only justified by mathematical convenience and it is easy to find situations where the assumption is not justified and the law fails [ibid].

I.3 FEEDBACK CONTROL

The notion of feedback control is as old as the term cybernetics. Although it has been developed to its present elaborate form only (relatively) recently, it dates as far back as 2000 years [Schoderbek et al., 1985]. The present way of understanding feedback control was derived from the family of engineering systems, namely systems of the deterministic type.

The objective of a feedback control mechanism is to keep the output of the system at a steady state in the face of disturbances from outside by direct intervention in the system itself, i.e. the environmental interference is considered independent of the control mechanism. In order that we can generalise the use of the concept of feedback we assume that the system under control is so complex as to render the knowledge of its internal dynamics impossible to specify. Therefore, we treat it as a black box. What we should be looking for is the "invariant" relationship between its inputs and outputs. We can then manipulate the inputs in order to get a steady and regulated output, i.e. without the need to know the black box's transfer function. A transfer function is defined here as the relation by which a system transforms (over time) its inputs into outputs.

Consider a deterministic system S with a transfer function T, with input x and output y. In control engineering this transfer function can be specified by a differential equation of some order. The system S is shown diagrammatically as in fig.6.2 below.

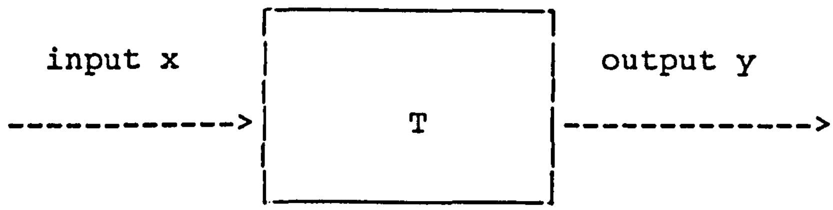


Fig.6.2. A deterministic system with a single input and a single output.

The input x is fed into the system and transformed, through T, into y, i.e.:

$$y = T(x)$$

A more typical case is where the system receives its inputs in the form of a vector xi = (x1, x2,...,xn) instead of a single input x. The output of the system is also a vector yi = (y1, y2,...,yn). This is shown diagrammatically in fig.6.3 below.

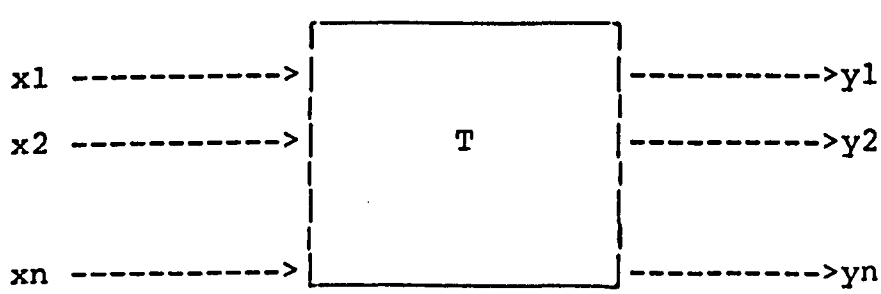


Fig.6.3. A deterministic system with multiple input and multiple output.

For the sake of explanation, we assume that the system is fed with only one input x, and produces one output y, i.e.

a system as depicted by fig.6.2. Now what happens when the system starts to operate? It may be that y is kept steady as desired at a certain level y*, and it may not. Suppose that the system is disturbed, through a change in the input x. This will lead to it departing from the norm (the desired output y*). To bring the system under control (back to its smooth operation), we measure the deviations from the norm and feed them back to the system as part of the input, so that ultimately, the system settles down to produce the standard output y*. These deviations /y-y*/ are fed back into the system only after having been through another transformation, which we denote by F.

A feedback control mechanism is "characterised by its closed-loop structure" [ibid: p.77]. It is basically a coupling of two systems: the regulated system S, with transfer function T; and a regulating (or a control) system C, with a transfer function F. This coupling is shown in fig.6.4.

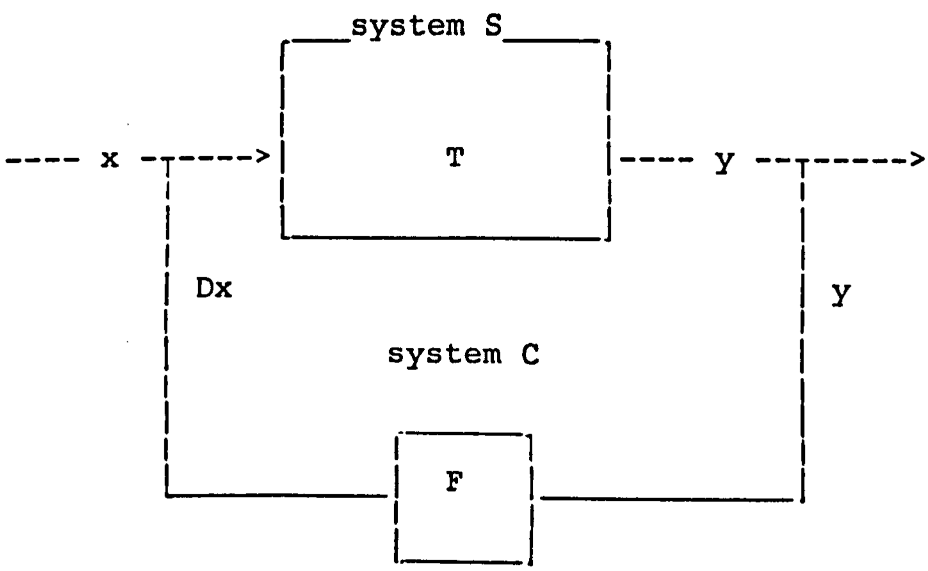


Fig.6.4. Feedback control system.

The objective of the system C is to take as its input y, compare it to the norm y*, calculate the error then transform it (say D) so as to adjust the input x of the system S in order to get the desired output y*. Let us explain formally how these calculations are performed:

We have: $y = Tx$, before the feedback operation and

$T = y/x$, by definition, and also have,

$Dx = Fy$, output of feedback transfer function.

After introducing the feedback into the system S, the new output is expressed as follows:

$$y = T(x + Dx) = T(x + Fy) = Tx + TFy$$

$$y - TFy = Tx \Longrightarrow y(1 - TF) = Tx$$

$$y = Tx /(1 - TF) \Longrightarrow y = [1/(1-TF)] * Tx$$

This is the formula for feedback control.

Investigating this formula would reveal the following: if for example $TF = 0$ in the denominator, it means that $y = Tx$. No feedback correction is needed.

When $TF > 0$, this means that $(1-TF) < 1$; or $y = [1/(1-TF)] * Tx$ is greater than the original y (i.e. $y = Tx$) in other words we have POSITIVE FEEDBACK.

When $TF < 0$, this will lead to $(1-TF) > 1$; or $y = [1/(1-TF)] * Tx$ is smaller than the original y. We have a NEGATIVE FEEDBACK.

Another important conclusion from this formula is that it is possible to calculate directly the value of the input x needed to allow the system with its feedback to attain the required value y* :

We have, $y = [1/(1-TF)] * Tx$ Substitute y* for y;

$$y^* = [1/(1-TF)] * Tx \Longrightarrow x = [(1-TF)/T] * y^*$$

In this abstract exposition of the concept of feedback control, it is assumed that the feedback operation is performed automatically. However, in an organisation there is usually a need for human intervention to close the feedback loop [ibid] and to carry out the operation.

The distinction made here between negative and positive feedback is not a mere mathematical manipulation. Systems regulation and control, invariably, involves the notion of negative feedback or deviation countering. As we shall see in the next section, this type of feedback is widely relied upon by management to keep the organisation's performance around a pre-determined goal. By employing the deviation countering (negative feedback) process the controller (management) concentrates its effort on keeping the output of the organisation as near as possible to the chosen target, that is by reintroducing the deviation from the target as part of the input for future periods.

Although much of the attention in the literature was (and still is) centred around the deviation countering version of the feedback control mechanism [ibid], this does not mean that the other version (deviation amplifying) is less important. The latter version, as the name indicates, is geared towards encouraging the deviation from the norm rather than containing or limiting it [Maruyama, 1968]. An organisation may contain the two types of feedback system operating within it simultaneously. A distinguishing feature of the cybernetic model of the organisation is that it incorporates the two types of feedback loop (as we shall see in part II). This is with the definite purpose of ensuring internal stability (deviation countering), and also encouraging elaborate structural mechanisms to promote growth and long term survival (deviation amplifying).

It is not enough just to be aware of the existence of negative and positive feedback loops in an organisation. It is fundamental to the understanding of the workings of an organisation to have full knowledge of both loops and the relationships between them. This understanding will be gained when we come to the elaboration of the cybernetic model in part II.

II. ORGANISATIONAL CONTROL IN THE CYBERNETIC CONTEXT

We recall from chapter 3 that the classical view of control is command. The essence of this notion of control is that the controller stands outside the system (the object of control). The two are linked together through the cause-effect relationship, where the system under control is supposed to do exactly what the controller wants it to do. Put crudely, control is seen as deciding on the goals, and then telling people what to do so that the organisation achieves its goals.

This attitude to control derives from a simplistic mechanical view of the organisation, i.e. organisational systems designed to serve predetermined objectives. A more sophisticated view considers organisations, in addition to being designed artefacts, as being also naturally occurring phenomena with self-regulating and self-organising capabilities [Beer, 1979; Espejo and Watt, 1978]. In this matter the cybernetic understanding of the system (organisations are typical cybernetic systems [Beer, 1959]) goes far beyond the classical. It is in terms of the wider sense of control, which takes into account complexity and uncertainty, that we will consider the cybernetic control of organisations.

Within the cybernetic approach, Jackson distinguishes two strands of thinking: management cybernetics and organisational cybernetics [Jackson, 1987(b)]. The adherents of the former (i.e. management cybernetics) have maintained the status-quo. They have tried to adopt the tools of cybernetics (black box technique, feedback, etc.) to management control without questioning existing assumptions. They see the controller as standing outside the system. Control is exercised on the system "without the controller being in any way affected" [Glanville, 1987: p.102].

Control of organisations in this framework remains essentially classical; cybernetics is seen as helping enhance the power of the controller (i.e. management) by applying new techniques. In other words, cybernetics "...recognises the authoritarian nature of control" [Robb, 1984: p.11]. However, this brand of cybernetics does depart from the classical, strictly mechanical and closed system view of the organisation, in that it recognises the influence of outside forces. In this respect it falls within the open system perspective of the organisation (see ch.5). Management cybernetics implicitly accepts that the smooth running of an organisation requires that attention be given to the environment as well as to the internal processes of the organisation: "It has been established that there will be a need for control activities to ensure survival. Furthermore, there are two distinct categories of such activities, internal and external regulation" [Strank, 1982: p.54].

To explain the affinity between the classical notion of management control and the management cybernetics notion of control, consider fig.6.5 below [ibid].

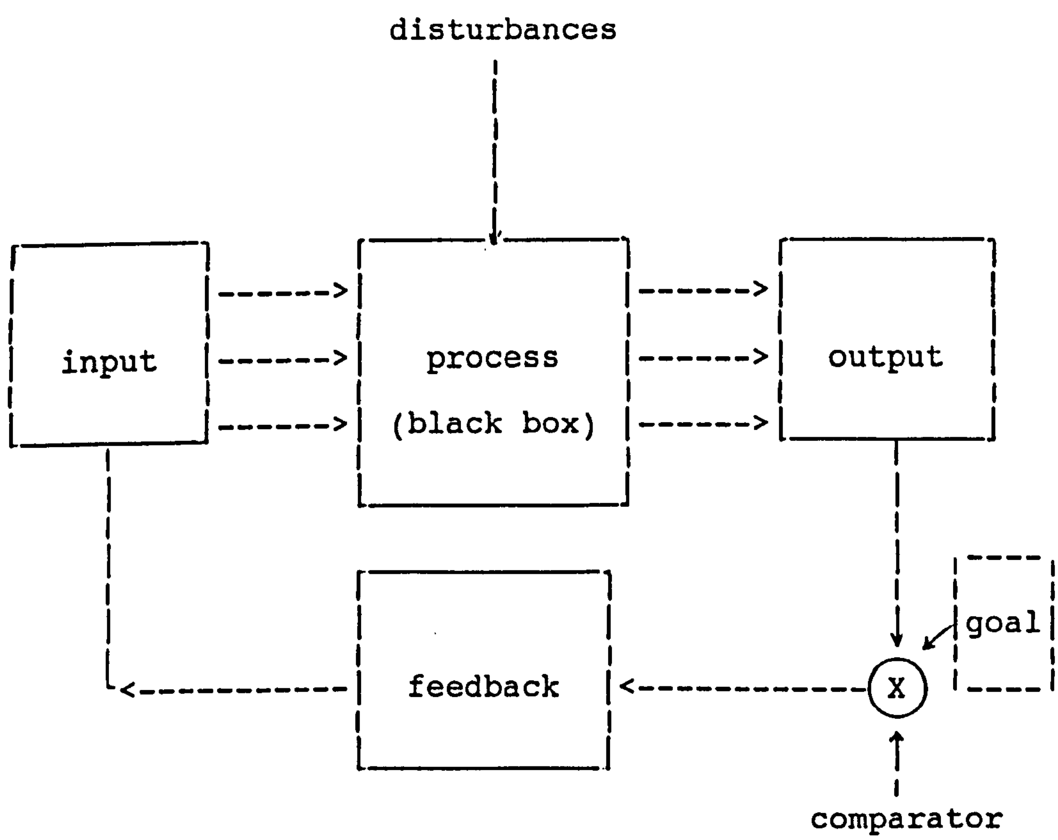


Fig.6.5. Management cybernetics control mechanism at the operational level.

This figure represents a model of the organisation where the process under control is seen as a black box [ibid; Schoderbek, 1985], and shows control by management being exercised through the feedback mechanism.

Considering the process under control as a black box is a recognition of the fact that systems amenable to cybernetic investigation are invariably complex and dynamic. The controller is seen to be setting up the goal(s), following the progress of the output(s) coming out of the black box, and then comparing against the goal (for each output). The system is left to carry on with its operations in the case that no deviations (compared with goal) occur in the outputs. Otherwise a decision will be made on corrective action to eliminate the deviations in outputs from the goal, this being fed back as part of the inputs.

The cybernetic reasoning applied here to the operational level of the organisation is held to be equally valid at the upper levels of the hierarchy: "It is worthwhile to point out that the application of cybernetic principles can be made at all levels of the organisation" [Strank, 1982: p.61]. Refer to fig.6.6 below. It is a synthesis of two hierarchical levels [ibid]: the operational level of fig.6.5 and its immediate superior level.

The controller at this (upper) level of the hierarchy performs his control operation in more or less the same fashion. He compares the outcomes from the process (the black box) against his own goals, from which are derived the goals of the operational level [ibid]. The corrective action taken (the feedback) is directed this time not at the inputs to the black box, but to the set of goals of the operational level.

As we can see the application of feedback control and the black box principle (this refers here to the fact that the upper level is not invigilating all the actions of the operational level) is the same at both levels of the organisation.

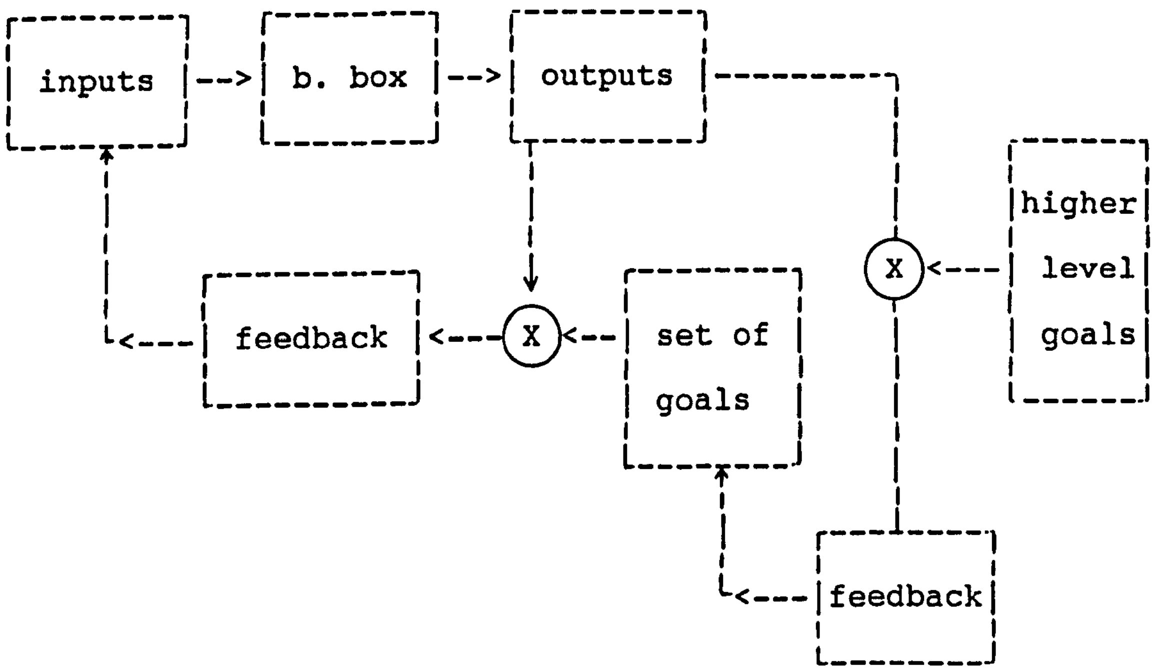


Fig.6.6. Management cybernetics control mechanism at the tactical level

The process does not change even though the two levels of control may employ different measures of performance. For example, at the operational level we find the use of physical measures (number of units produced, number of units sold, etc.); at the next level up (corresponding to Anthony's tactical management [Anthony, 1965]) management may use financial measures. This feedback control model is considered (by the adherents of management cybernetics) as "sufficient to explain many of the reported features of organisation, and offers the means of quantifying many of the problems occurring in organisations" [Strank, 1982: p.74].

In the same fashion management cybernetics proposes a slightly modified model to meet the requirements of Anthony's strategic management. It is termed feedforward control: "The basic reasons for postulating such mechanisms are cybernetic necessity on the one hand and observed management practice on the other" [ibid: p.75]. The distinguishing feature of "feedforward", as opposed to feedback control, is that it derives its information for correcting the organisation's progress from the inputs rather than from the outputs as is normally the case with feedback control.

As we can see, management cybernetics does not provide its own model of the organisation. It seizes upon the classical model (refer to ch.3) and attempts to adapt the cybernetic techniques of black box and feedback in order to make management function more efficiently; "between this form of cybernetics and traditional management science there is little to choose" [Jackson, 1987(b): p.141]. Indeed the model presented in fig.6.6 above, although it employs cybernetic principles, hardly qualifies as a cybernetic model. It still remains within the confines of the traditional and hierarchical model, but with cybernetic colouration and flavour. Because of this close association with the classical model, it is incapable of acquiring sufficient regulatory power to meet the complexity of modern organisation and the complex and changing relationship the organisation has with the environment. Without adequate complexity in the model it is not possible to control the organisation [Graham, 1967].

The control mechanism in the model above appears to be designed to meet the immediate needs of the organisation for stability and equilibrium. The way this model seems to operates implies that outside disturbances (although unknown) are fairly predictable. It does not seem to have provisions to meet those states of the environment which cannot be envisaged in advance by the controller. It is not explicit how cybernetic control as presented here can help in the process of learning and adaptation necessary for the long term survival of the organisation. We know that long term survival implies the capacity of the organisation to self-organise [Espejo and Watt, 1978]. To ensure that feedback control arrangements have sufficient regulatory power to match the variety increase in the black box as induced by environmental pressure, we need continuously to redesign these mechanisms [Beer, 1979]. However, this possibility is clearly lacking in management cybernetics.

A model adequate for the control of an organisation requires to be based on more than the input --> black box --> output schemata underpinning management cybernetics. The model must meet the dictates of the law of requisite variety [Ashby, 1964]. Since organisations are faced by higher variety from the environment than they themselves can exhibit [Beer, 1979], it is essential that organisations find ways by which to counter the overwhelming environmental variety. That is to say they must acquire requisite variety not by merely maintaining their position in the environment but also by growing and expanding. In other words, it is necessary to supplement negative feedback or deviation correcting mechanisms, with also positive feedback (see section I.3 above) or deviation amplifying mechanisms what Maruyama refers to as the second cybernetics [Maruyama, 1968].

The methods of variety engineering necessary to meet the requirements of the law of requisite variety, and the keys to self-organisation and structural elaboration allowing the organisation to grow and expand, are to be found in what Jackson refers to as "organisational cybernetics" [Jackson, 1987(b)]. Speaking of organisational cybernetics one is essentially referring to the work of Stafford Beer [Beer, 1979, 1981, 1984, 1985], and to that of the adherents of his Viable System Model [Espejo, 1977, 1987; Clemson, 1984]. Although Beer himself and the others do not explicitly employ the phrase organisational cybernetics, it is a useful term to use to distinguish the structuralist approach of the VSM [Jackson, 1987(a,b)] from the positivistic and mechanical view held by management cybernetics.

The VSM can be justified as the embodiment of the cybernetic model. It stands on its own, developed from cybernetic first principles [Beer, 1979, 1985]. The unique feature of the model is that it provides for the full-scale variety engineering necessary for internal stability of the organisation, i.e. "the inside-and-now" [ibid], while, at the same time catering for the requirements of the organisation to meet the challenges of the environment, i.e. "the outside-and-then" [ibid].

With respect to information systems design, the cybernetic model (examplified by the VSM) stands apart from the other models of the organisation (refer to ch.3, ch.4, and ch.5). It recognises that organisational design must follow the information requirements of the organisations: "The recognition in the cybernetic model that it is information flows and communication links which more than anything else bind organisations together, is significant testimony to the superiority of this model..." [Jackson, 1985: p.37]. This emphasis on proper communication channels and elaborate information networks as a prerequisite for organisational design, makes the cybernetic model (meaning the VSM) our chosen model of the organisation. However, since we have devoted a full part of this thesis (part II) to the model, it is thought appropriate to leave the discussion and elaboration of the model until part II. As to the discussion of the criticisms directed to the model, they are postponed until the end (refer to ch.16), that is after we have seen the application of the model to an on-going organisation, which will be the subject of part III. Thus we must ask the reader, for the moment, to take largely on trust the VSM as an organisational model to support information systems design. The proof of our contention is to be found in the remainder of this thesis.

PART II

THE MODEL FOR THE ORGANISATION:

THE VIABLE SYSTEM MODEL (VSM)

Chapter 7

THE RAISON D'ETRE OF THE ORGANISATION

INTRODUCTION: THE SYSTEM IN FOCUS

Before we can confidently discuss the anatomy of the Viable System Model (VSM), we need first of all to identify the system of which it is a model, i.e. identify the " system in focus". This discussion relies, by and large, on the work of Stafford Beer [Beer, 1979, 1981, 1984, 1985, 1989]. Our understanding of the cybernetic system has been explained in chapter 6 of part I. However, we are not being over cautious when we emphasise the fact that, the definition of the system and our perception of it, cannot possibly capture all the underlying complexity of the situation. It is no other than a subjective interpretation of the perceived reality. This perception is influenced by the way we view the outside world which, to a large extent, is directly determined by our physical sensors on the one hand, and our past experiences and cultural background on the other [Ben Eli and Probst, 1986].

Identifying a set of social activities and naming it to be the system for investigation is a difficult task. Unlike the objects of the natural world, where agreement about their identity is feasible and attainable, such an agreement is far from being a straightforward matter in a social set-up. One name given to a piece of social reality is as good as any other, and these names are as numerous as the number of observers involved [Beer, 1979]. It is argued here that this multiplicity is in fact inevitable in the face of unstructured situations [Espejo, 1985]. Out of the multiplicity of viewpoints is formed the notion of the multi-system, which defines an "on-going process of interaction" [ibid], of different perceptions of social reality. Our concern, however, is not in the process of interpersonal interaction, it is rather, when this process takes the form of a "closed network...with autonomy vis-a-vis particular tasks or missions, then the multi-system IS an organisation" [ibid: p.59]. In other words, the exceedingly complex situation with which we are faced may be considered, by the observer(s) or participant(s), only from one particular angle, i.e. from the purpose(s) he ascribes to the situation which he/ she subjectively has named as a system.

This is what is referred to in Beer's terminology for the VSM as a recursive dimension: "Whatever viable system we wish to model exists in a variety of recursive dimensions" [Beer, 1985: p.6]. The relevance of any one dimension is purely a subjective matter, depending on the purpose of the observer (participant) of the system under investigation. For example, consider a manufacturing company, say, of electrical spare parts, as the system in focus. It may be that this company is a division of another (parent) company specialising in the production of electrical products. At the same time, the manufacturing activity of our company is organised geographically, having plants in the regions A, B, C, etc. This trio: parent company, the manufacturing company of electrical spare parts (the system in focus), and the regional plants constitute a recursive dimension. Meanwhile, our system in focus belongs to the light industrial sector (as a component of total industry). Along this dimension, the company might be organised in terms of the products it provides to the market: division I for radio and television equipment, division II for other domestic appliances, etc. Another observer may choose to study the same system in focus for a different purpose altogether, say, the technology employed for production. Fig.7.1 below attempts to depict the notion of recursive dimension of a viable system; for obvious reasons only two dimensions are involved.

In this example, although the system in focus is the same for both recursive dimensions, the components making up the next level up and the next level down are different. For one observer, the next level of recursion up is the parent company, and the parts making up the operational level are the plants. From the second observer's standpoint, the situation is different. The next level up in this case is the light industrial sector of the economy, whereas he sees the next level of recursion down as organised into divisions, regardless of the geographical locations of the plants manufacturing the spare parts (further discussion of the notion of the system in focus and the relevant recursive dimension is deferred to ch.12)

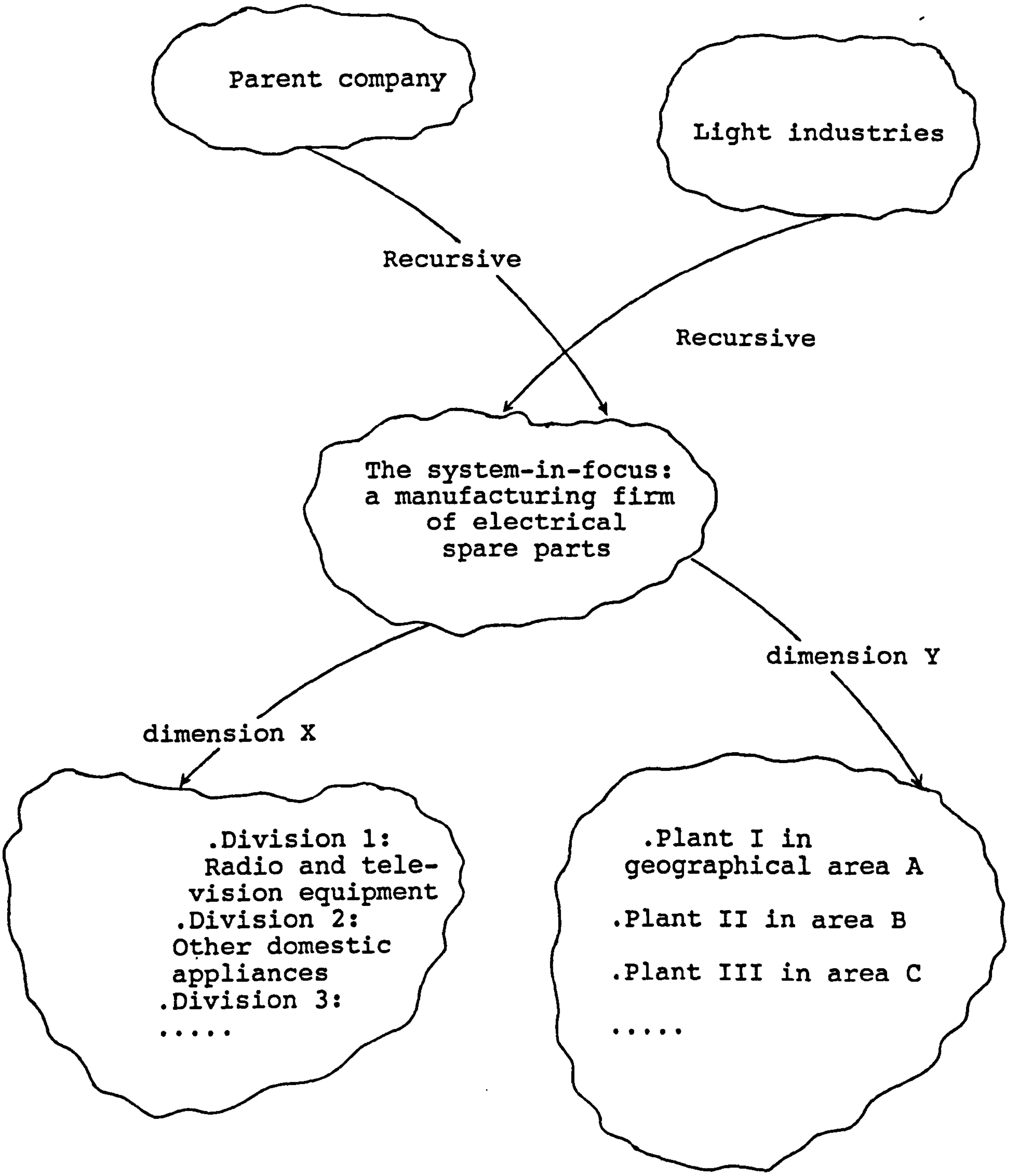


Fig.7.1. The recursive dimensions of a system in focus.

Having arrived at this understanding of recursive dimensions and the system in focus we can begin to elaborate on the anatomy of the VSM. In so doing an attempt is made to avoid abstraction. To bring the point home, we will build up the model (following Beer's terminology and convention) in the light of our existing experience of organisations. If an organisation is capable of maintaining a separate existence and working, then it is only reasonable to assume that it already adheres to the laws of viability. The purpose of using the VSM in that case would be to enhance the necessary design mechanisms in order that it becomes more efficient.

The prevailing view of organisations assumes a pyramidal order of authority (refer to ch.3). Plans, together with orders to carry them out are considered at the top of the hierarchy. Implementation of these plans is carried out at the operational (bottom) level. The number of levels between the two varies from one organisation to another. To supply management with information for planning and control of the organisation, an information system is built around the structure (see ch.2) through which orders flow downwards, and reports about execution flow upwards. For years the standard tool of analysis of organisation structure has been the all familiar organisation chart. However, this is inadequate. It continuously proliferates variety and in all directions [Beer, 1979]. We endeavour in this chapter to abandon the concept of hierarchy in the orthodox sense, as exhibited by the organisation chart. The only sense we can attribute to hierarchy in our present context is "logical", i.e. one level is "metasystemic" to another [ibid]. With these points in mind we can move on to the "building blocks" of the VSM.

I.THE BUILDING BLOCKS

Once we have defined our system in focus, and decided on the recursive dimension along which it moves or exists, we move one level of recursion down, i.e. to the components (the viable systems) of our system in focus. With reference to the example of fig.7.1 above, these components are the divisions 1, 2,...etc.; or, if we opt for recursive dimension X, the components will be the plants in the various geographical areas. It is at this level that the viability of the system is ensured. In other words, these contained elements are the primary activities of the organisation. They carry out its mission as defined. Cybernetically, these components are called the operational elements (OE) of the VS.

As would be expected, the number of OEs will vary from one organisation to another. For any one organisation, the number of OEs corresponds to the number of identifiable primary activities. The important point, however, is that all these elements should meet the criterion of viability when taken separately. They must be viable systems in their own right. As an example, take the School of Social Sciences at the University of Hull as the system in focus. Then we may consider the different departments of the School as its OEs. Any department, in turn, can be considered as a VS and modelled accordingly.

The recursive arrangement of the VSM is the answer of the model to the need of an organisation to provide requisite variety vis-a-vis the complexity of its task environment.

The capacity of the management of the system in focus to handle the complexity of the organisational task is limited. To achieve effective implementation of the task, it is necessary to move down a level of recursion. At this new level, local management is left autonomous to deal with its defined primary activity, i.e. form an OE of the system in focus.

The same logic applies to the management of the OE. The complexity of its task renders that task virtually a black box. Again, the answer to the variety generated by the box (the managed operations) is structural; drop another level down along the recursive dimension. This structural arrangement of the VSM provides an answer for the organisation facing the unfolding complexity of its environment.

As to how to build a VSM, "the basic device is to divide the notion of the viable system into two, and to form a LOGICAL (Beer's emphasis) hierarchy of these two parts" [Beer, 1979: p.116]. There is the implementation part which is made up of the OEs which carry out the operations of the organisation. The second part is a service part, in the sense that it exists to facilitate the working of the operational side of the organisation (the OEs). The logical hierarchy between the levels of the VSM will be made abundantly clear towards the end of part two. We will consider next the detail of an OE functioning.

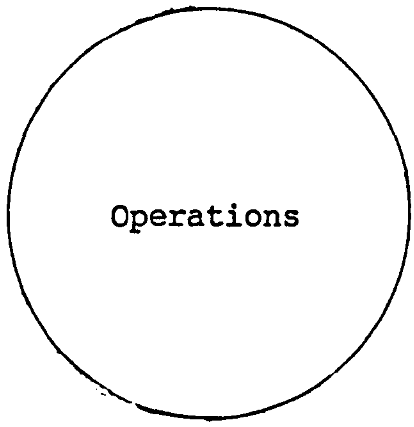
I.1 THE AUTONOMIC OE

As has been stated, an operational element is an embedded viable system in the designated system in focus. It is one of the elements that is necessary for the continued existence of that organisation with its current identity. In a business organisation, for instance, an OE is a part which undertakes one of the primary activities of the enterprise; turning out a product in the case of a manufacturing concern, or providing a service in a service organisation, such as a market research bureau. An example of a non primary activity (therefore not an OE) of an orgnisation, is the marketing department in a manufacturing firm. It cannot be considered as an OE since its very existence is to provide a service for the producing parts of the organisation. In other words, if we do not have production there will not be any marketing. On the other hand, this marketing department can be an active OE if the system in focus is a market research bureau.

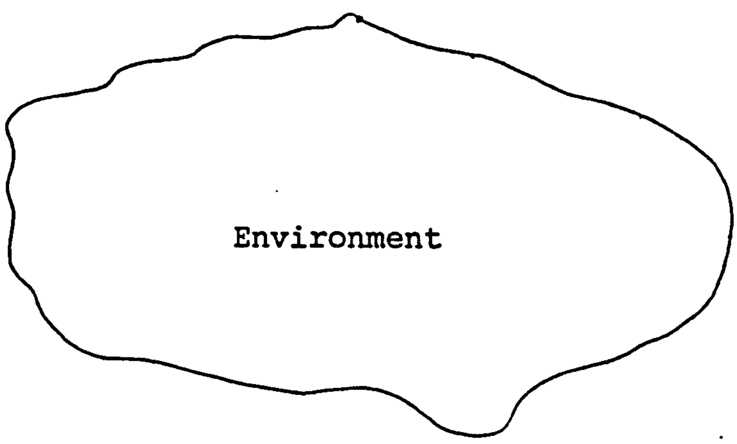
However, identification of an OE is made not only with reference to the system in which it is embedded. It is also important to take into account its relationships with other possible operational elements [Espejo, 1984]. This is particularly important for getting the level of recursion of the system in focus right.

A further important point to consider when identifying OEs is that they must be capable of maintaining a separate existence if hived off from the organisation. They are, after all, supposed to be VSs in their own right.

Once we know what our OEs are we can think about representing them diagrammatically. Following Beer's convention, the operations (the primary activities) are designated by a circle. This circle contains all aspects of organisational life which have any bearing on the production of the organisational output for the particular OE in question, be it a physical product or a service.

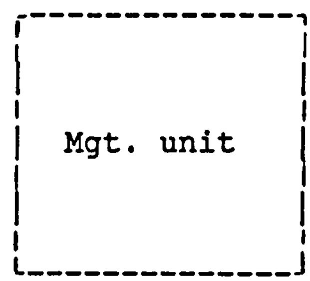


The output of an OE is disposed of in an environment. This environment is multi-dimensional [Beer, 1979]; it is everything relevant to the operation which lies outside it. Graphically, it is represented by the symbol below.



It has an amoeba-like shape to reflect the fact that the boundaries are hazy. They can extend in one direction and contract in another. The boundaries of an operation's environment are uncertain and have no permanent status.

This state of affairs, i.e. the operations embedded in an environment, needs control. That is the task of management. The management of the operations is represented graphically, according to the convention, by a square.



We will continually refer to this square box as a management unit. It performs the task of regulating the operations under its control through the manipulations of inputs in relation to outputs (see black box treatment of ch.6). At this point, it is worth emphasising again the notion that the management unit perceives the operations through its model-in-the-head. Its capacity to regulate the operations is a function of the amount of variety contained by the model it holds of the operations [Conant and Ashby, 1981]. Clemson makes a graphical distinction between the management unit and the model it holds of the operations under its control [Clemson, 1984]. However, for the purposes of this exposition, it is assumed that the management unit and the model it holds of the operations are a single entity.

These three distinguishable components of an OE can be represented as embedded in one another, i.e. the management unit is embedded in the operations, the object of its control. The operations, in turn, are embedded in the indeterminate amoeba-like symbol which is their relevant environment. This process of embedment appears graphically as in fig.7.2 below.

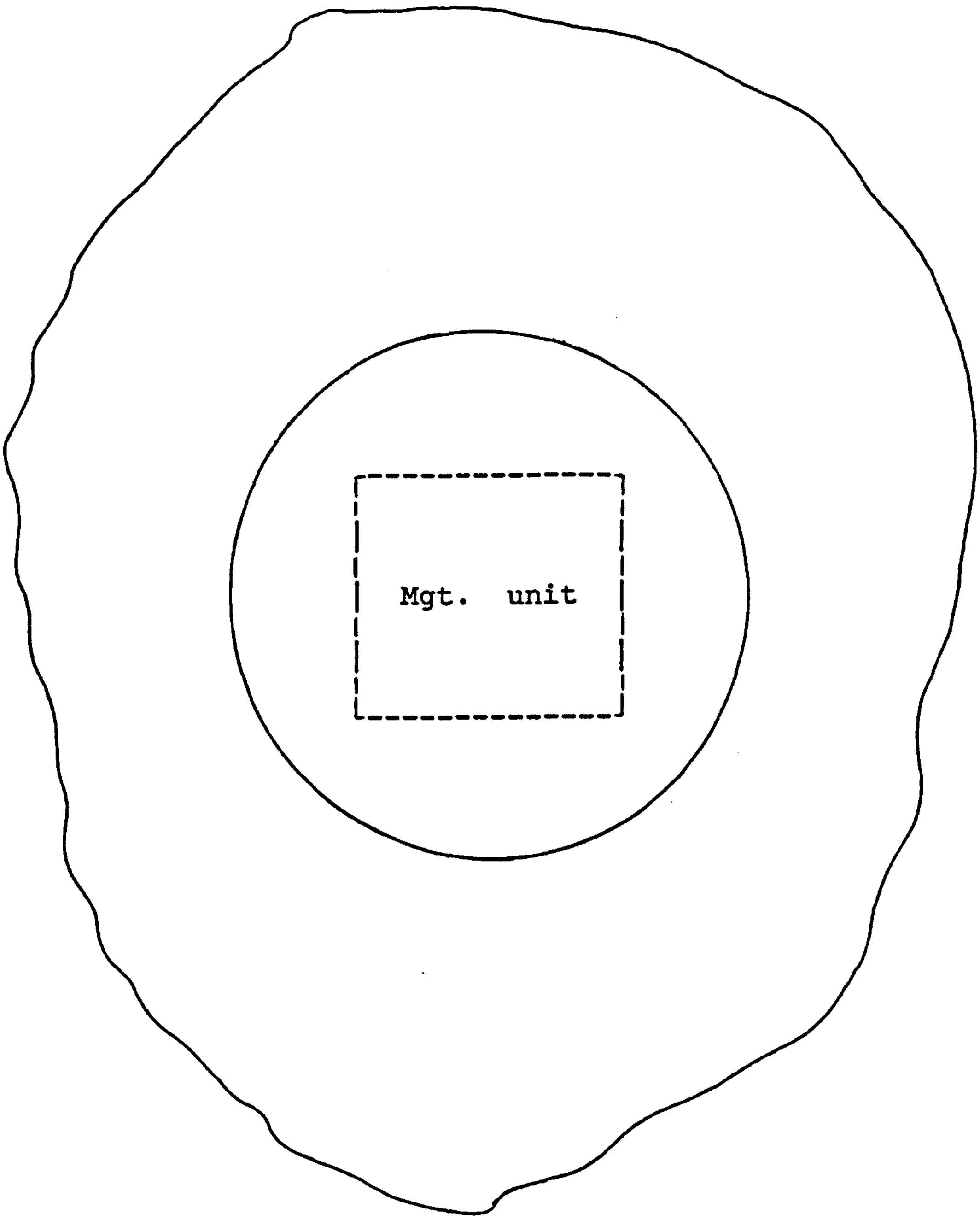


Fig.7.2. The embedment of the components of an OE.

This graphical representation of the embedment of OE components reflects, on the one hand "organisational life" [Beer, 1979]. Such a representation also allows us to appreciate the "relative varieties" of the components [ibid]. However, for convenience and for analysis purposes, an OE will be drawn to make apparent the variety diffusion across the boundaries of the three components. The new graphical representation of an OE will, thus, appear as in fig.7.3.

The variety exchange between the components of the OE of fig.7.3 is through the arrows connecting them. However, this simple variety transfer (by the arrows) should not lead us to overlook the fact that the boxes are embedded in each other, and that the flow of variety is "by diffusion", i.e. multi-faceted and multi-directional.

For the OE of fig.7.3 to be operational and in working order, it is assumed that it has achieved internal balance and stability. This in turn implies that the law of requisite variety is satisfied [Ashby, 1964]: the variety of the management unit, the operation and the relevant environment are in equality. However, we have stated above that the embedding of one box in another reveals the fact that their variety differs, i.e.:

Env. variety > Ops. variety > Mgt. unit variety

The missing feature, to make explicit the way the above law exerts itself when variety is transmitted across the boundaries of an OE, requires two more symbols to explain. These are borrowed from electrical engineering and are:

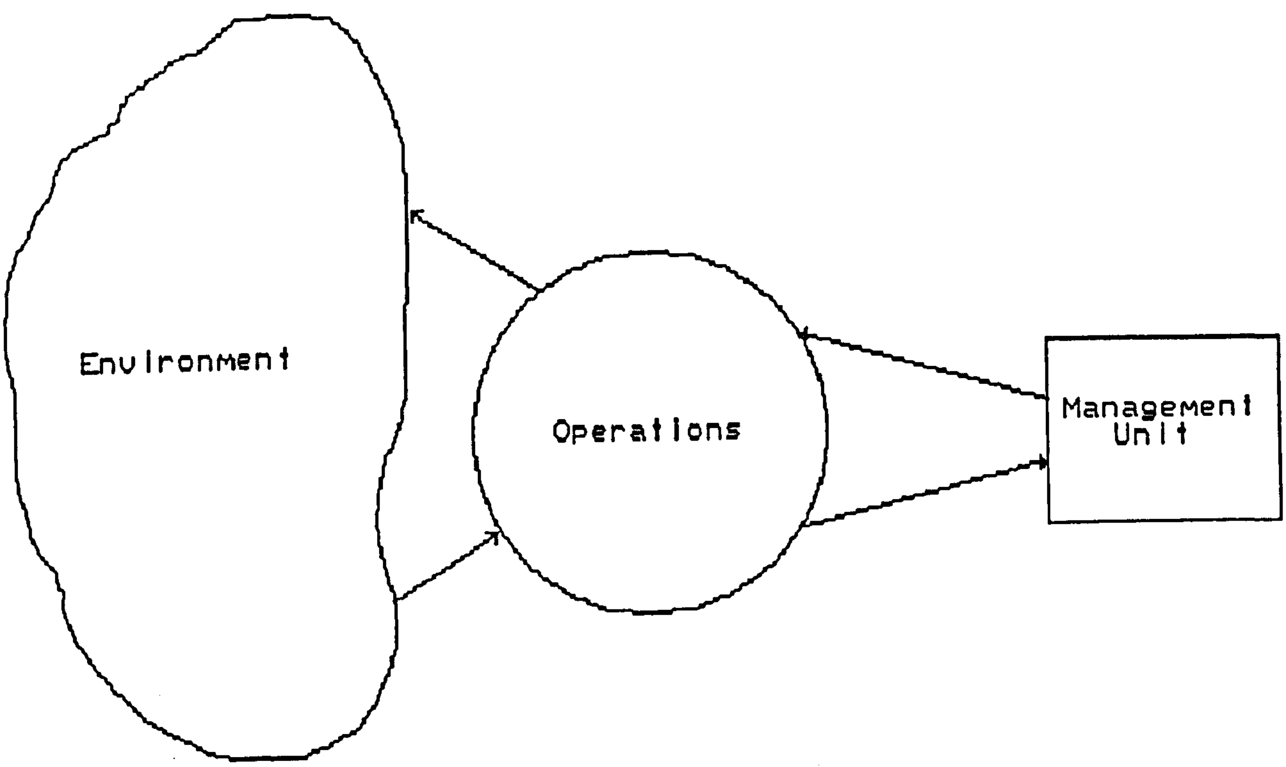
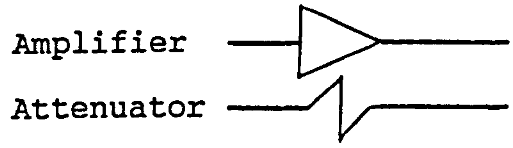


Fig.7.3. Typical presentation of an OE.



Thus an improved diagram of the OE of fig.7.3 will look like the one in fig.7.4.

The amplifiers and attenuators of fig.7.4 imply that, for the management unit to be able to control the operations within the context of Ashby's law (which exerts itself anyway), it must filter the operational variety through properly designed attenuators and/ or amplify its own variety vis-a-vis the operational variety. The same logic applies to the loop relating the operations with the environmnt.

This OE if at all viable (which it is by definition, according to the recursive system theorem of the VSM [Beer, 1979, 1981]) must be self-regulating, i.e. capable of attaining state of homeostasis. Beer defines homeostasis as: "The capability of a system to hold its critical variables within physiological limits in the face of unexpected disturbance or perturbation" [Beer, 1979: p.402]. What is required of management is properly to design the above homeostatic regulators (amplifiers and attenuators) in order that this homeostasis can be achieved and maintained with least cost (in human and financial terms). In this way organisational efficiency can be attained when an OE acts in a self-regulating way to achieve stability.

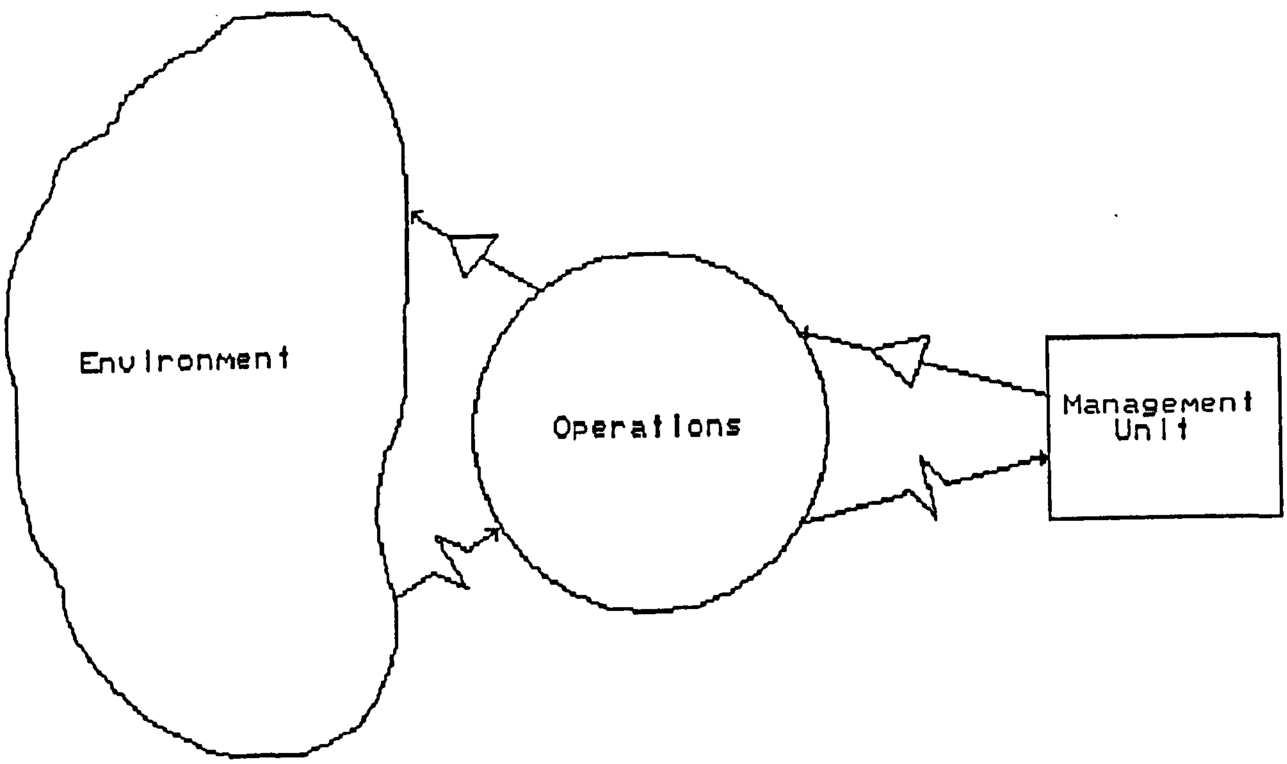


Fig.7.4. An OE with amplifiers and attenuators.

I.1.1 AN EXAMPLE OF VARIETY ENGINEERING IN AN OE

The objective of control in an OE is manifestly to achieve and maintain homeostasis. However, owing to the inherent complexity of the situation the management in the OE has to face, many things may go out of control: there may be new and unexpected disturbances in the environment, for example a sudden take-over bid by a rival competitor, or a merger of two rival competitors; or the disturbance to the stability of the OE can be purely internal, such as a grievance action of the labour force, or a break down in an assembly line, etc.

In the normal course of things, OE may be homeostatically balanced, requisite variety being achieved throughout. This homeostasis is necessarily the result of properly designed amplifiers and attenuators in the loops connecting the three components of the OE. However, the state of internal homeostasis is never permanent. Unexpected external influences and the dynamics of the interaction between the system and outside, see to it that an OE can go into oscillation

No matter what causes the imbalance to the stability of an OE, the first necessary task is to detect change [Beer, 1981]. Given the subjective nature of the system and the complexity surrounding it, it is not possible to determine in advance the future disturbances to the system. So these disturbances and the response to them are registered as they happen. Take an example of a manufacturing company. A purchasing agent detects change in the environment, say a shortage in the supply of certain items and that probable delays are to be expected in acquiring materials. This information is transduced into a language understandable to the stock handling subsystem (in the operations). The transduced information may explain the type and number of items expected to be in short supply, the probable delays in delivery, alternative sources of supply of all or some of the problematic items, the cost of the alternative supplies, etc.

In the operations, in the light of the new information input from the environment, existing plans have to be reevaluated, new programmes for production worked out, and new target dates set. The information about the change in the internal state of the system (the operations) reaches management after (yet again) it has undergone a process of transduction and filtration. The management unit, and the channel operations ---> management unit, will not have requisite variety to absorb all the details of the reworked plans of the operations. If transduction and filtration did not take place, therefore, the result would be to overload the information network and the information processing capacity of management.

However, change in one aspect of the operations, in this instance a shortage of supply of materials, will have a definite impact on other aspects of the operations, for example, a possible need for overtime work on the production line to offset the delays, reprogramming the marketing activity to meet the requirements of the new situation, etc. Coordination of the activities in the circle (the operations), is the task of management unit. The amount of information passed over to management from the operations, should be what is necessary to coordinate the various activities, and bring back the system (the OE) under control.

Put differently, variety flow on the channel operations ---> management unit has necessarily to be attenuated to satisfy Ashby's law because the capacity of this channel and of the management unit is not designed to carry detailed operational information.

Feedback information, enhanced by management's view of the realities which the system has to confront, is sent back on the return channel. These realities sometimes go beyond the comprehension of those dealing with the operational activities in the circle. The feedback information, through proper channels, is meant to induce an overall and coherent response from the multifarious activities in the operations, to meet whatever is required to keep the OE on course. A full picture of this variety engineering is given in chapter 10. Suffice it to say that management's response will have to be amplified.

The variety diffusion in the operations-environment interaction is also subject (like any other channel) to Ashby's law. To have requisite variety vis-a-vis the environment, the operational variety is amplified and carried through a channel(s) which has sufficient capacity. The variety flowing to the environment is transduced at the boundary at the operational side. The difficulties encountered regarding the shortage of supply of materials, their consequences on the scheduling of production and the consequences this has on sales, are transduced by sales people and conveyed to customers through appropriate channels, for example, individualised letters to customers, visits by sales agents, etc.

Variety engineering through an OE, as outlined above, is a continuous process, as opposed to the classical view where information circulates on a periodic basis.

I.2 SYSTEM ONE

We have set out in this chapter to show that the "raison d'etre" of an organisation (the system in focus), lies in the operations or activities it undertakes. So far we have touched upon only one such operation, which has been nominated as an operational element (OE). However, we assume that a viable system has more than one operational element. If it has only one element, this in itself would be the system in focus and we would be moving one step down along the recursive dimension.

We might expect that the operational reality of a system is of multiple and distinctive activities. Whatever the differentiation one might find between the activities, cybernetically, they all show an organisational invariance [Beer, 1979]. That is to say that, an operation is regulated and controlled by a management, and the operations and its contained management unit take place within an environment. Diagrammatically, the operational system of an organisation would look like fig.7.5 below. The number of OEs varies from one organisation to another, the lowest number being two. The upper limit is difficult to determine, an excessive number of OEs could indicate confusion in identifying the apparent levels of recursion of the system. Schwember maintains that the number of OEs should not be excessive [Schwember, 1977]. However, the point is fig.7.5 could, in principle, contain more than four OEs.

I.2.1 THE NATURE OF AN OE-METASYSTEM RELATIONSHIP

The next step, after nominating the would-be OEs of the system in focus, is to explain how they relate to the METASYSTEM, i.e. the higher level managerial system which looks after the system in focus as a whole. Consider fig.7.6 below. In this diagram we depict the way the metasystem is related to each of the four OEs through their management units. An OE, although a viable system in its own right, is nevertheless part of another system (for which this VSM is to be built). This assertion implies that an OE is bound by a systemic purpose beyond its own level of perception, for which the coherence of the ensemble of OEs is essential. The task of maintaining the coherence of the system (in focus), is that of the metasystem.

The detailed working of control and coordination for the totality of OEs is the subject of the next chapter. In this section, we limit the discussion to the variety engineering between an individual management unit of an OE and the metasystem. This discussion is presented in more or less general terms, since it can be extended to all the OEs. The relationship is seen graphically in fig.7.7 below. We should note that the vertical presentation of the metasystem-OE relationship on the diagram is not meant to represent a superior-subordinate relationship as is the case in the classical tradition. It is a mere graphical convention, where the horizontal dimension is exhausted to show the variety engineering of the autonomic forces at the operational level.

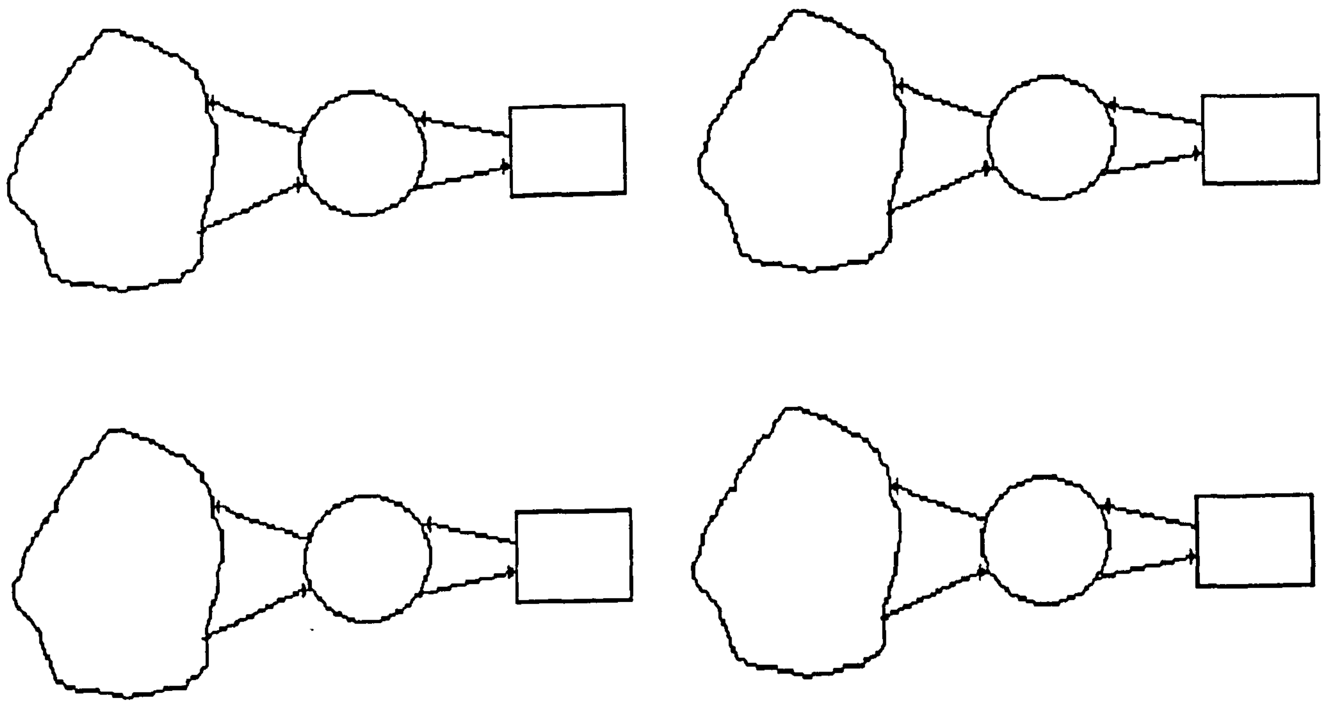


Fig.7.5. A collection of operational elements.

The vertical dimension of the graph depicts the notion that the operational level belongs to another level of recursion one step up. In other words, the vertical dimension of fig.7.7 represents variety engineering of the coherence forces of the viable system. This vertical loop is subject (like any other loop) to the various principles of organisation defined in the VSM [Beer, 1979, 1985].

The first principle we have met already and is about requisite variety itself, i.e. in any managerial context, attenuators and/ or amplifiers have to be designed to accommodate Ashby's law. Beer defines the first principle of organisation as follows: "Managerial, operational and environmental varieties, diffusing through an institutional system tend to equate; they should be designed to do so with minimal damage to people and to cost" [Beer, 1979: p.97]. Fig.7.7 makes explicit only one type of mechanism for achieving this; that is to say, variety transfer along this channel is essentially attenuative [Beer, 1985]. However, the absence of amplifiers in the above channel should not be taken to mean that metasystem-OE variety flow is always attenuative. The amplified variety is carried downward on other channels not made explicit in the diagram. As will become clear later on, metasystemic variety, when amplified is destined for the totality of OEs.

The upward variety flow is also attenuated because the metasystem is unable to cope with the variety generated by any one of the OEs, let alone all of them at the same time [ibid]. The vertical link of fig.7.7, then, consists mainly in the downward flow of the conditions that bind the OE to its parent (the system in focus). This variety relates to

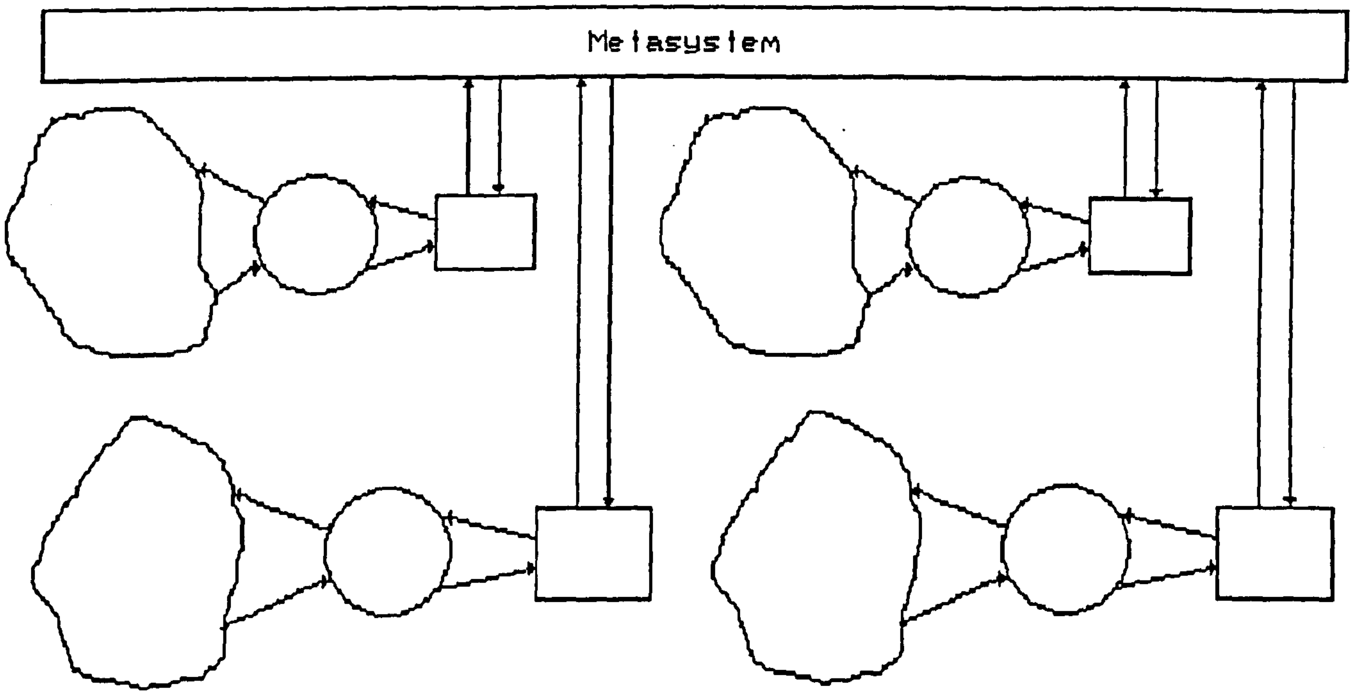


Fig.7.6. The metasystem -- OEs relationship.

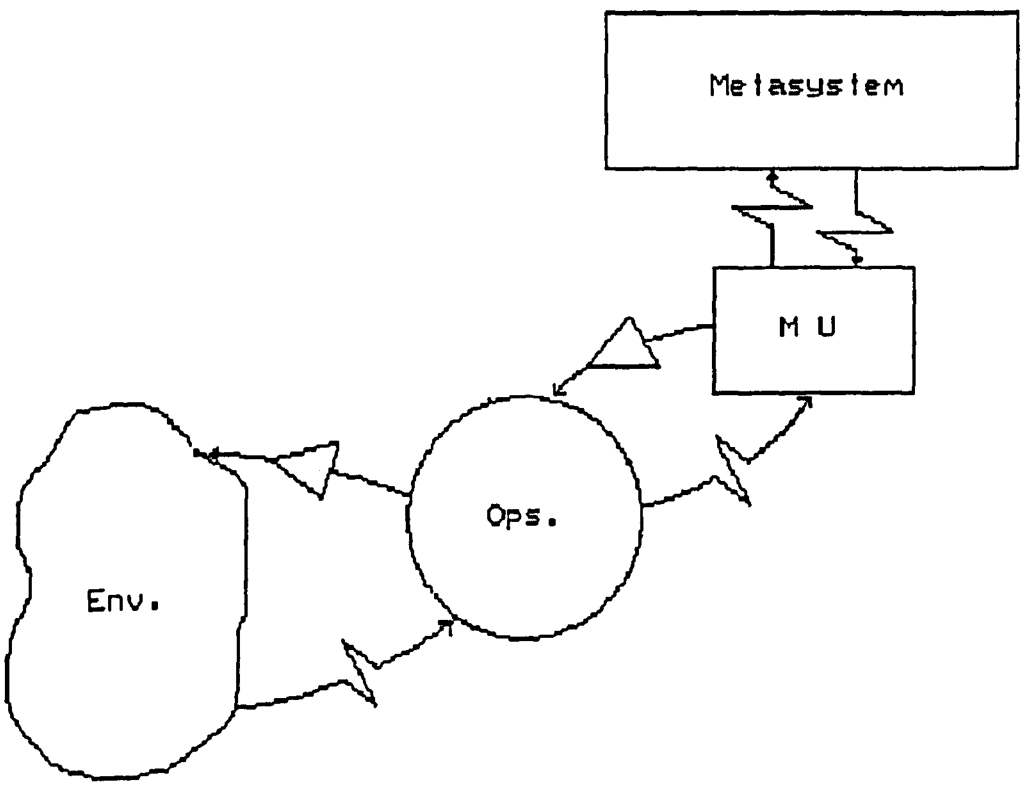


Fig.7.7. The metasystem --- OE relationships with designed amplifiers and attenuators.

the agreement arrived at between the two sides. In return for allocated resources, the OE is responsible for meeting the objectives agreed upon. This homeostatic loop is revealed in managerial terms by the continuous bargaining process between the management unit and its metasystem.

Having dealt with the question of the design of mechanisms to transmit variety between the management unit and its metasystem, we come now to the capacity of these mechanisms (or channels) to carry out the transmission. The capacity of variety tranmission should be compatible with the second principle of organisation. Beer defines this principle as: "The four directional channels carrying information between the management unit, the operations and the environment must each have a higher capacity to transmit a given amount of information relevant to variety selection in a given time than the originating sub-system has to generate in that time" [Beer, 1979: p.99]. A point worth making, however, is that the rate of variety transmission is not expected to be constant over time, which implies that the requisite variety of the channel should be made superior to the average variety, in order that it can accommodate bursts in variety flow in extraordinary circumstances.

There is a third principle of organisation to be accounted for in the homeostatic loop of fig.7.7. This principle stipulates that: "Wherever the information carried on a channel capable of distinguishing a given variety crosses a boundary, it undergoes transduction; and the variety of the transducer must be at least equivalent to the variety of the channel" [ibid: p.101]. The variety flow has to be made in the language of its destination. Again the transduction question is conditioned by the mechanisms in place. If for example, the OE is highly autonomous, the transduction needed by the metasystem from the OE would be limited to, say, two states, namely that the operations are under control or not under control.

I.2.2 THE TOTALITY OF OEs

The diagram of fig.7.6 above shows that the system in focus contains (arbitrarily) four operational elements and that each one of them is managerially, and individually, related to its metasystem. These elements occupy the same organisational space: they exist in one horizontal plane. What fig.7.6 fails to make evident, however, is that the OEs do interact through all of their components (environments, operations, management units). This deficiency is compensated for in fig.7.8 below.

In fig.7.8 we see all possible interactions (let's concentrate on the vertical side) which may exist between the OEs of a VS. Obviously the strength of these interactions may differ from one organisation to another. For example, in a distribution company organised geographically, we expect to find a strict delimitation of the environmental boundaries of the OEs. Nevertheless the interaction, however small, is still there (this point is made empirically clear in part three). The same goes for the operations and management units. The connections always exist even in highly diversified organisations [ibid].

Diagrammatically, however, fig.7.8 although it makes explicit all the connections, remains inconvenient, for it does not convey the picture neatly, particularly when the number of OEs goes beyond three (a reason for dropping one OE from fig.7.6). A more convenient form is to imagine that the channels carrying variety vertically, to and from the metasystem, like an electric cable, where the individual wires emanate from individual units. The same applies to the operations. As to the environments, when the overlap is not apparent, we assume its existence implicitly. This new presentation appears in fig.7.9. In it all assumptions carried by fig.7.6 and fig.7.8 hold true. Fig.7.9 below presents explicitly and neatly the variety flow at the operational level of an enterprise. Unlike the conventional view of the organisation, variety proliferation is contained by the black box treatment of every OE.

The detailed modelling of the operations of each OE is the task of management at that level of recursion, where the management unit assumes the role of the metasystem. The role of the metasystem, as shown in fig.7.9, is to ensure that the OEs which are by definition autonomous, belong to the system (in focus) as a whole. These elements (the OEs) are the pillars of the system; without them it no longer has a raison d'etre. In the terminology of the viable system model, the collection of the OEs is called SYSTEM ONE.

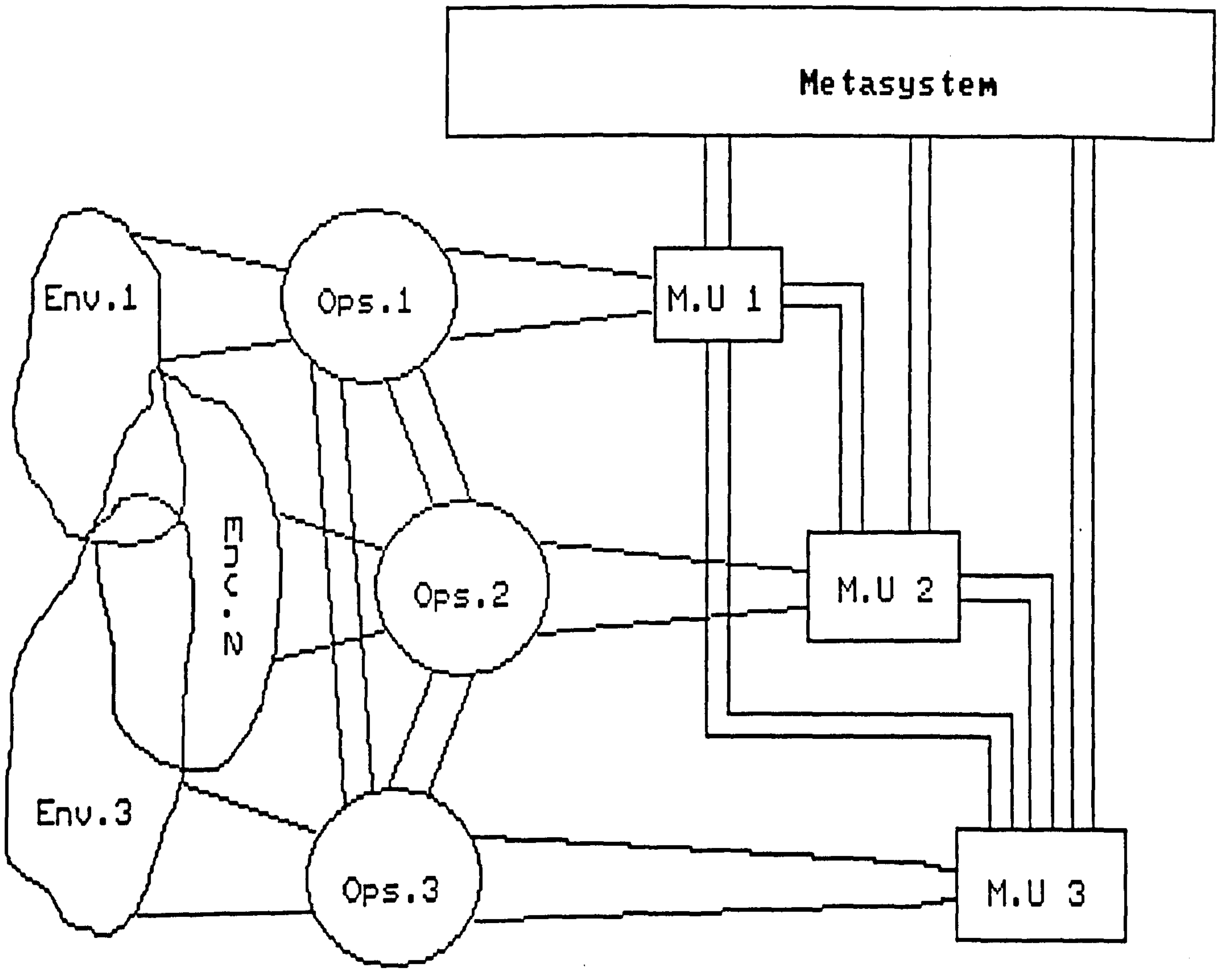


Fig.7.8. A possible relationship between the metasystem and the OEs.

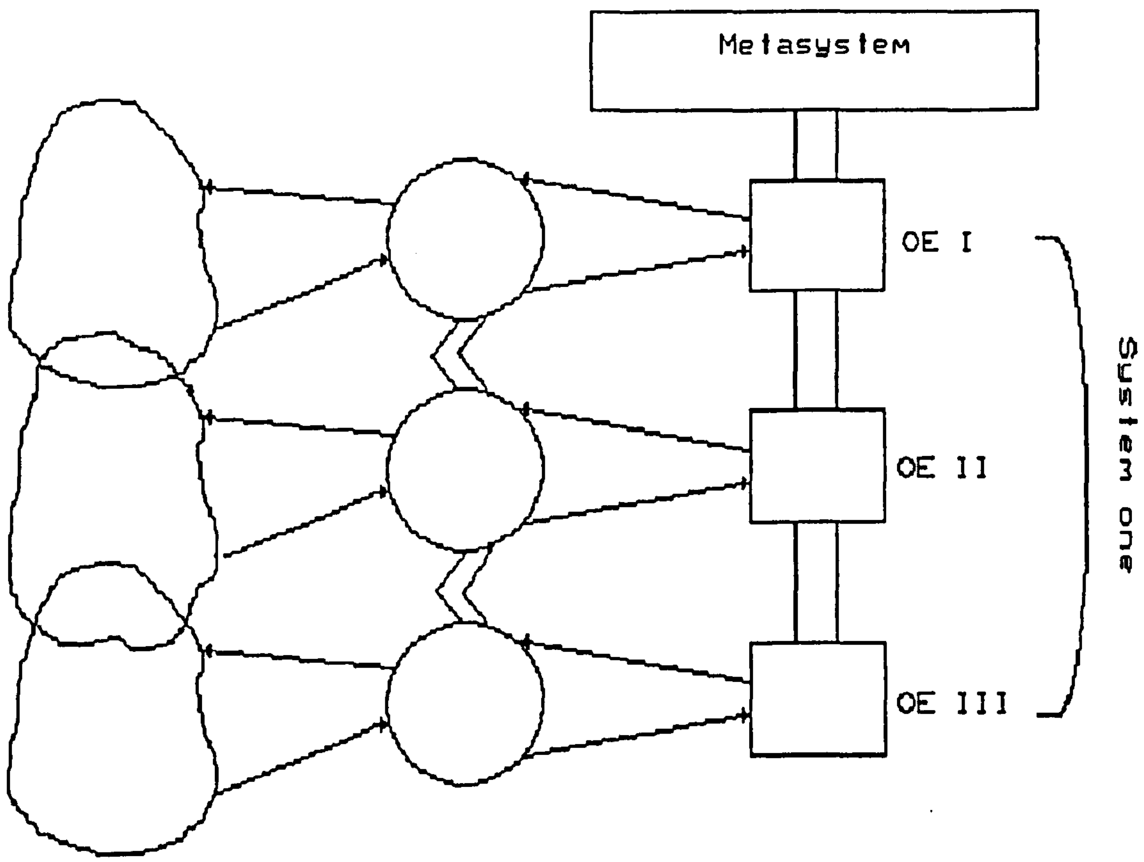


Fig.7.9. A typical presentation of the relationship between S1 and the metasystem.

Chapter 8

THE INTERNAL REGULATION
OF THE VIABLE SYSTEM

In the last chapter we came to understand that the OEs of the viable system (VS) are its pillars, the basis of its continued existence, also that every OE is autonomous. We have also established that, being autonomous, the OEs adhere in a recursive sense to a metasystem. As far as this metasystem is concerned, the OEs are considered in their totality, which was named SYSTEM ONE.

An organisation considered as a cybernetic system (i.e. a VS), tends towards a state of internal homeostasis and settles down towards an equilibrial state: "this happens because the many parts of the complex system absorb each other's capacity to disrupt the whole" [Beer, 1975: p.426]. However, this equilibrial state cannot remain permanent, otherwise the VS would be in a state of death. The environment to which it has to adapt dictates that the system's equilibrium is in a state of continuous adjustment (the subject of the following chapter). Both stable and unstable states are necessary for the system's survival, "which stability is the ultimate long-run goal of the system, short-run instability is necessary for system adaptation and learning" [Schoderbek et al., 1985: p.106].

On the other hand, the concept of homeostasis implies that the VS's search for its state of equilibrium is constrained by its "physiological limits". These limits are not so much imposed from outside as generated from within the system itself [Beer, 1967]. If change occurs too quickly, and beyond the tolerance limit of the structure of the system, instead of the VS achieving equilibrium, it will disintegrate [Beer, 1981]. Operationally, in a self-organising system (i.e. a VS) transactional processes occuring at the different domains of interaction between the components (OEs), tend towards complexification of the relational network over time [von Foerster, 1960]. Thus the achievement of overall stability is extremely difficult to obtain.

Within the prevailing practice of organisational control (the orthodox view), it is difficult to identify properly the inputs and outputs of the system in order that we can use a feedback model to control its behaviour. According to this view of control (see ch.3), a high variety situation is subdivided into parts, and then sub-controllers are set up to deal with the variety generated by each part. For every sub-control system a list of expected disturbances is made and an appropriate action is prepared to bring it back on course. Thus, we have an arrangement whereby the stability of the system is attained. If all the necessary feedback loops are in place for every subsystem, and between the interacting subsystems, the organisation as a whole should normally be able to self-regulate, i.e. achieve an internal stability [Strank, 1982]. However, we know that for a dynamic system, complexification increases over time [von Foerster, 1960], and there comes a point where an entirely new kind of perturbation invades the system, at which stage the feedback control in place is no longer capable of producing the desired effects.

The point to make here is that it is fruitless to indulge in the elaboration of all the possible fluctuations and disturbances that could happen to a system. Instead, we had better design a system which can control an organisation even in the face of an unexpected disturbance. In other words, it is not enough for the system to be stable, it should be ultrastable, in the sense that it is capable of regaining equilibrium after being disturbed by whatever cause, even with types of causes not known to the system before [Beer, 1967; Ashby, 1960]. However, we must not overlook the fact that although it can respond to unexpected disturbances, a system attains and maintains ultrastability within given "physiological limits"; outside them it is ultrastable no longer.

An ultrastable system is a self-organising system [Beer, 1979]. We cannot specify analytically the feedback control loops for such a system owing to the inherent complexity and uncertainty of the situation with which we are dealing. In variety engineering terms, this means that when the system is faced with an unexpected disturbance, extra variety is pumped into the system (the black box) which the feedback control is trying to regulate. Up to that point (i.e. prior to the unexpected perturbation) the feedback control will have acquired requisite variety vis-a-vis the system under control and self-regulation been attained. However, with the sudden increase in variety, the regulator (feedback circuit) no longer has requisite variety and, therefore, the system goes into oscillation.

To achieve ultrastability, the regulator must have requisite variety vis-a-vis the system under regulation at all times. New arrangements are necessary to enable continuous redesign of the regulator so as to accommodate whatever extra variety is induced in the system regulated. In organisational cybernetics, the learning process by which the regulator is continuously updated and modified to counter variety proliferation in the system is called self-organisation [Ashby, 1960]. At the system one (S1) level, any OE is an ultrastable system (since every one of them is a VS in its own right) and, therefore, a self-organising system. As part of the system in focus, an OE gets from the metasystem, i.e. the regulator of the system in focus, that additional variety necessary to enable it to counter whatever disturbances are induced from the outside [Beer, 1967, 1979]. We now move on to discussing the new arrangement in detail.

I. COORDINATION OF OEs

In this section we start at the level where we left the last chapter, at the operational level where the VS is produced. Consider fig.8.1 below. It will be abundantly clear by now that each OE is autonomous and that every activity (operation) is a black box as far as the metasystem is concerned. Now, we know that it is not necessary for the regulator of the system in focus (the metasystem in fig.8.1) to enter into the operations of system one (S1) to understand the nature of the activities taking place. Beer calls this a regulatory aphorism. He states that: "It is not necessary to enter the black box to understand the nature of the functions it performs" [Beer, 1979: p.40]. The control of any operation is through a range of feedback loops and this is supplied by the management unit of the OE. This is tantamount to saying that from the metasystem's viewpoint, S1 is a set of feedback loops. For every operation, the management is seen as a feedback system designed to ensure that the operation produces the desired output [Clemson, 1984]. Viewed in this context, S1 therefore is a collection of vertically interconnected feedback loops. The distinctive approach of organisational cybernetics to this matter will become more apparent by the end of part II.

I.1. UBIQUITY OF INTER-ORGANISATIONAL OSCILLATION

One outstanding conclusion of the previous chapter is that an OE is necessarily an autonomous entity. The vertical connections between the OEs, across their environmental, operational, and managerial domains is an organisational fact. The regulator of an OE, namely the management unit (MU), is free to act on the horizontal axis and for this reason, the MU disposes of a certain amount of variety. Refer to fig.8.1 and consider OEII. The management unit in OEII engages in a range of activities in its operations (the object of his regulation). Being autonomous it is oblivious of the happenings in the other two OEs, I and III. However, owing to the vertical interconnections, its actions are bound to have repercussions on its neighbours in S1. The impact of these actions depends on the existing connections between the OEs. These vertical interconnections may have positive as well as negative effect, i.e. add or subtract variety from the disposable variety of the OE.

To appreciate the organisational constraints that could hinder or curb the autonomous drive of an OE, let us consider the three vertical interconnections across S1 in turn, taking as an example a distribution company for steel products. This company is organised geographically. Take one of its OEs as a regional subsidiary and assume that it corresponds to OEII of fig.8.1 below. In geographical terms, it lies to the west of OEI and east of OEIII. The geographical area covered by OEII is less populated than the other areas. Owing to the relative slackness of economic activity in that part of the country in general, OEII has accumulated stock of a particular type of product (steel rods) which it is keen on selling.

As part of the drive to encourage urbanisation of the south (a policy formulated at upper levels of recursion), the management of OEII decides to amplify its variety in its environment by a range of amplifiers: a publicity campaign, discounts, delivery facilities for those who live in remote areas, all relating to the product of which the subsidiary has an excessive stock. Other initiatives from the MU of OEII might be directed towards skilled workers and technicians. In this regard the management introduces a new scheme for free transport to and from the place of work and paid vacation in a seaside resort for one child of school age for all employees. Another daring decision taken by management is designed particularly to attract new university and college graduates. It takes the form of free credit loans (to be deducted from salary over a period of five to ten years).

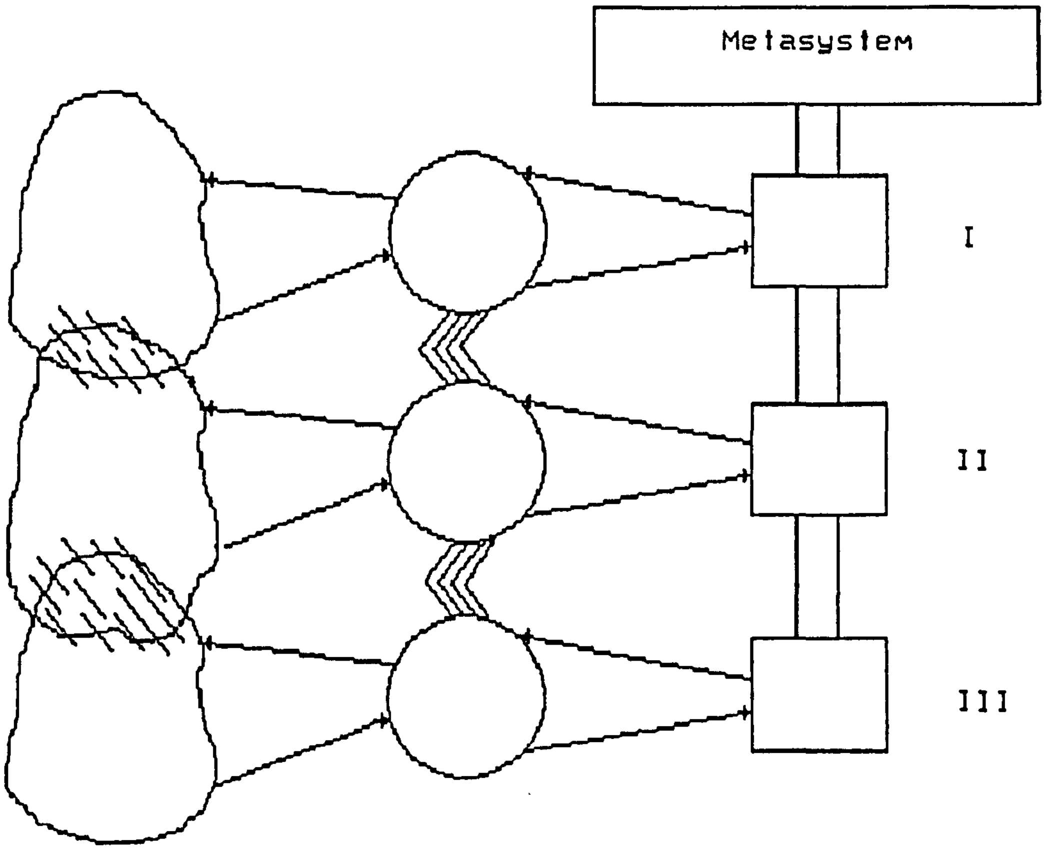


Fig.8.1. The interconnections between OEs.

Graphically, the deployment of variety on the part of the MU of OEII across the horizontal axis could be depicted as in fig.8.2 below. The effect of this new variety deployment is not instantaneous, due to the relative lack of capacity of the channels in use (mainly human contacts). Nevertheless, after a certain time lag, the repercussions begin to appear on the territory of both OEI and OEIII. On the diagram of fig.8.2, we see MUII deploying variety through relevant amplifiers towards its operations; this is at stage one. In the second stage, managerial variety of the first stage is diffused towards the environment through another set of amplifiers. For the purpose of graphical clarity, this variety is symbolised by the small arrows (-> ->), and it is shown as the only type flowing in the diagram.

Now take the operational interactions. Ostensibly, there may appear to be no connection between the operations of the subsidiaries; there is no physical flow of materials between them, they have their own separate warehouses, own means of transport of materials, etc. However, on the human side the interactions are felt, and strongly so. The employees, despite the geographical location of their place of work, feel that they all belong to the same national company, and that they should be treated equally in every respect. In other words, people on the operational domain of OEI and OEIII start to complain and demand that the same services should be provided for them also.

In the managerial domain (the interconnections between the MUs) the repercussions of OEII's management actions are probably more apparent. This is perhaps due to the relative ease and availability of communication channels between the

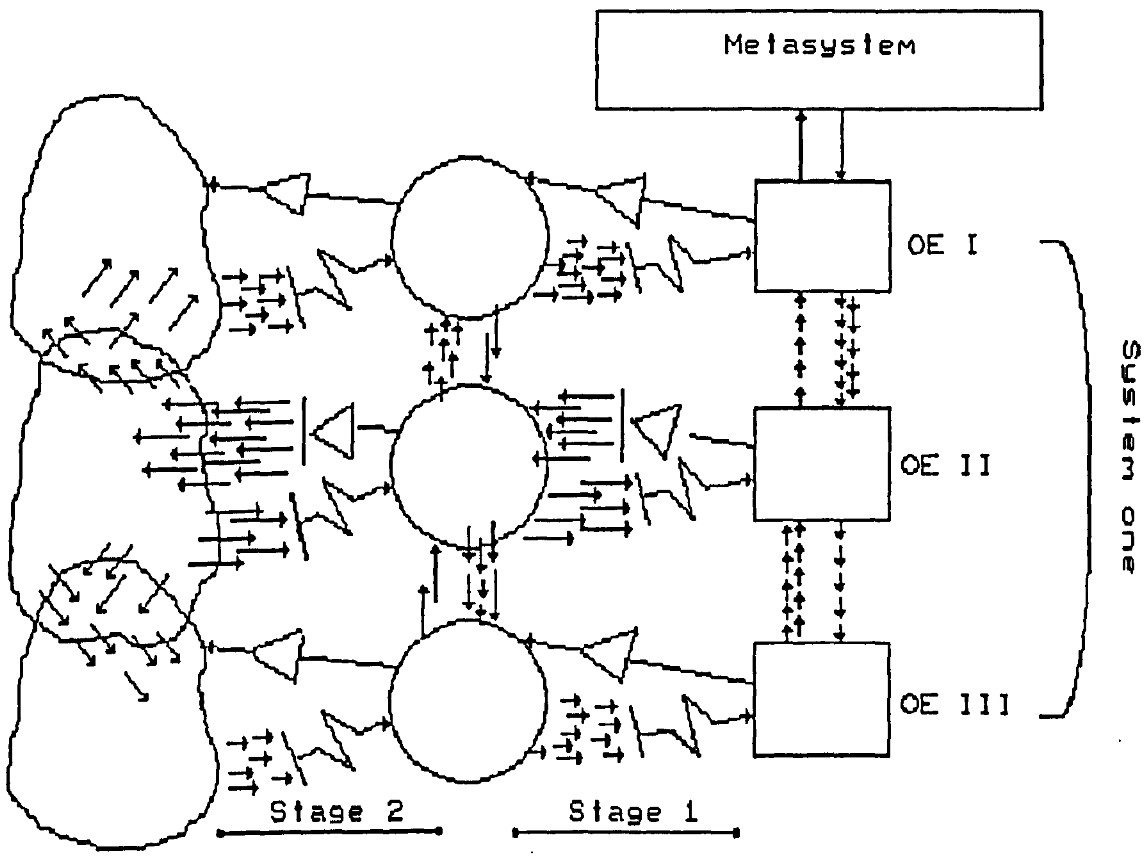


Fig.8.2. Variety flow across S1.

management units. The echo of the MUII initiative will come back from MUI and MUIII in the form of grievances, and possibly protestations against MUII going out of line with company-wide policy regarding treatment of and fringe benefits to the staff and/ or junior managers.

In the meantime, the environment of OEII is taking in the horizontally deployed variety. In this particular example, the environmental boundaries are delimited by the metasystem. However, even in this clear formal delimitation of boundaries, it is not possible to stop customers in neighbouring areas from knowing the delivery facilities offered in the next village. The outcome of this new publicity drive on the part of OEII is that customers in the neighbouring environments of OEI and OEIII will try to obtain their supplies from OEII even in a round-about way. If not, at least some of them will wait in the hope that MUI and MUIII will follow the example of MUII. As a consequence, stocks will build up and it is possible that OEI and OEIII will be compelled to take the same steps as OEII, if only partially. In fig.8.2 an attempt is made to show graphically the above interactions.

One important feature not made explicit in this figure, is the time lags involved: on the one hand the time it takes MUII to get feedback from its operations and environment regarding its initiative; and on the other, the time lag it takes for its variety deployment to have an effect on OEI and OEIII, and come back to it on the vertical plane. At this stage, MUII would realise the practical difficulties and the constraints imposed on it by organisational life. Soon others would react to the actions taken; consequently MUII would find itself devising new plans to counter the latest reactions from OEI and OEIII. Or arrangements would be made whereby every OE must accommodate the needs of every other OE. In either case, oscillation is bound to set in. Oscillation engendered by time lags is a common feature whenever we find ourselves dealing with interconnected sets of feedback loops [Clemson, 1984].

Throughout this discussion no mention has been made of the metasystem. In an actual situation the metasystem would intervene, and rightly so if chaos (or possibly disintegration) in S1 is to be averted. Refer again to fig.8.2. From this figure we can see that the only contact available to the metasystem with its S1 is through the square boxes, i.e. the MUs. What this implies, in fact, is that the metasystem is cut off from the reality of the OEs. The only knowledge and access it can have to these highly complex operations is through the models contained in the MUs themselves. In other words, the metasystem falls short of the requisite variety needed vis-a-vis S1, for its intervention to be meaningful.

In addition (as was indicated in the last chapter), the vertical (command) channel metasystem ----> S1, is of low variety, whereas the variety generated on the vertical plane of S1, and which has led to oscillation, is of high variety. Therefore, any effort to damp the spread of oscillation in S1 through the command channel would not work because of the lack of requisite variety.

On the face of it we have a dilemma. On the one hand, the OEs of S1, being autonomous, dispose of high variety in order to act on the horizontal axis. On the other hand, owing to the vertical interconnections (managerial, operational and environmental), however loose these may be, variety proliferates vertically. This may subtract or add variety to that disposable on the horizontal plane. In this situation, with the OEs being ignorant of one another's variety, oscillation sets in. This is usually the case whenever we are in the presence of interrelated subsystems in continuous interaction [Beer, 1979]. Furthermore, the existing arrangement as depicted in fig.8.2 shows us clearly that the metasystem does not have the requisite variety to intervene in order to damp oscillation. The metasystem requires an "oscillation damper".

I.2.THE OSCILLATION DAMPER

We have explained in chapter 6 how feedback is applied as a basic tool in cybernetics to regulate high variety situations without necessarily entering into them [ibid]. The only requirement is that the supposed regulator is expected to manifest requisite variety vis-a-vis the system regulated (the black box). We equally have touched upon the notion of how the viable system is organised recursively. The system in focus (under consideration) is itself an OE at the next level up of recursion, where the totality of S1 is one set of operations and the present metasystem is an MU. This recursive embedment is shown graphically in fig.8.3 below.

For the MU (the metasystem of the system in focus) to be capable of damping the oscillations of the operations under its control, it must apply the feedback technique, discussed

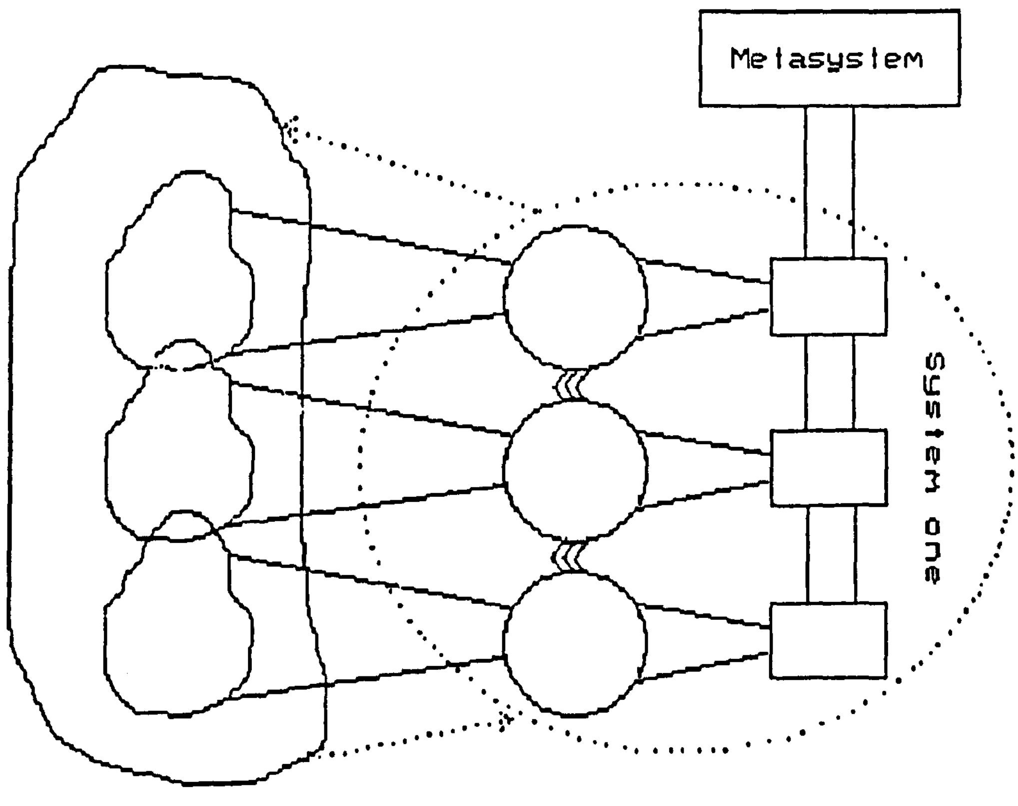


Fig.8.3. S1 seen as a black box.

in chapter 6, once again. This time, however, because we are focusing on this level of recursion, an elaboration of the mechanism for damping oscillation in the black box (S1 of the system in focus) is in order. From section I.1 above and with reference to fig.8.3, we see that oscillation (inside the circle containing S1) is engendered on the vertical plane as a result of the OEs' interactions, and that the variety generated is very high. To operate within the confines of the law of requisite variety and the principles of organisation, the mechanism needed to absorb this high variety must be at least of equivalent variety. This damping action cannot be undertaken by the OEs, since they are ignorant of each other's variety. Overseeing overall interactions of the OEs is, obviously, a prerequisite for the damping function to be successful. Put differently, the task of damping oscillation in S1 is metasystemic. New channels have to be opened and added to fig.8.2 and they have to be of high variety. Obviously the principles of organisation should be taken into account when designing these channels.

We have, thus far, made the case for the necessity of coordinating the OEs of S1. However, one very important feature is missing; where on the diagram of fig.8.2 are the channels for coordination to be introduced? Before we can answer this question we must remember that the OEs are autonomous and opaque vis-a-vis the metasystem. Whatever knowledge the latter holds of the operations of S1 is through the models contained in the regulators of these operations, namely, the MUs. Any attempt to carry out the coordinating task has to come through these MUs. Putting this diagrammatically, fig.8.2 is redrawn to appear as in fig.8.4

below. We can see from this diagram that the coordinating channel runs parallel to the already existing command channel. The message carried through this new channel is specific: damp oscillation in S1.

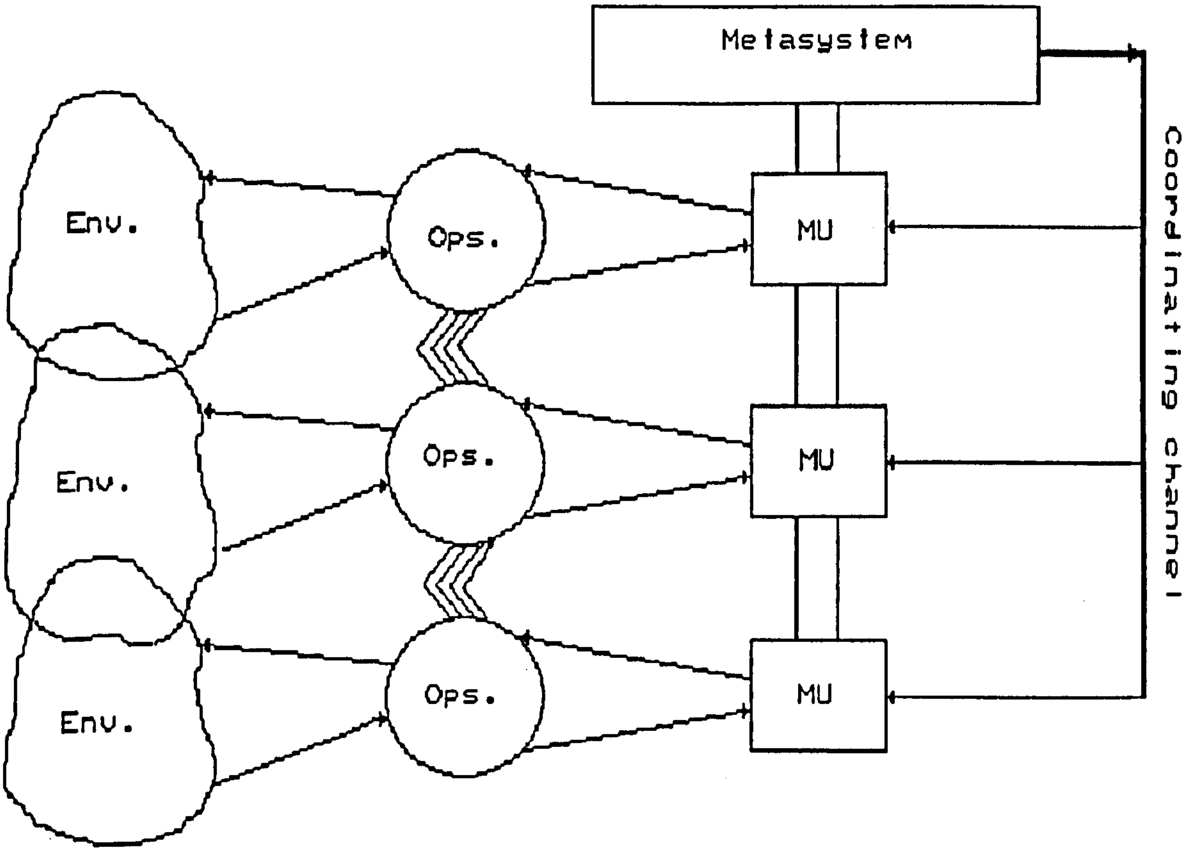


Fig.8.4. Coordination channel.

The subsystem of the metasystem in charge of this specific function is referred to in the vocabulary of the VSM as SYSTEM TWO (S2). It is also referred to as the regulatory centre [Beer, 1985]. Graphically it is symbolised by a triangle. If we remember that any OE is a reproduction of the organisation of the system in focus at the lower level of recursion, it too must have a system two. The new diagram introducing S2 at both levels of recursion and showing the likages appears in fig.8.5 below.

As will be expected in modern organisations, the sources of oscillatory behaviour can be numerous. We have seen how these oscillations come about as a result of the high variety of vertical interactions all over the territory of S1, i.e. environmental, operational, and managerial (see fig.8.2). This leads us to the question of the design of S2. Beer suggests that, since the raison d'etre of S2 is to service S1, it falls upon the latter to design the S2 it wants with (of course) the help of the metasystem [Beer, 1979]. It is clear that the mode of operation of this regulatory mechanism (S2) ought to be continuous, just as the interactions among OEs which generate oscillation are continuous. A further important requirement of the design of S2, is to do with the multiplicity of the sources of oscillation, i.e. we are faced with the need for specialised functions within S2 itself. For instance, referring back to our example of the distribution company for steel products above, S2 needs to include within it functions for coordinating personnel policies, marketing policies, etc. This design requirement is made explicit in fig.8.6 below which, is an extension of fig.8.5. Fig.8.6 shows clearly how the regulatory centre disposes of or executes the coordinating function. The separate channels, emanating from S2 of the system in focus to the corresponding regulatory centres of the OEs, refer to the flow of variety for different specialised subfunctions (A,B,C, etc.) and are intended to tackle distinct sources of oscillatory behaviour.

II. REAL TIME CONTROL OF THE OEs

We have so far identified two distinct organisational forces; the autonomous force (on the horizontal axis of fig.8.6), where every OE is free to dispose of its variety the way it sees fit, these OEs being in a dynamic interplay, and another force on the vertical plane. Part of the variety generated is absorbed mutually by the OEs themselves, in their "matter of fact" interactions. Some of it is dealt with by the metasystem through the command channel as it tries to keep the viable system as a cohesive entity within the agreed purposes of the institution. In terms of those states of the system which are identified as oscillatory, we have discovered that the VS possesses a damping apparatus to deal with the variety leading to oscillatory behaviour, in the form of S2. Assume now that we have all these regulatory mechanisms properly designed and in place. Can it be claimed that we have achieved the internal homeostasis of the viable system? For that to be the case we would have to have a variety balance in the two dimensional space of the VS as depicted in fig.8.6, where the metasystem (as a regulator) has requisite variety vis-a-vis S1.

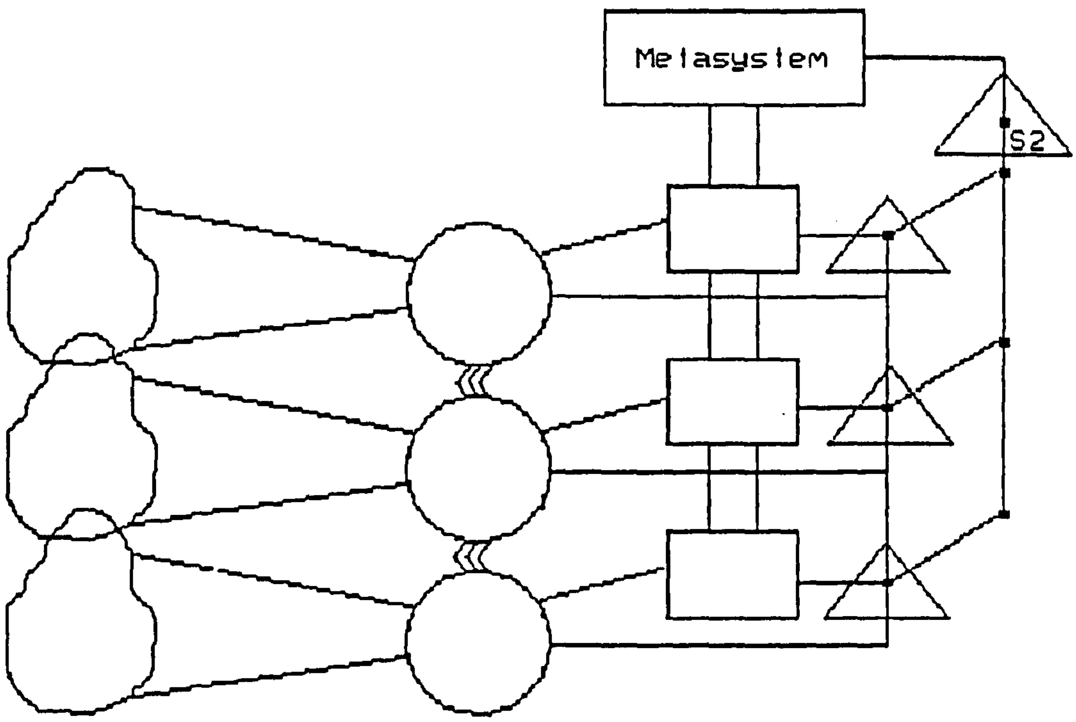


Fig.8.5. S2 at two levels of recursion.

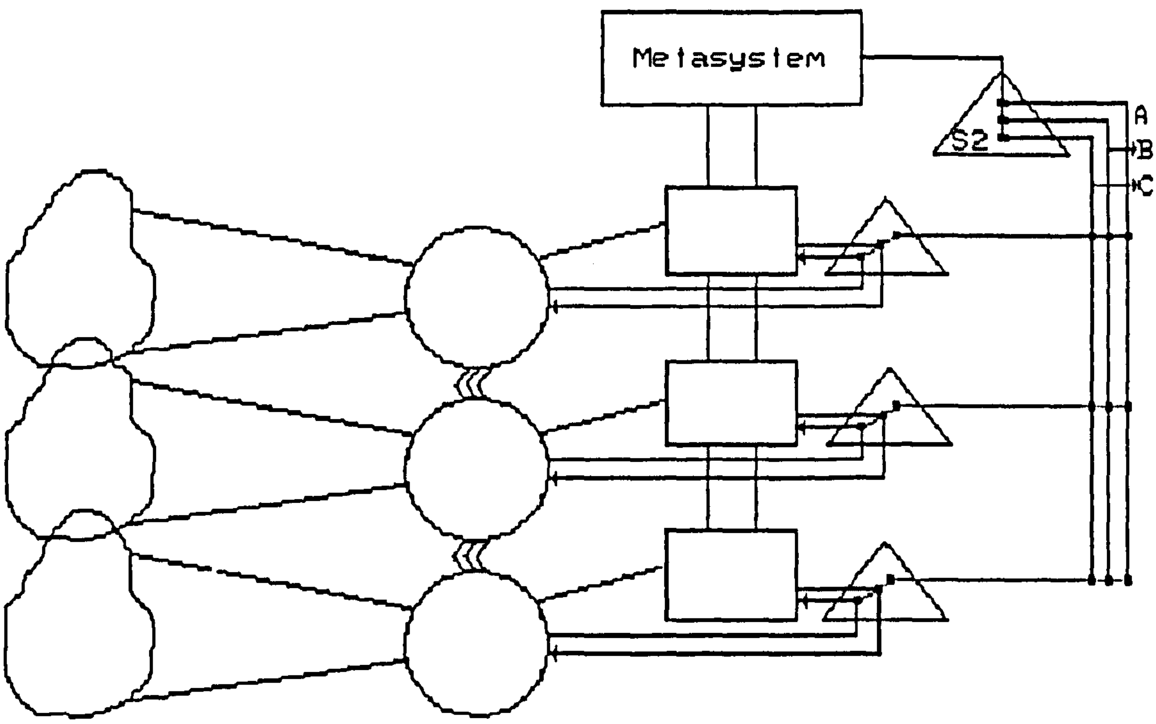


Fig.8.6. Elaborate presentation of S2.

To answer the foregoing question, we need to elucidate further the internal functioning of the system, as a whole. This requires a brief detour to look again at how cohesion is achieved in a VS.

II.1. THE NEED FOR SYNERGY: INTEGRATION OF THE OEs

It cannot be often enough emphasised that a viable system is an integrated whole, and not merely a collection of operational elements. Given a purpose these elements (OEs), as already stated, are cohesive. Maintaining cohesion of the VS is another function performed by the metasystem. This particular aspect of the function of the metasystem needs further elaboration. Refer to fig.8.6 again. We have noted earlier that the vertical interaction of variety between the OEs in the environmental, operational, and the managerial domains, may rob the individual elements of their variety. However, this vertical interaction can equally enhance the actions of these elements. It is the area where all (or most) OEs intersect (and where the robbing and enhancing takes place) which constitutes the target of the synergistic effort of the metasystem.

We have also seen that the shared domain of action of the OEs can be a destabilizing force for overall homeostasis. However, oscillatory behaviour is taken care of and continually monitored by S2. Being a subsystem of the metasystem, a flow of information about the actions of S2 is accessible and in continuous supply to the metasystem. Added to this, the metasystem is in direct and continuous link with the MUs of S1. This simultaneous flow of information from S1 to the metasystem along different channels enables the latter to oversee the operations of S1, and to direct it towards a balanced and integrated response which will increase synergy of the system as a whole and strengthen its long-term viability.

The synergistic role of the metasystem can shed some more light on the hierarchical (not in the orthodox sense) dimension of control exercised directly on the MUs, and on the amount of variety flowing on the vertical command channel. Previously, we have emphasised that this variety is kept to that minimum necessary to ensure cohesion of the OEs. Now we have come to understand the context and purpose of ensuring a cohesive S1 i.e. getting the most out of it, even when it implies sacrificing the needs of the OEs individually. However, whatever sacrifice is incurred, it is not expected to be great, since the variety required to enforce synergy is a fraction of the total variety disposable on the horizontal axis of any one OE [ibid]. This is explained by the fact that synergy lies in the intersect of all OEs. Unless there is a great overlap between all operations, the number of the states that impinge on all the OEs is obviously much smaller than the variety (the total number of the states) of any OE.

II.2. MONITORING THE OPERATIONS OF SI

We have set out in this chapter to investigate the internal regulation of the viable system and the way by which it can achieve its homeostatic equilibrium. Referring back to fig.8.6, and the question posed in the introduction to section II, can we claim that the metasystem deploys requisite variety vis-a-vis S1? In fact, checking the variety transfer across the various components shown in the this figure, we can soon detect an imbalance in the variety deployment.

We know by now that the vertical variety interchange between operations and between environments is very high. That part leading to oscillation is absorbed by S2; another portion (of low variety) is taken up by the metasystem through direct intervention in the MUs in order to promote synergy in S1 and make sure that the VS remains cohesive. There remains a substantial variety commerce in the vertical domain of S1 not acknowledged by the metasystem [ibid]. Balance cannot be achieved by means of the existing arrangements of fig.8.6, where the vertical channels relating S1 to its metasystem are exhausted, nor can the VS be homeostatically stable if the metasystem does not have requisite variety vis-a-vis S1.

The answer to this variety dilemma must be to introduce additional specialised channels through which the metasystem can monitor the operations of S1 without using the command channel or the channels of S2 (since the latter's task is already specified). This thought is translated into a diagram in fig.8.7 below. We see from this figure that the monitoring channel runs straight into the operations of S1. The reason for the direct link with the operations is that the dynamic interplay of the latter is the very source of the excess variety which results in the lack of requisite variety of the metasystem vis-a-vis S1. In variety engineering terms, the monitoring channel, appearing in fig.8.7, should have sufficient capacity to transmit an amount of variety to compensate for the manifested lack of requisite variety of the metasystem vis-a-vis S1. In other words, the total variety engendered by the OEs on the vertical plane must be equal to the total variety deployed by the metasystem also on the vertical plane [ibid].

As with S2, the monitoring activity of the metasystem can be subdivided into different activities depending on the nature of the functions to be fulfilled in the operations of S1. To give an example of the monitoring subactivities of the metasystem, let us refer once more to the example of the company for the distribution of steel products (given in section I.1 above). An outstanding application of the monitoring activity is the auditing function. The management of the company (the metasystem), in order to investigate the accounting practices of its regional subsidiaries (OEs) and to make sure that no fraud is committed, employs an auditing team. The auditing team is not expected to go to the regional MUs and be satisfied with a statement report. Instead, the auditors' job is to inspect the inventories in the warehouses, check the invoicing system and satisfy themselves that the rules of the accounting system of the country are adhered to.

Another instance of monitoring activity might be the inspection of the physical state of the warehouses and the heavy transport vehicles of the company throughout the territory. The investigation is designed to tell the metasystem (the management of the company) whether the company's property is properly maintained and the vehicles are properly serviced. The design and operation of the

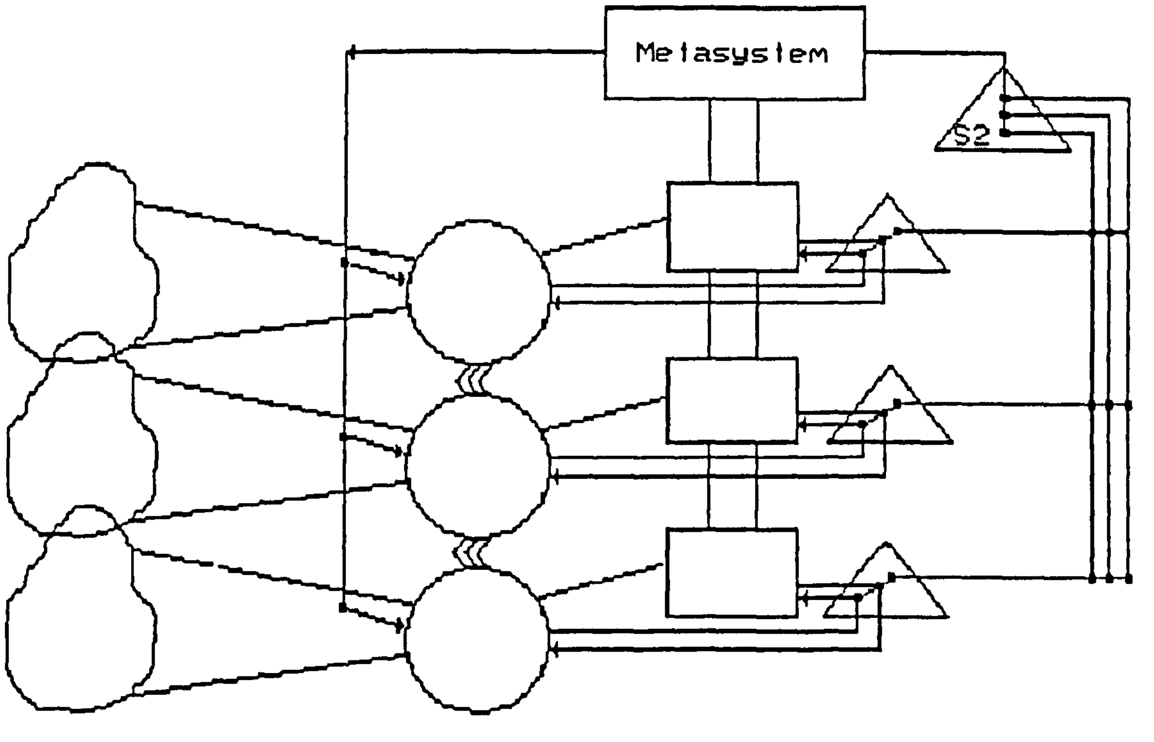


Fig.8.7. Coordination, command and monitoring channels.

monitoring channel are fully dealt with in part three. The point to make at this stage, however, is that the number of subchannels can be numerous, depending on the system to be modelled. To make the point clearer, fig.8.7 above is redrawn to appear as in fig.8.8 below.

The flow of variety in the monitoring channel drawn on the left of fig.8.8 (as with any other channel) is two ways. An example of S1 ---> metasystem transmission of variety, is when the channel is made to register undue pressure on the operations of S1 and transmits this information directly to the metasystem.

Proper design of the monitoring channel requires adequate knowledge of the type of information it is required to handle. As we know, wherever and whenever variety is engineered, the principles of organisation must be adhered to. One important aspect, requiring knowledge of the type of the variety transmitted, concerns what transducing mechanisms to employ at the point of reception.

With the operational monitoring channels added to the picture, we can now assert that the metasystem has in fact attained requisite variety vis-a-vis S1 [ibid]. Good design of the aforementioned channels emanating from the metasystem (S2, intervention channels, and the monitoring channels), enables the latter to fulfil the task of internal regulation of the VS, and in real time. However, it is not sufficient to maintain the viability of a system to simply ensure its internal homeostasis. The system exists in an environment which it has to face and to which it has to adapt. Put differently, internal regulation of the VS does not exhaust the functions of the metasystem (as will become clear in the next chapter). Nevertheless, the bringing together of the information necessary to achieve internal homeostasis is clearly a separate function in its own right. It follows that the subsystem of the metasystem which undertakes the internal management of the VS in the now-sense as elucidated in this chapter, must be denominated as SYSTEM THREE (S3), as the next logical hierarchical step after S1 and S2, where S1 is autonomous and S2 is a subsystem of S3.

Fig.8.8 depicts the final arrangement of S3, S2, S1 and the necessary loops by which S3 undertakes the task of maintaining the internal stability of the VS in real time. This diagram shows that there are various channels emanating from S3 (and converging on it). To the right, we find S2, as already stated, its specific function is to damp oscillation in S1. It is a filter of the huge variety flowing upwards from S1 and is linked to the OEs through their S2s. To the left of the diagram, we find the monitoring channels (which we can distinguish from now on as S3m). The monitoring mechanism is symbolised by an inverted triangle. Its mode of operation is different from that of S2 in that it operates sporadically, whereas S2 is continuously in operation. The monitoring activities (S3m) of System three involve whatever necessary activity is not of S2, and not to do with the synergy and cohesiveness of the VS. In variety engineering terms, the monitoring channels provide S3 with that additional variety without which it (S3) cannot manage the VS internally.

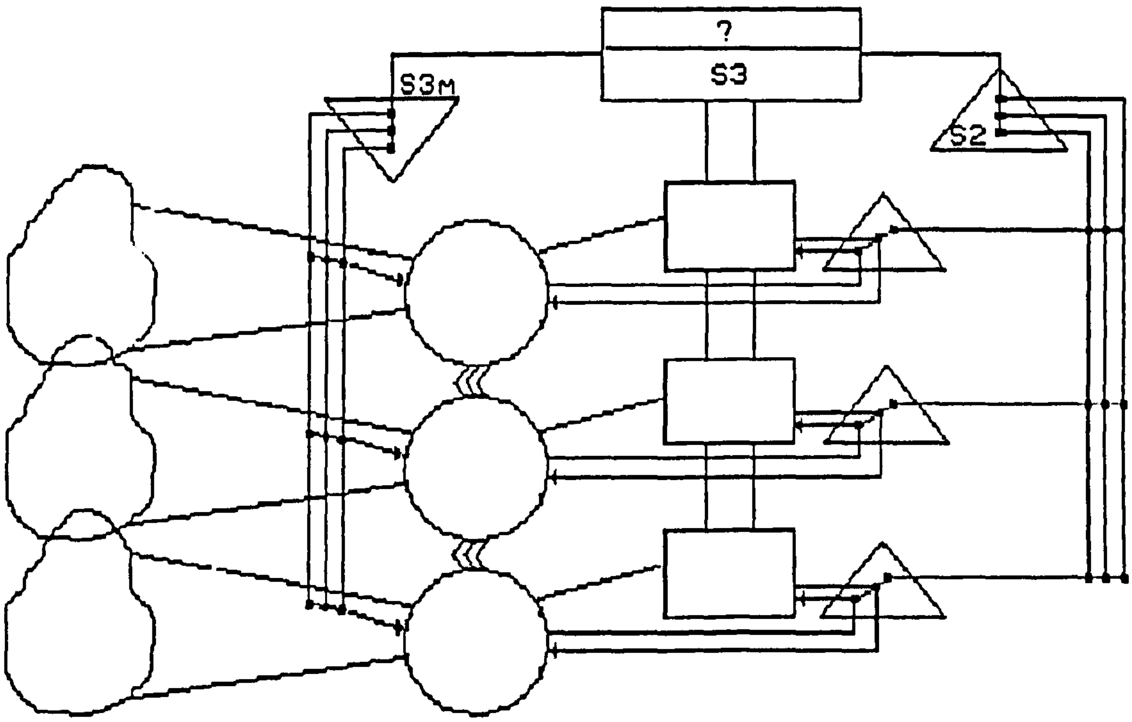


Fig.8.8. The information network for internal regulation

To sum up, the internal homeostasis of the VS is maintained by what we now know as SYSTEM THREE (S3). It ensures that the OEs are carrying out the tasks they are supposed to be doing, and in line with the "perceived" purposes of the system as a totality. More formally, the internal homeostasis of the VS is expressed by the first axiom of management [Beer, 1979, 1985], which, as the reader will remember, states that: the sum of variety generated on the horizontal plane of S1 is equal to the variety disposed on the vertical plane of the VS. From fig.8.8 the horizontal variety generated by the three OEs (i.e. S1) should be equal to the variety disposed vertically on the whole diagram which is composed of: the matter of fact variety exchange of the environments, operations and the MUs in S1, plus the variety of the intervention channel the variety of S2 and the variety of the monitoring activity (S3m) of System three.

Chapter 9

THE INTELLIGENCE AND POLICY FUNCTIONS OF THE VS

We have seen in the last chapter how system three (S3) carries out the task of regulating the viable system internally. Ensuring internal homeostasis of the VS requires inputs other than those supplied by S1 and S2. Is the box labelled "metasystem" in fig.8.8 (ch.8) exhausted by S3? Above all, can the VS carry on being viable only by maintaining internal homeostasis? The answer is bound to be in the negative because the VS is by its nature an open system. It exists in an environment and interacts intimately with it. The relationship between the two is more or less organic. "For, after all, the environment of a system not only affects it; the system belongs to its environment" [Beer, 1966: p.285]. However, views diverge on how the system "lives with" its environment.

I.THE INTELLIGENCE FUNCTION OF THE VS

An organisation is often presented as an adaptive open system [Buckley, 1968], with the environment taken as a constraint to which the system must conform. The response to environmental influence is through undergoing internal change to meet environmental requirements. This internal change can take the form of structural modification, or change in the process the system undertakes to produce its output [Egelhoff, 1982; Galbraith, 1973; Lawrence and Lorsch, 1969].

However, this passive orientation or unilateral approach to environmental forces may prove harmful to the organisation in the long run: "The key to long-term success even survival in business is... to invest, to innovate, to lead, to create value where none existed before" [Hayes and Abernathy, 1980: p.77]. The adaptive framework for presenting the organisaton's interactions with its environment is, therefore, incomplete. In addition organisations, in order to ensure long-term survival and success, need to adopt a proactive approach towards the environment [Waelchli, 1985; Ackoff, 1981(a)].

The assumption behind the proactive approach is that the organisation exerts an influence on the environment to the extent that the incoming signals are causally related to those signals going out of the organisation. Within this framework, the system can produce outputs which will effect changes in the environment that are favourable to its continued viability [Waelchli, 1985]. The VS, therefore, needs to have a healthy "internal milieu" as a precondition for it to succeed in its approach to the environment, and to design whatever strategy is appropriate for its long-term well being. The last chapter was devoted to the conditions for getting this healthy "internal milieu" in order. It should be emphasised, however, that if a system dedicates itself to achieving internal homeostasis, it is not for the purpose of remaining static. Systems of interest intend to learn, evolve, and in general to 'improve themselves' [Beer, 1966]. In what follows, an attempt is made to expose the mechanisms by which the VS improves itself in the unfolding complexity of the environment.

Before we begin discussion of the VSM's mechanisms for dealing with the environment, let us recapitulate, briefly, the way that strategic planning is performed at present, to prepare the ground for the argument put forward by the VSM. It is characteristic of modern organisation to have a strategic planning function (see ch.2 and ch.5), which plans for the future of the organisation. To do so, this function extracts information from the environment. Out of the processed information come plans by which resources are committed in order that the future might be different. The organisation's image of that future is derived from the model it has of the environment at present. The device through which organisations look into the future is what we know today as planning. In this context, planning can be described as the process of determining the organisation's future environment and then considering the means which it can reach its desired future.

Planning, in this sense, involves different degrees of futurity. For this reason, forecasting is an important part of the process of planning [Kast and Rosenzweig, 1985; Beer, 1978]. By means of forecasting, planners endeavour to make the future less uncertain. The underlying assumption, implicit or explicit in their endeavour, is that "the process in question is stationary; that it has been going on for a long time and that sufficient information is available to identify the process and estimate its parameters" [Fildes and Stevens, 1978: p.119]. Put differently, the accuracy of forecasts relies heavily on the assumption that the behaviour of the system planned for and its environment do not radically change, and that they constitute part of a larger deterministic system governed by the natural laws of cause and effect [Ackoff, 1981(a)]. However, we are not dealing with natural phenomena; the world of social reality does not always seem to obey the laws of cause and effect.

Moreover, the prevailing approach to planning mirrors the classical view of the organisation. The latter considers the organisation as a set of functionally and hierarchically related parts and subparts (see ch.3). The overall plan in this approach reflects this model of organisation and derives from the aggregation of the separate plans of the various hierarchical levels [Shirvani, 1986].

Another characteristic of modern planning is to do with the planning function itself. The ever-increasing sophistication of the planning and forecasting techniques, and the use of computer models, have led to an almost total divorce between those who plan (i.e. the experts) and those responsible for the implementation of the plans. Obviously it is to be our argument that the intelligence function of the VSM provides a superior means of undertaking the planning function.

I.1 REVISING THE PLANNING PROCESS

The VSM's restatement of the planning process is meant to address our understanding and attitudes towards the notion of the environment and future, and the context and assumptions underlying the process of planning.

The prevailing attitude of planners (so-called "experts" as distinct from decision makers) towards the future is that it is somehow "out there", and that all we can do is move forward towards it. The future is sliced into time spans ranging from one year to, say, twenty years; sometimes even further into the future, hence the categorization of plans into short, medium and long-term. The planning process in this sense is basically discontinuous. However, the future does not unfold itself in the same way everywhere and all the time. The element of change, and more importantly, the rate of change renders the prevailing mode of planning irrelevant and obsolete [Ackoff, 1981(a); Beer, 1978]. If planning is not an end in itself, and assuming that the whole process of planning is meant to facilitate the process of adaptation of the system to the external world, then "the evidence that the whole process of adaptation is not working very well is all around us" [Beer, 1978: p.187].

The prevailing approach to planning is heavily institutionalised. Plans are set for predetermined and arbitrary time epochs; annual, five year plans and so forth... as if all that happens to the system occurs with the same likelihood. This discontinuous planning is nonsensical; at best it is no more than an academic exercise. For it to be worthwhile, planning should be continuous [Ackoff, 1981(a); Beer, 1978, 1979], for the obvious reason that the world outside for which the supposed experts are planning is itself continuous.

Another characteristic of the current approach to planning is its insistence on the separation between the preparation of the plan and its implementation. In other words, plans are prepared by experts and handed over to the decision makers for execution. However, as the future unfolds, the implementation of the plan is likely to run into difficulties and for many reasons. No matter how detailed and sophisticated the plan may be, by definition it cannot contain all the complexity of the environment. This being the case, modifications in the plan will be necessary. These cannot be made by the decision makers since the sophistication of the plan is beyond their comprehension. The modifications have to be performed by the experts and so time lags are introduced, even it there were none in the first place. The obvious conclusion to be deduced from this state of affairs is that "no one can plan effectively for someone else" [Ackoff, 1981(a): p.66], and that: "The only planners are managers, namely those people who are entitled to commit resources" [Beer, 1979: p.367].

The third major flaw of planning at present, is that once the plans are made they become a sacrosanct, whereas, for the planning process to be practical they should be capable of being aborted [ibid]. This is because any forecast made for the future is made with the available information at that point in time. As the many states of the environment manifest themselves, new information is acquired and it is only logical to use the new knowledge to gain insight about the future. This entails that the old forecast becomes invalidated and should be replaced with the a new one, and the process should continue in this manner indefinitely.

This misconceived state of affairs regarding planning cannot in fact be otherwise because it is the outcome of the existing mode of organisation. To change attitudes towards planning, it is argued here, one has to rethink the organisation itself: "In fact, what is needed is structural change, nothing else will do" [Beer, 1975(a): p.35].

I.2 THE VS's FORECASTING DEVICE

We have come to the conclusion that the prevailing mode of planning cannot answer the needs of the organisation for adaptation and learning, i.e. long-term viability. In this section an attempt is made to demonstrate the mechanisms employed in the VSM to provide the conditions for organisational adaptation and learning.

We start where we ended the last chapter. Refer to fig.8.8. It represents the synthesis of the various feedback loops employed by S3 to maintain the internal homeostasis of the VS. A quick check of fig.8.8 above will show that this structural arrangement cannot be sufficient for the viability of the system. If we remind ourselves that the VS is organised recursively, i.e. every OE is structurally isomorphic to the system in focus, we will soon discover the reason why the structure of the system in focus of fig.8.8 above is insufficient to ensure viability. The logic of recursivity implies that the VS is itself an OE at the next higher level of recursion, which means that it is embedded in an environment, as is the case with its own OEs.

We have touched upon the notion of the embedment of an operation in its environment before (ch.7). The purpose then, was to show that the environment is a necessary component of what has now become a building block of the VS, namely the OE. It is now time to explain how the system in focus behaves in its environment, as an OE at the next higher level of recursion, for in this recursive sense the environment of the system in focus is more than the sum of the individual environments of S1 [Beer, 1985].

As defined, S3 is totally dedicated to the internal management of the VS. As it turns out, the part of the metasystem covered by the (?), the outer box in fig.8.8 above, is not empty. It is there that the intelligence function of the VS is housed. Before we engage in the elaboration of this function, it is important to put the environment of the VS in perspective. This environment has two aspects: the general environment, which the system as an OE shares with other OEs at the same level of recursion, and the specific or the "problematic" environment which is proper to the VS and not shared by other OEs at its level of recursion [Beer, 1979].

I.2.1 FORECASTING THE GENERAL ENVIRONMENT

As we have said, the general environment of the VS can be presented as that part of the outside world which it shares as an OE, with other elements operating at the same level of recursion. As an illustration, refer once again to the hypothetical example of the company for steel products of section I.1 of the last chapter. The general environment of that company is that shared by other economic agents operating at the same level of recursion in the economy, for instance, suppliers of steel products and their customers, who rely on steel products as the basic input for their processes. The behaviour of the company in this kind of environment is basically reactive, in the sense that its responses are confined to adaptive action in response to the forces of change, technological, economic or political. Let us find out now how the responsibility for the adaptive behaviour of the VS is discharged by the metasystem.

It is an accepted fact, that contemporary organisations exist in an environment that is continuously changing, and that the rate of change is itself in continuous change. In addition, the environment is multidimensional, i.e. it incorporates technology, market conditions, economic and social climate, etc. Each requires a special language and a particular tool of investigation. Market research for example demands the use of forecasting techniques. Appreciation of the changes in the economic conditions necessitates a know-how of the use of input-output and econometric models. Investigation of the long-term trends in population migration requires an extensive background in demographic sociology, etc. These activities of the metasystem, of sounding out the environment, are depicted diagrammatically in fig.9.1 below.

As the figure shows, every one of the activities of the metasystem generates variety to absorb the relevant variety of the environment. As they appear in fig.9.1 the VS activities for investigating the (general) environment bear no relationship with one another. This arrangement in fact symbolizes the state of affairs that often exists in the modern organisation.

I.2.2 FORECASTING THE PROBLEMATIC ENVIRONMENT

This particular environment of the VS falls within the envelope of the total environment. Unlike the general environment, it is specific to the VS, and not shared with other OEs at its level of recursion. It is important to distinguish the problematic from the general environment, in that the strategies for tackling the future in the former are different from those of the latter. In the problematic environment, the VS has scope for initiative. When the forecast of the future states of the environment is made, and supposing that the prospects are undesirable, the consequent action is not to adapt and cope in a fatalistic way to what is supposed to happen. It is rather geared to the design of strategies which will influence and change that undesired future. In fig.9.2 below is shown the variety interactions between the metasystem and its problematic environment.

I.3 SYSTEM FOUR

We have made the distinction between the two environments (one contained in the other) of the VS. The question it is now necessary to ask, however, is: does the arrangement as conveyed by fig.9.1 and fig.9.2 provide the metasystem with requisite variety vis-a-vis the outside? The answer is that, fragmented as it is, the metasystem cannot possibly regulate the environment. To do so, it must have a model of that environment, sufficiently rich in variety, as Conant and Ashby's [1981] principle of regulation states. Every activity (three in the above mentioned figures) of the metasystem generates variety, independently of the others, so as to absorb the relevant variety of the environment. The variety thus generated, put together, will overwhelm the metasystem, because it has no structural capacity to cope with such proliferation of variety.

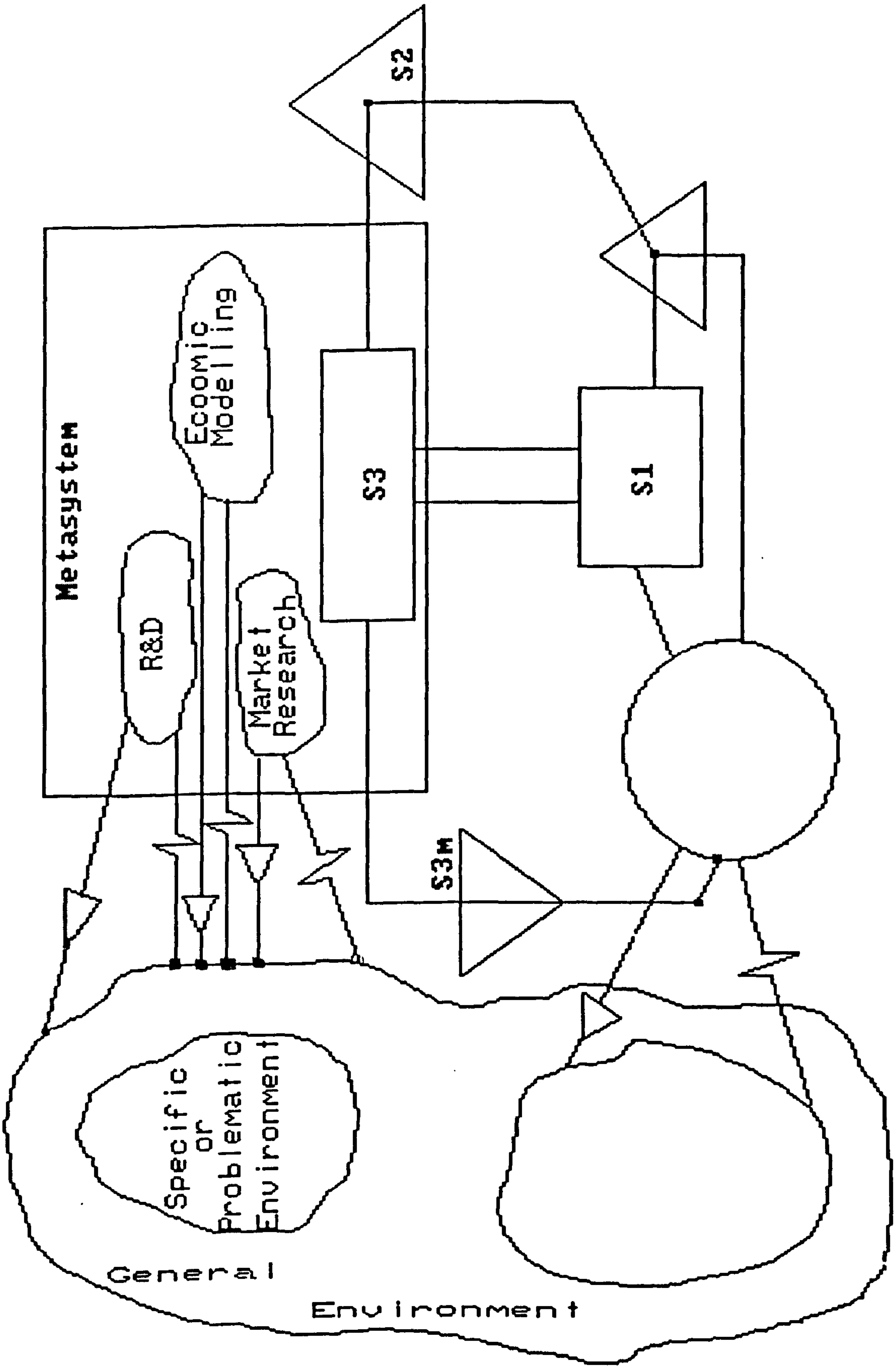


Fig.9.1. Monitoring the general environment.

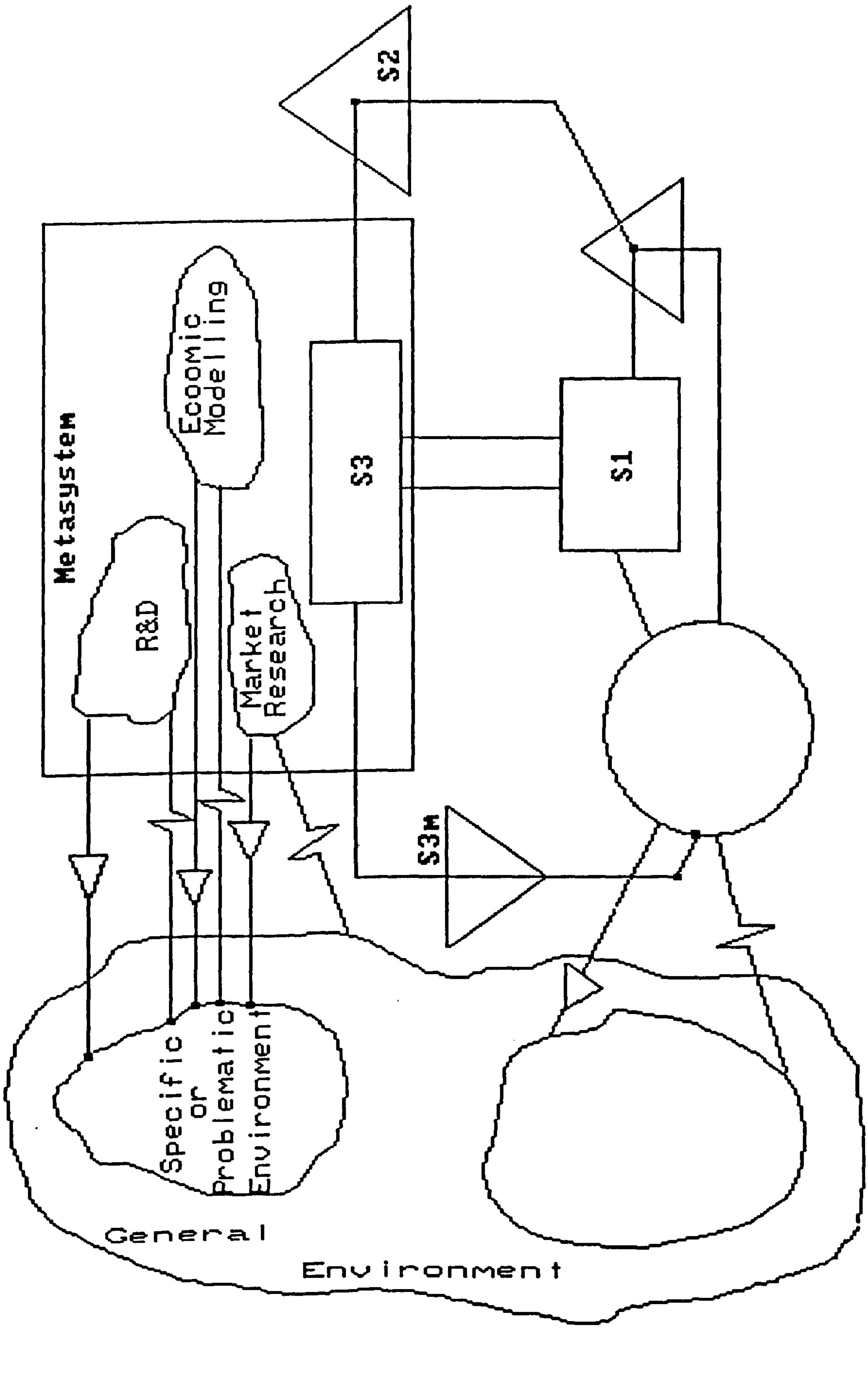


Fig.9.2. Monitoring the problematic environment.

The requirements of the law of requisite variety [Ashby, 1964], added to the dictates of the principle of regulation above necessitate reconsideration of the arrangement of the VS's mechanism for dealing with the outside and future. The multi-faceted activities of the metasystem depicted by fig.9.1 and fig.9.2 need integration. As they are, they operate independently, as if they do not belong to the same metasystem; and no due regard is given to the requirements of the "internal milieu" of the VS. To steer the organisation in its environment and in the proper direction, it is necessary to know the capacities of the system and its needs. These requirements cannot be appreciated with the way the activities of the metasystem are currently organised. Having disparate goals, planning for different time horizons and not speaking the same language make them pull in different directions at the expense of the viability of the system as a whole.

The point of departure of any activity for monitoring the environment must be the VS itself. It also provides the "focus" around which the integration of the multiple activities can be effected [Beer, 1985]. Hence the apparatus for such integration, replacing the previous arrangements of fig.9.1 and fig.9.2, is as shown diagrammatically in fig.9.3 below.

In this figure is represented a different outlook upon the apparatus which looks after the adaptation function of the system. This apparatus is none other than SYSTEM FOUR (S4) of the VS. To the left of the box we have a replacement for the scattered activities of fig.9.1, this is the S4 model of itself. It represents the degree of overlap between the

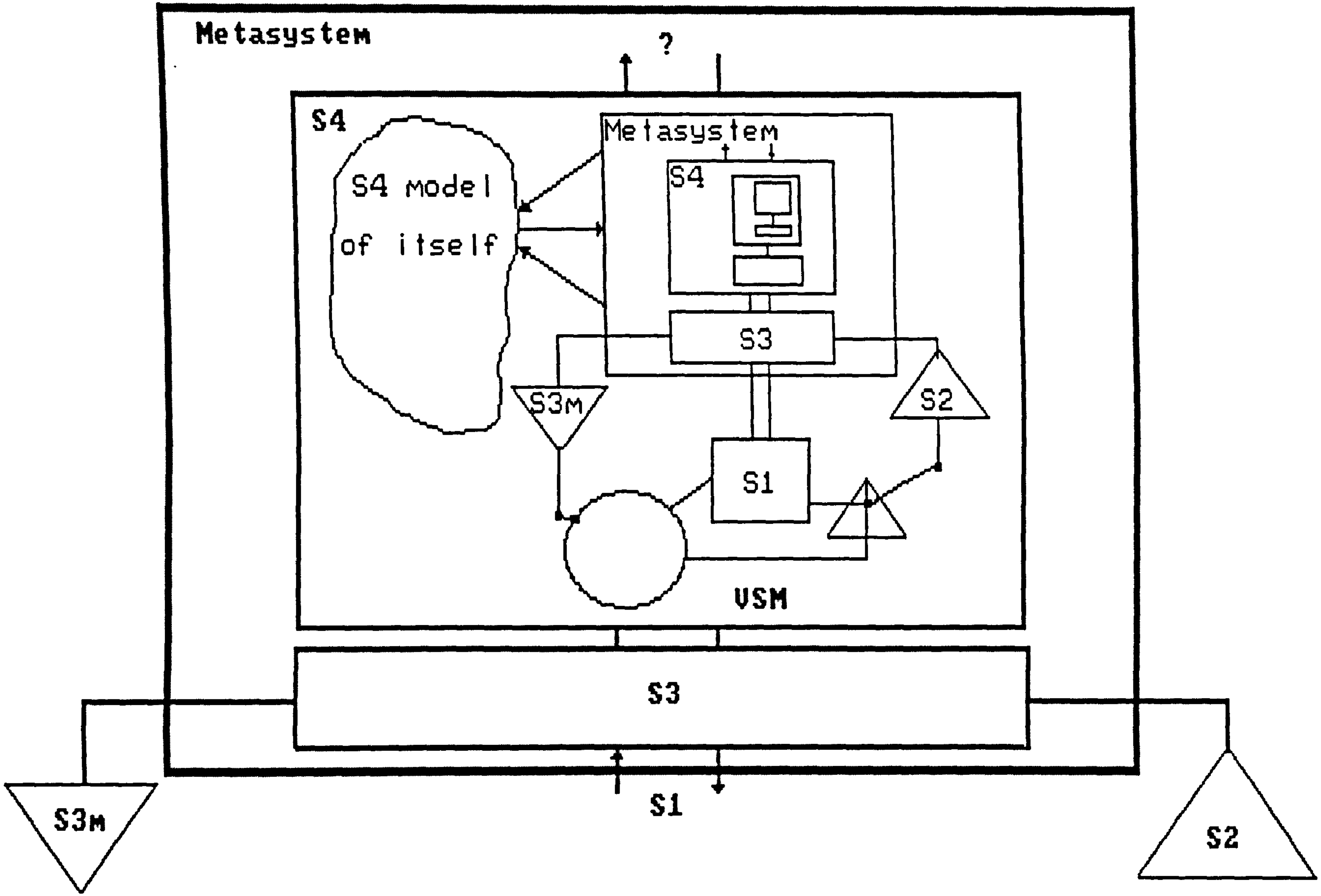


Fig.9.3. System Four of the VS.

various activities which deal with the outside and the future, and shows how they fit together. It is through this model of itself that S4 can see where it can best direct its synergistic efforts. Having this model of itself, S4 can now construct a model of the organisation of which it is the system four. The necessity of this model is apparent when it comes to matching the VS's capabilities with the challenges of the environment. In other words, it is necessary for S4 to house the model of the organisation (i.e. the VSM) through which it can properly appreciate the "internal milieu" of the VS.

With this S4 apparatus in place, the process of intelligence gathering and delivering the responses of the VS to the environment is entirely different. Before engaging in the exploration of the future, S4 must know "what does this organisation do and how it does it" [Clemson, 1984: p.133]. Here comes the usefulness of having the model of the total system where it is, in the S4 box. However, as it stands in the diagram of fig.9.3, S4's access to the operational reality of the organisation is not made apparent (apart from the fact that it has a model of that reality). The process by which it is informed by S3 of that reality is dealt with in the next section.

We now come back to the question of handling the proliferation of environmental variety. Consider fig.9.4. The VS is now equipped with a suitable and powerful device to penetrate the environment, particularly the problematic environment. This device is S4. In fig.9.4, two activities of S4 are shown to have launched themselves into both the general and the problematic environment. The difference that should be noted between this figure and its predecessors, fig.9.1 and fig.9.2, is in the returning filters or attenuators. The design of these filters and the input transducers (a and b) on this loop is of particular interest. Since we are dealing with filtration, they might automatically filter out any novelty which may come in from the environment. The answer to this problem is to introduce a feedback mechanism as a learning device in the loop joining the amplified outgoing stimuli, S4 ---> problematic environment, and the attenuated returning signals, problematic environment ---> S4, and that for every activity in S4 engaged in probing that environment [Beer, 1979]. The purpose of introducing such a mechanism is to allow a modification in the design of the transducers "a" and "b" so as to make them filter in novelties which may turn out to have a beneficial effect on the adaptive capacity of the VS.

We have explained above that the prevailing approach to planning assumes that the future is "out there", and the organisation is sailing towards it. In believing this, the planners stop or freeze the environment at the time of setting up the plan. However, the environment is not static; it is in continuous change, and the rate by which it is changing is itself in continuous change. In addition, the available planning techniques are also "inoperable" for the reason that they are not systemic [Beer, 1978].

A realistic approach to tackling the VS's future is to adopt a systemic approach. This involves simulating the available courses of action and evaluating their consequences on the system. The essence of simulation modelling is to understand the dynamic interaction of the system and its

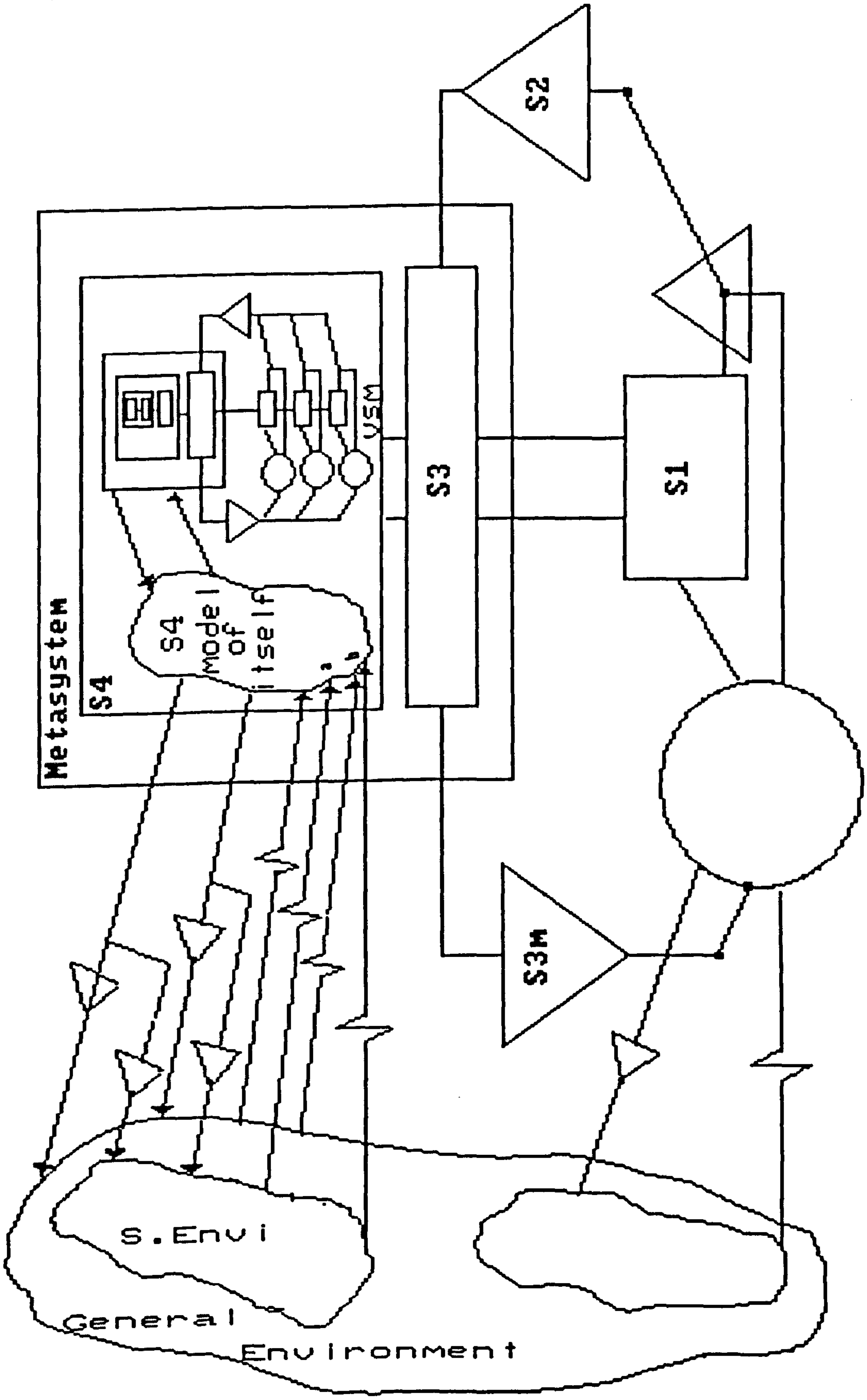


Fig.9.4. System four and environments monitoring.

environment [Forrester, 1961], in particular the problematic environment. The VS is now equipped with the device (i.e. S4) which allows it to undertake such dynamic simulation. Dynamic simulation should be viewed as an experimental approach to exploring the future. The adoption of this approach is not only a logical necessity, it has been proved effective in practice: "I see a definite methodological improvement in the dynamic simulation procedures as compared to deterministic planning for fixed timespans" [Schwember, 1977: p.125].

II. THE META OF THE METASYSTEM

We provided an elaborate description of the various subsystems of the VS, namely S1, S2 and S3, which constitute "the inside-and-now" of the VS. We have now added the composite S4 which assumes the function of adapting the VS to its environment and also managing the problematic part of that environment. However, nothing so far has been said about the interactions of the first composite (controlled by S3), and the outside and the future (as monitored by S4). System three in its daily running of the VS strives to maintain stability; its approach is mainly conservative. The efforts of S4 are, on the contrary basically progressive. What are, then, the consequences for the VS of these two antithetical tedencies?

II.1 THE S3-S4 HOMEOSTAT

We know from the second axiom of management that: "The variety disposed by S3, resulting from the operation of the first axiom, equals the variety disposed by S4" [Beer, 1985: p.118]. We also know that the variety disposed by S3 (from the first axiom) is colossal [ibid]. Let us find out now how this variety commerce takes place within the metasystem.

We start by redrawing fig.9.4 above, but with the emphasis this time on the interactions with S3 instead of the environment. On the new diagram of fig.9.5, suppose that for a particular environmental loop (i.e. for one activity of S4), S4 aquires certain information at one point in time regarding the position of the VS vis-a-vis the environment, and this information is received at node "a". This information is passed over to S3, through "b", at node "c". However, "c" is also a point of reception of the information emanating from S1. This information, in turn, is transmitted from node "d" following change of state in S3 induced by the feedback information from "b". The loop is closed at "a". Again new information from the environment and the feedback from S3 (i.e. from "d") leads to change of state in S4, where the new messages are sent from node "b" to S3. This loop is in continuous operation. We arbitrarily began in S4; we could have just as well started in S3. The fact is that there is no beginning nor end for the variety flow between S3 and S4.

However, fig.9.5 gives a very simplified account of the variety transactions between S4 and S3. We know from previous analysis that S4 monitoring of the environment involves more than one loop. Every activity in S4 is engaged in probing the environment and making scenarios for the future. On the other hand, the information accessible at S3

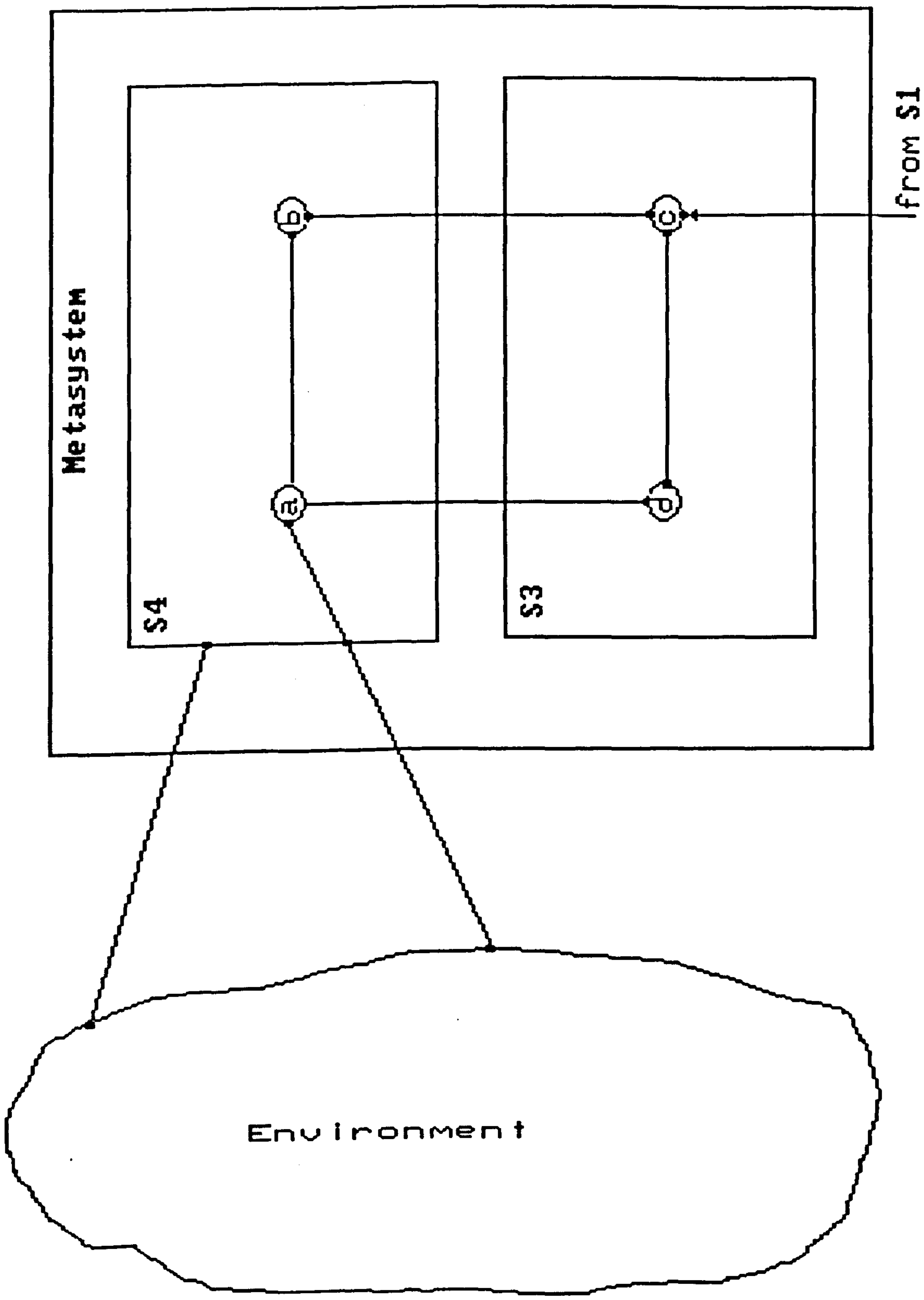


Fig.9.5. The S3--S4 feedback loop.

from the next level of recursion down emanates from more than one OE. Taking these considerations into account, the added sources of variety added to fig.9.5 would make it look like the diagram, fig.9.6, below.

In fig.9.5 we see how the feedback loop between S3 and S4 is closed. The new arrangement of fig.9.6 makes explicit the variety flow from S3 for more than one OE and also the involvement of two loops in S4 for monitoring the environment. As the diagram shows, node "d" represents the synthesis of the variety of S1 as viewed by S3. This boils down to S3 presenting to S4 the needs of the system under the existing circumstances, i.e. with the available investment (human and capital), also the difficulties the VS may encounter if it embarks on new investment in new projects or new technologies (as advocated by S4) which S1 or the operational side of the organisation have not yet experienced.

By analogy, node "a" in S4 symbolizes the synthesis of the synergistic view of S4 of the environment as supplied by the two loops e1 and e2 (there could be more) through what we came to know in the last section as the S4 model of itself.

Let us now proceed with an examination of the quantity of variety flowing in both directions between S3 and S4. At node "d" we have the synthesis of the variety carried over and filtered through the channels of S2. The nodes Ci symbolize the fact that there is more than one OE. This synthesis is transmitted to S4 through the channel "d" ---> "a". However, OEs are autonomous and could be different, therefore, the impact of the information arriving from the environment through the activities e1 and e2 (say market

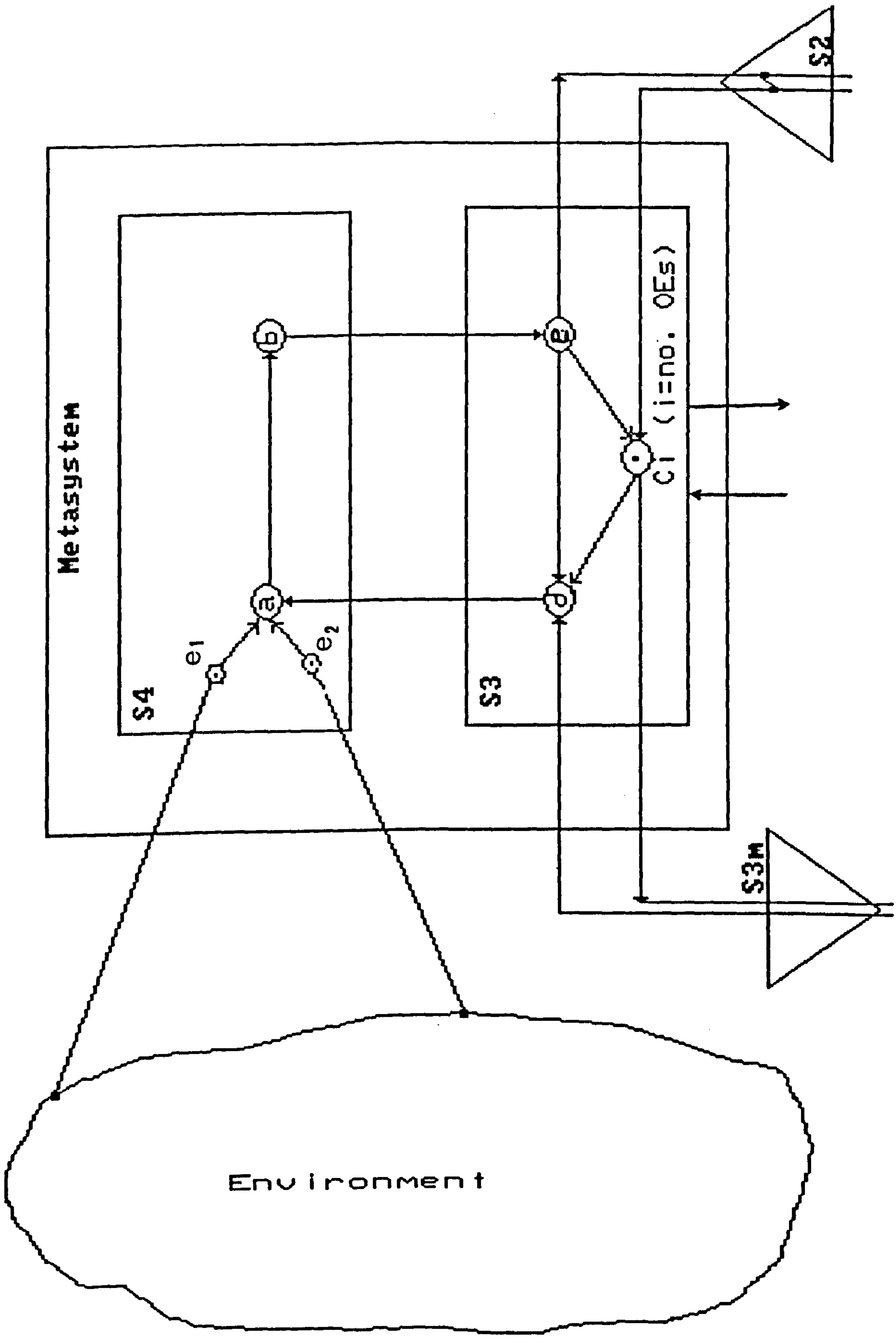


Fig.9.6. The S3---S4 as a homeostat.

research and R&D) is bound to be different, and S3, although it can provide the synthesis, is in no position to evaluate the impact of every activity of S4 on every OE. As a consequence, all the variety received at C must be passed over, through "d", to S4.

By the same token, and for the same feedback purposes, the channel "b" ---> "e" must also carry the total variety available at "a", which is made up of the synthesis as seen by the synergistic view of S4, plus the individual variety of every activity i. It is now possible to appreciate the magnitude of the variety transactions between S3 and S4, and the capacity needed on the channels concerned to carry this variety through.

II.2 THE BALANCE OF THE S4---S3 HOMEOSTAT

The antithesis that exists between S3 and S4 stems from the nature of the function performed by each. S3 is conservative in character; its main concern is internal stability and maintenance of the status-quo. By contrast, S4 is progressive by nature, it pushes towards adaptability and change: "This arrangement is bound to cause some tension and conflict. In fact, it looks like conflict is structurally built in" [Clemson, 1984: p.137]. On the other hand, we have seen that the variety engineered between them is colossal. Having stated this, can it be assumed that the metasystem (S3 and S4) will remain stable? If it cannot, the metasystem is not in a position to regulate the VS.

The VS, having the regulator so far described, cannot remain viable. It is either torn apart by the high tension created by the interactions between S3 and S4, or eventually by one of the two dominating the scene. In the event of either of them dominating, the VS will consequently suffer. Therefore, some mechanism is needed to engineer variety and manage the tension in the metasystem, so that the viability of the system, as a whole, is not jeopardised.

Before we can identify the mechanism for keeping oscillation from setting in, in the metasystem itself, we need a definition of the framework within which it is to operate. At any one point in time, what are the variables that require change and those which need be kept stable? We know by now that the VS exists in a continuously changing environment, with a continuously changing rate of change. This fact leads to an obvious conclusion: the criteria by which to hold the equilibrium of the S3-S4 homeostat need to be modified continuously. That subsystem, of the metasystem, which achieves this and oversees and governs the homeostat S3---S4 is SYSTEM FIVE (S5).

When we encountered the problem of oscillation across the operations of S1, in the last chapter, we came to the conclusion that S1 could not by itself damp that oscillation, because it lacked the metasystemic view. The same argument held for the true synergy of the OEs, only S3 had the synoptic view to locate that synergy. The same logic applies regarding the interactions between S3 and S4. Neither the one nor the other is in a position to provide a balance. The mechanism required to damp the potential oscillation, that might set in at the metasystem level, must be in a logical sense metasystemic to both S3 and S4.

Put explicitly, it falls upon S5 to set the criteria of what is to count as stability, without interfering directly in the operations of the homeostat. S3 and S4 must be left to absorb each other's variety. However, it is not enough for S5 simply to set the criteria of stability. It should also make sure that this stability is maintained; in other words, detect instability and bring the system back to the desired stable state. By "desired", it is meant that it is S5's responsibility, in addition to detecting instability, to recognise that the stability it seeks to maintain is not stagnating or detrimental to the long term viability of the system [Beer, 1979]. This implies that the criteria of the working homeostasis should be changed to meet the needs of the system as it sails in the environment and into the unknown.

In fig.9.7 below we see the role of S5 as a metasystemic monitor of the S3---S4 homeostat. In this diagram the homeostat appears in heavy arrows to emphasize the fact that the variety transaction is very high. According to the second axiom of management which states that: "The variety disposed by System Three resulting from the operation of the first axiom equals the variety disposed by System Four" [Beer, 1979: p.298], it can be expected that requisite variety will be achieved between these two subsystems of the metasystem. In variety engineering terms, S5's role is expressed by the third axiom of management which stipulates that: "The variety disposed by S5 equals the residual variety generated by the operation of the second Axiom" [Beer, 1985: p.130]. It can then engineer the variety balance so as to suit the overall VS.

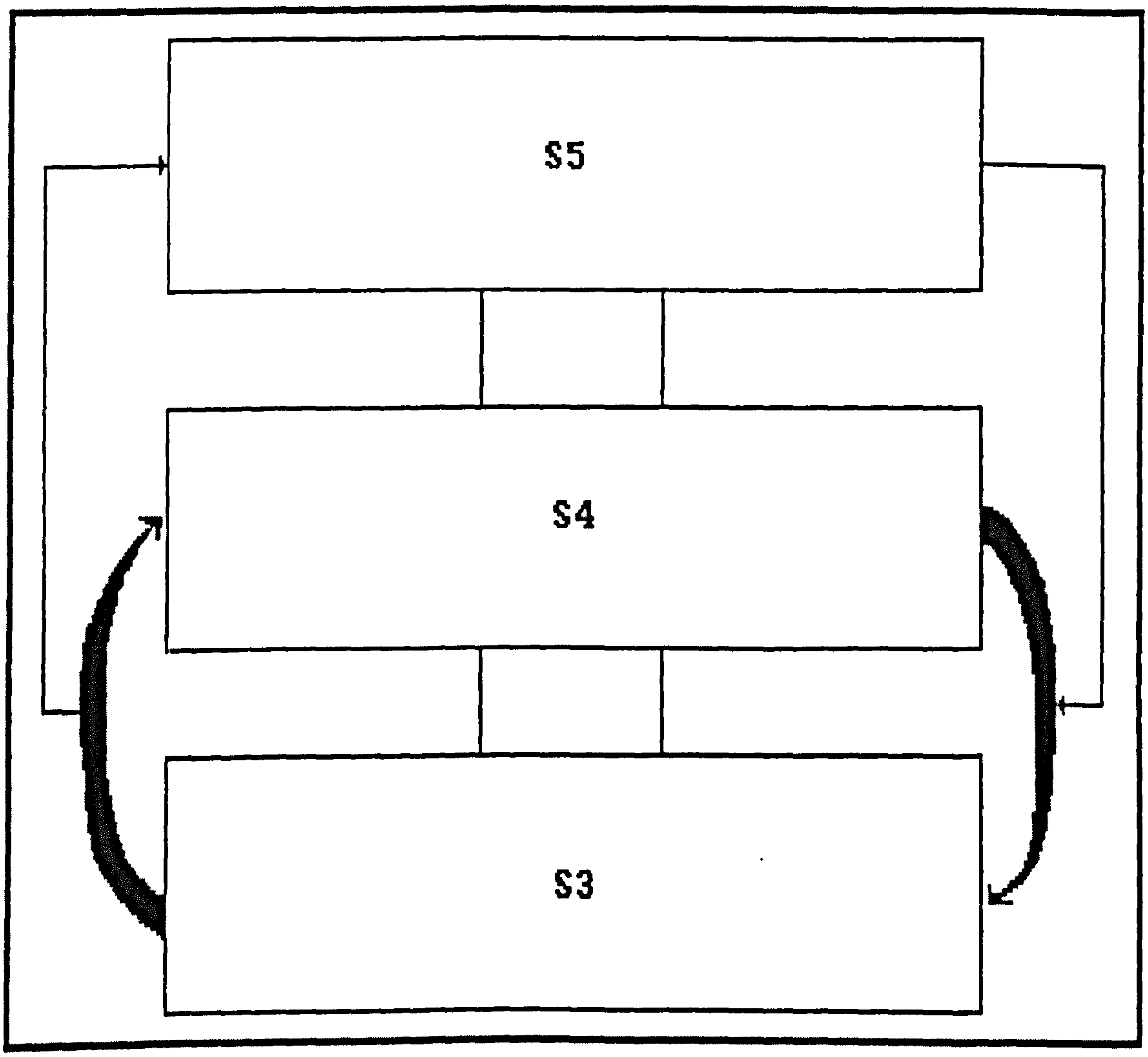


Fig.9.7. The meta of the metasystem.

However, its capacity as the metasystemic regulator of the S3---S4 homeostat, S5 appears to be (as shown in fig.9.7) lacking requisite variety. We remember from the Conant-Ashby theorem that every regulator must contain a model of that regulated [Conant and Ashby, 1981]. In other words S5, as it is, cannot succeed in its role as a metasystemic regulator. What it needs is a model of S3, S4 and of the homeostat S3---S4 in the box labelled S5 of fig.9.7. This new arrangement appears in the diagram, fig.9.8, below.

With the models of S3, S4 (S3m and S4m) and their interactions in place, S5 can now deploy requisite variety vis-a-vis the homeostat, and conforms with the third axiom of managerial requisite variety. However, the diagram of fig.9.8 falls short of making clear another important role of S5. The background or the context within which S5 operates is that of the organisational identity and, at the same time, S5 incarnates this identity [Beer, 1979]. It falls upon it to ensure that the identity of the system is presented properly to the outside world. Given the conflicting drives of S3 and S4 mentioned above, in time the organisation may develop towards a situation where it is difficult to have agreement between S3 and S4 on what is to be the identity of the organisation, at which point the role of S5 becomes paramount and decisive [Clemson, 1984].

In terms of the VSM, S5 provides the logical closure (i.e. the identity) for the VS. Logical closure in the context of fig.9.9 below means that the VSM is complete. The next step up is not another subsystem of the VS (say S6), it is another level of recursion, where this system in focus is an OE.

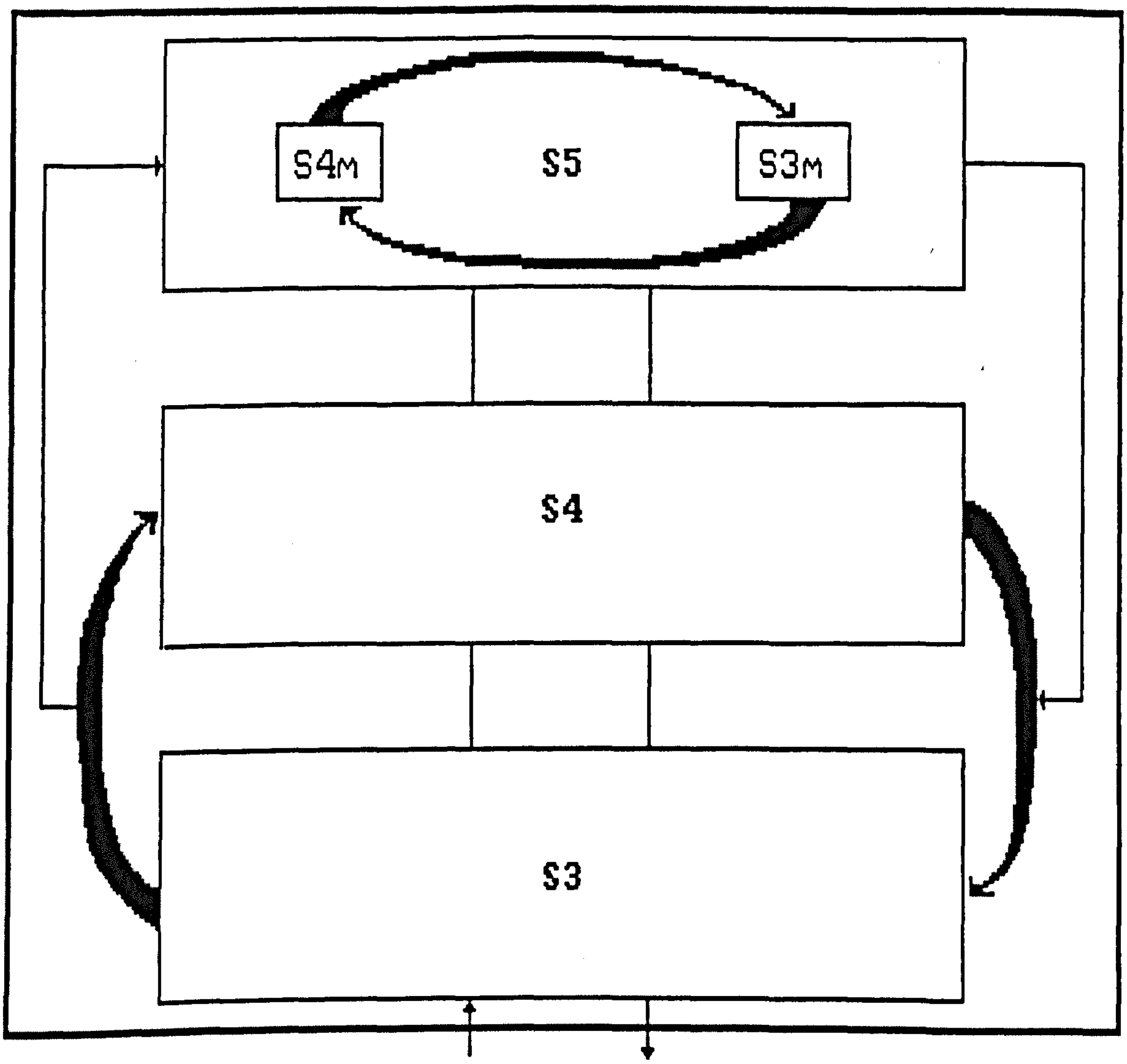


Fig.9.8. S5 as the metasystem regulator.

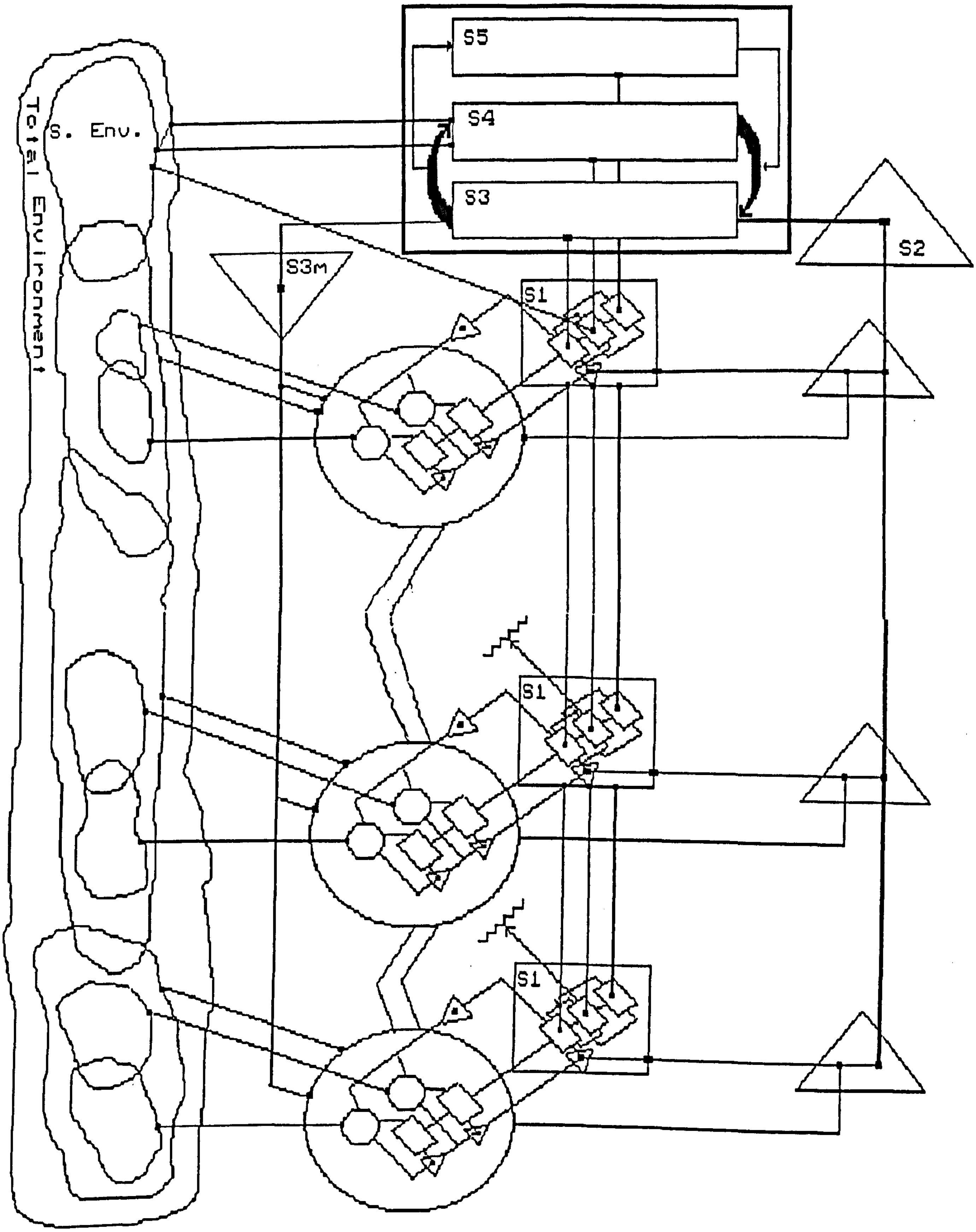


Fig.9.9. The complete VSM.

With the five subsystems (S1, S2,...S5) in place, the VS has aquired the necessary and sufficient conditions for its viability [Beer, 1979]. Its structure is arranged according to the recursive system theorem which states that: "In a recursive organisational structure, any viable system contains, and is contained in, a viable system" [ibid: p.118]. In fig.9.9 we see the final arrangement of the VSM. The OEs are the isomorphic mapping of the system in focus and so are their OEs. By the same token, the system in focus is embedded (as an OE) in another VS at the next level (up) of recursion. The process continues indefinitely to form a spiral like the shape of the double helix.

Chapter 10

THE DYNAMICS OF THE VSM

In this chapter an attempt is made to explain the dynamics of the VSM in its totality, as depicted in fig.9.9 of the last chapter, as a first step towards understanding the workings of actual organisations.

However, before proceeding any further, it is fundamental to note the essential difference between what flows through the networks of the VSM, and the traditional concept of information entertained by MIS. This difference lies in the measurement of the relevant variables which management needs to control, and also the format in which the information is to be supplied to those concerned.

The entries to the usual MIS are all sorts of input data: financial, production, personnel or sales figures, etc. All this data is processed in various ways to produce massive printouts of tables, averages, and statements of all kinds in different units of measurement, i.e. monetary, weights and so forth. Whereas the "stuff" of management employed for measurement by the VSM is variety, which is the measure of complexity, its proliferation, attenuation, amplification and filtration. The VSM disposes with all those data banks and massive printouts that overload management. In the following section an attempt is made to present the convention of measurement as developed by Beer [Beer, 1979, 1981].

I. THE MEASURING TOOL OF THE VSM

We have come, by now, to understand and appreciate that the manager of any operation cannot know everything about all the variables involved in that operation. The approach to follow, therefore, should be to adopt the black box technique (refer to ch.6), where the output of the system (the box) is the only means by which the manager, as a regulator, can infer the health and performance of the system regulated, i.e. the operation. The needs of a regulator for measurement are then focused on the extent to which a measure can inform him about the stability or instability of the system under his control [Beer, 1979].

Let us draw a picture for this argument. Consider fig.10.1 below. In this diagram, a and b correspond to the levels of performance or the physiological limits within which the performance of the system can fluctuate if it is to remain stable. C is the stability level of the system as defined subjectively by the regulator. The curve represents the behaviour of the system over time. The measure(s) required by the regulator in this context, is that which can inform him about the stability, or instability of his system. In terms of this figure, the system is stable or homeostatic if the fluctuations remain within the limits defined by a and b. It would be unstable if it oscillated wildly beyond these limits of normality a and b [Clemson, 1984].

At this stage, definitions of the terms data and information are needed [Beer, 1979].

.Data is "statements of fact".

.Information is "that which CHANGES us" (Beer's capitals).

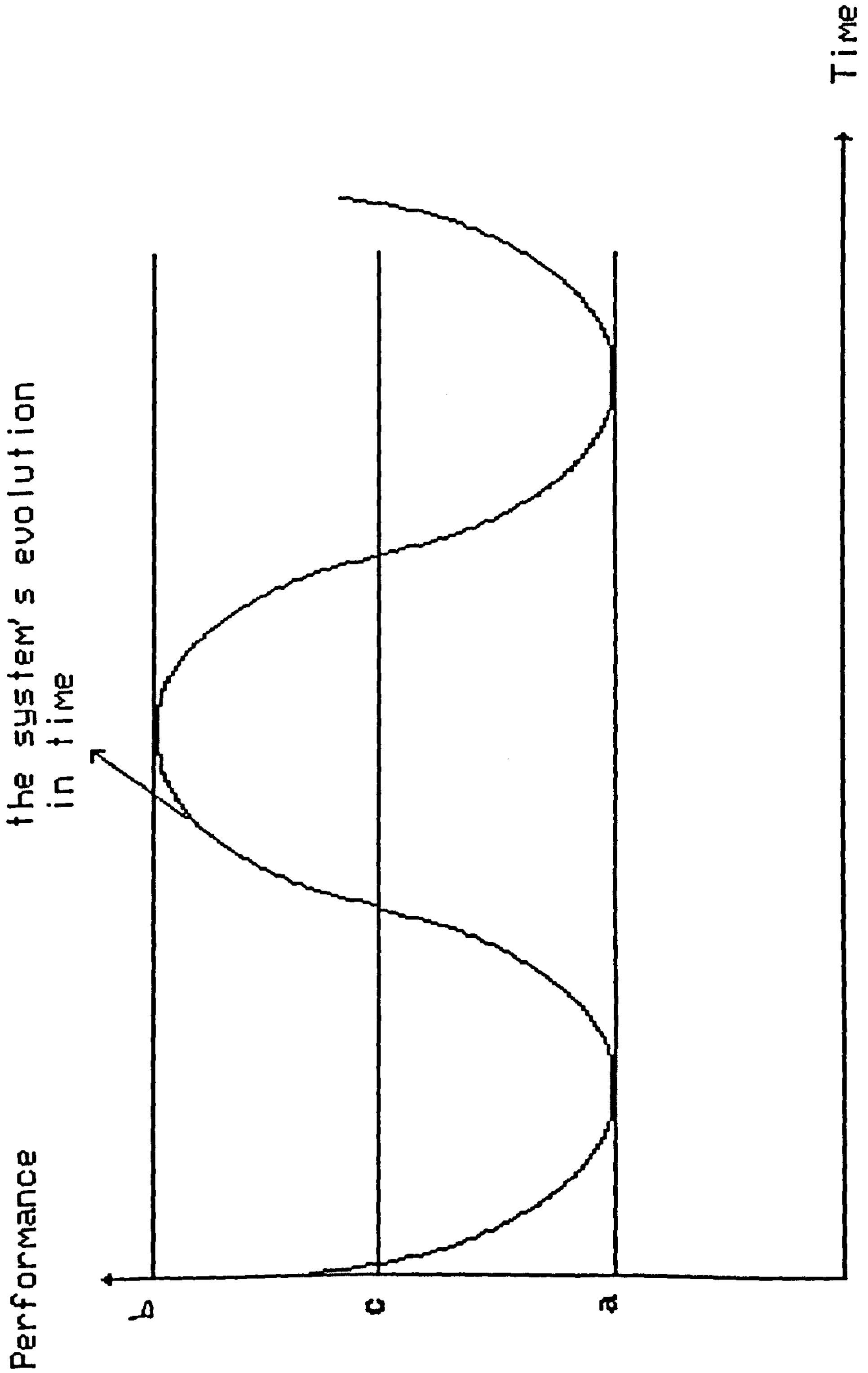


Fig.10.1. The physiological limits of a system

If a manager cannot "recognise" the facts in the data provided to him, then this data is no more than noise [ibid]. When computer printout given to a manager, which is meant to inform him, does not lead to his change of state, it is not information. Inundating the manager with endless reports and statements about the process under his control is not what he most needs. What he requires in fact is knowledge of "how to build a filter of variety of the process" [Schwember, 1977].

The starting point, for this, is to model the process in the form of a quantified flow-chart, i.e. build a "variety-attenuating filter" [Beer, 1975(b)]. This device is convenient regardless of the level of recursion under consideration. The flow-chart could present the flow of material for production in a factory, cash flow if our system in focus is a bank, or movement of vehicles in the case of a transportation company.

To avoid unnecessary abstraction we can take a hypothetical example, to explain quantified flow-charts as a measuring tool. Consider a small company manufacturing two types of domestic appliance: refrigerators and cookers. It has two plants (i.e. two OEs), plant A for refrigerators and plant B for cookers. In turn, each plant is made up of two production lines. Fig.10.2 is a VSM representation of this hypothetical company. The flow-chart for this example is shown in fig.10.3 below. In it are presented the critical activities of the production line (x) (refer to fig.10.2), which the controller of the production line considers as the key indicators of the process of production in that line. Notice how the two assembly lines are taken as black boxes.

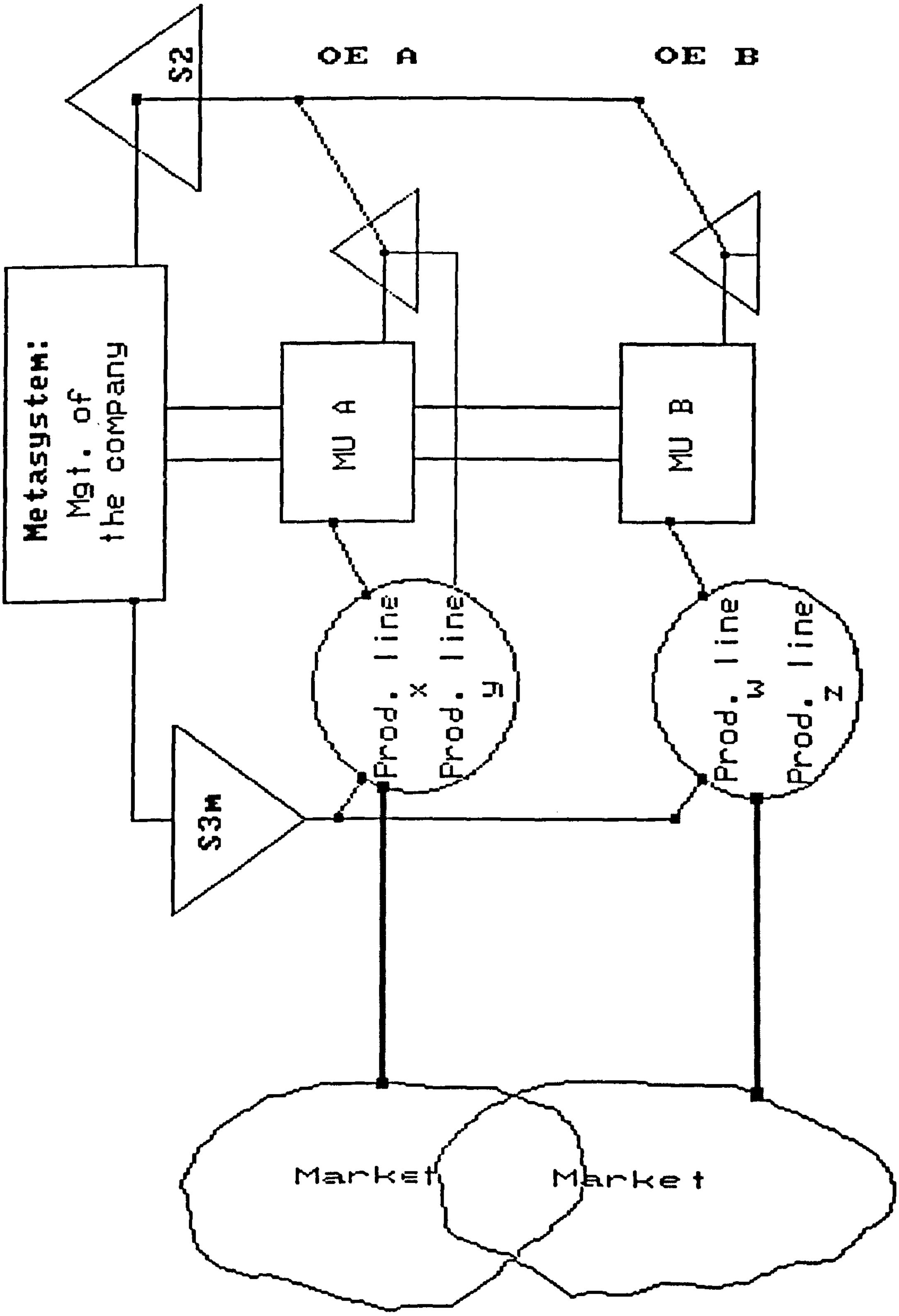


Fig.10.2. A hypothetical company producing domestic appliances.

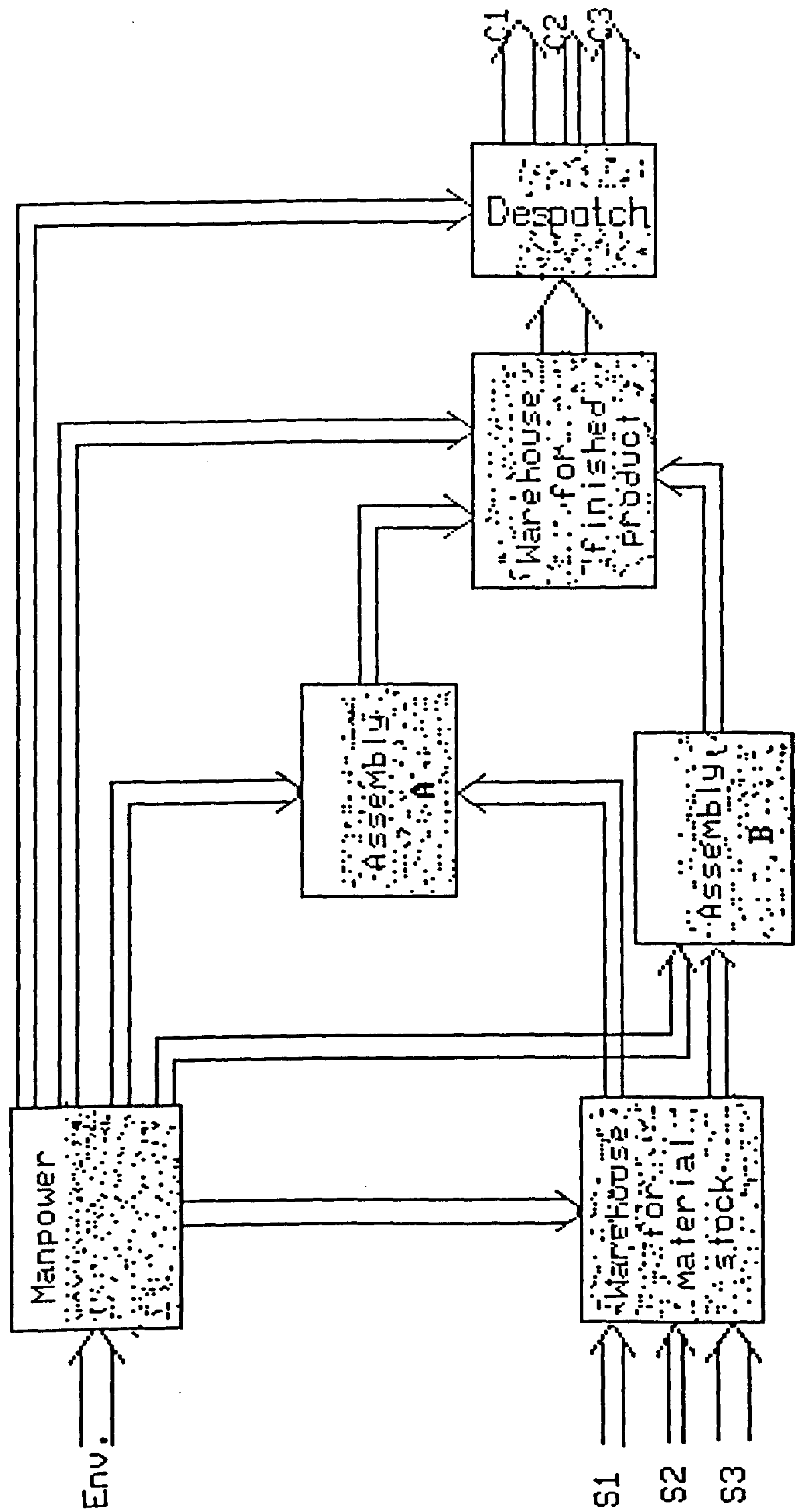


Fig.10.3. The flow-chart for the hypothetical company.

To carry out detailed analysis in their regard, we would be required to move down a level of recursion.

The boxes show the key points in the process. The level inside each is an indication of the level of the activity represented by the box. For instance the level of the box labelled despatch is 3/4 of the capacity; meaning that this activity is less critical than, say, the one labelled warehouse, which is shown by the flow-chart as being saturated. The width of the arrow depicts the relative importance of the flow of the material between the boxes. The arrows also show the logical connections between the activities of the process.

The usefulness of the flow-chart as a variety filter is very apparent. It indicates, without the need for quantities or figures, the inputs, the critical activities of the process, i.e. its key indicators (the boxes), the way they influence one another, and the output(s), i.e. the arrows marked c1,...,cn in fig.10.3. The logic of the flow-chart is similar to that of the PERT technique, in the sense that it highlights the critical elements. However, the flow-chart is time independent, and the flow of material (the case of fig.10.3) is continuous without a beginning or end.

Having established the flow-chart, the next step is to build indices from it. These are labelled: Actuality, Capability and Potentiality [Beer, 1975(b), 1979].

.Actuality means what is being done under the existing conditions and constraints.

.Capability implies what could be achieved, given the current resources and constraints.

.Potentiality is what the system ought to be doing if it is allocated extra resources and the existing constraints are removed.

From these indices we obtain the measures of achievement, which are also three in number. They are defined as follows [ibid]:

Productivity = ratio of actuality and capability.

Latency = ratio of capability and potentiality.

Performance = ratio of actuality and potentiality.

= productivity x latency.

These measures are summarised in fig.10.4 below.

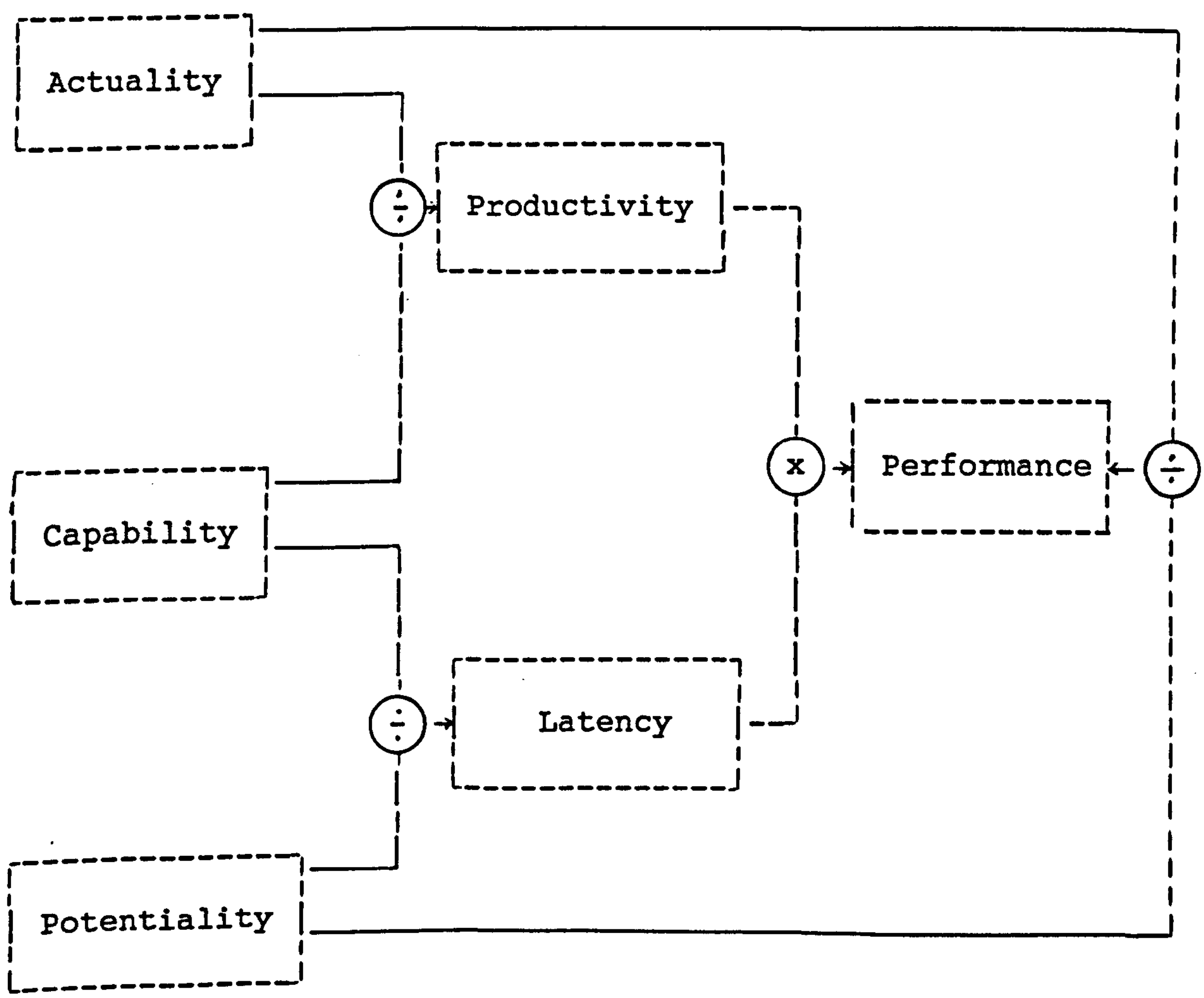


Fig.10.4. The VSM's measurement indices.

It follows from the above definitions that the limiting case for actuality and capability is potentiality, where the value of the latter is unity. That is to say the values of actuality and capability are defined over the range [0, 1]. Further clarification is needed concerning the last three measures of achievement, namely productivity, latency and performance. By definition, potentiality is better than capability, and this in turn is better than actuality. However, it is not always a straightforward matter which is to be assigned the numerator, and which is assigned the denominator. The word "better" in this context should not be confused with the word "greater". For instance (refer to the production line (x) in the example above), if we are discussing sales, profits or the number of units produced, better will mean greater or higher. If we are analysing production rejects or production costs, Potentiality will necessarily mean lower costs or fewer rejects, i.e. pot. < cap. < act.

To illustrate the use of these measures, consider again the example of fig.10.3 above. Suppose that the activity labelled despatch is capable of despatching 1500 items a week, while the actual number of items being despatched is only 1200. With a few improvements, management estimates it could increase the capacity of this particular activity to 2000 items a week. The measures of achievement regarding this indicator (despatch) will be:

Productivity = act./ cap. = 1200/ 1500 = 4/ 5 = 0.80

Latency = cap./ pot. = 1500/ 2000 = 3/ 4 = 0.75

Performance = act./ pot. = prod. x lat.

= act./ cap. x cap./ pot. = 1200/ 2000 = 0.60

On the other hand, assume that the management is interested in the cost of material waste in the warehouse caused by handling, packaging, etc. The current percentage of waste is evaluated at, say, 10% of the total stock (i.e. actuality), while the management considers on the basis of industry wide comparison, i.e. competitors operating under similar conditions, the percentage of the wasted stock to the total cost of production should be in the neighbourhood of 6% (capability). With the few improvements mentioned above, the target is set by management to reach 3% (potentiality). The measures of achievement in this case are calculated as follows:

Productivity = cap./ act. = 0.06/ 0.10 = 0.60

Latency = pot./ cap. = 0.03/ 0.06 = 0.50

Performance = pot./ act. = prod. x lat.

= cap./ act. x pot./ cap. = pot./act.

= 0.03/ 0.10 = 0.30

We should note that the importance of the achievement indices in the evaluation of systems performance does not lie in the absolute values of these indices, since the latter depend on the fixed value the management have already attributed to the capacity measures, i.e. actuality, capability and potentiality. What is significant, however, is the movement of these indices over time [Beer, 1981].

I.1 STATISTICAL AIDS FOR MEASUREMENT

Thus far we have built the flow-chart and decided on the relevant indicators which can allow us proper description and understanding of the system. Out of these came the measures of capacity, namely actuality, capability and potentiality, from which we deduced the indices of achievement, i.e. productivity, latency and performance, which can really show the homeostatic behaviour of the system. It remains now to understand how these measures and indices can be put into effect to "...create a numerical model which properly reflects the fundamental quantitative relationships in which classes of events stand to each other" [Beer, 1966: p.317].

To set up the limits of normality, a sample of indices and measures is selected according to normal statistical criteria. The limits of normality contain the interval within which an index can fluctuate. These fluctuations are accepted as natural minor perturbations. However, the dynamics of the process (for which indicators are built) ensure that the limits of normality will not remain stable. In other words, the process (the black box) as a system learns from experience and continuously modifies its parameters in order to adapt to changing conditions [Beer, 1979].

By the use of statistical filtration, management can determine the likelihood of incipient change [Harrison and Stevens, 1971]. The particular statistical model advocated [Beer, 1979] is particularly sensitive in showing that, for a value of an index (for instance the performance index), the system is in a "no change" state, undergoing a step change, i.e. when there is a jump in the value of the index, or a slope change, which means steady increase or decrease in the value of the index; or simply that the change is transient and can be ignored.

An information system built in this way spares management the masses of data indispensable to conventional MIS. It suppresses the information unless it registers a significant change in the movement of the indices involved, i.e. a step or slope change. It is concerned with the future rather than reporting the past. By operating in real time management is informed of the probability that something is about to happen and can do something about it before it occurs.

There is another practical advantage to having such a system in that, once it is understood and the right software is incorporated, it can be extended to other levels of recursion, or if applied by any one operational element (OE) of the VS, it will be equally valuable to other OEs and their OEs.

II. ENGINEERING WITH VARIETY

From the variety engineering standpoint, the VSM is a set of feedback loops. There is the network of channels through which variety flows between S1 and S3, this variety being dedicated to maintaining the VS's internal stability (see ch.8). The second set of loops operates at the metasystem level. We have seen in the last chapter how S5 monitors the variety flow between S4 (the outside and the future) and S3 or "the inside and now". S5 also provides the closure for the VSM, which means that the VSM as an informational network is closed by S5, where the informational network, in a variety engineering sense, has no beginning or end.

We touched upon the question of variety engineering on the loops in chapter 7, when we considered the OE as a building block of the VS. It was emphasised, then, that attenuators and amplifiers of variety should be designed properly on the loop relating the management unit (MU) and its operations and on the loop relating the latter with the environment, so as to accommodate Ashby's law of requisite variety. Armed with the tools of measurement and the redefinition of planning as a continuous process (ch.9), we can now proceed with the question of variety engineering in the whole VSM.

II.1 ENGINEERING WITH VARIETY INTERNALLY

Let us redraw the part of the VSM which looks after the "internal milieu" of our hypothetical example (section I above). This appears in fig.10.5 below.

Consider the OEA (plant A). Data concerning the actual production in the two production lines (x) and (y) is collected and transduced at the level of the operations. This transduction process involves the classification of data according to the distinct activities in the production lines. In other words, data is organised in samples and made ready for processing on its arrival at S2 of OEA. Before we go any further, we must remember that the data in question should not be confused with the measures used by the classical MIS (eg. units of production, cost of production, etc.). It is instead presented in the form of pure numbers corresponding to the measures of capacity and achievement as defined above.

On receipt of actual data, S2 already has the models of the capability and potentiality of the activities generating this data. Out of these two models, and actual data, achievement indices are computed. This stage is denoted by node "1" in fig.10.5. Having carried out the computations, the next step is to arrange the results so that a trend in the movement of the indices can be detected. This check is made against a background of parameters which determine the limits of normality, within which the fluctuations in the values of the indices are taken as minor perturbations and part of the natural dynamics of the system.

The statistical filter [ibid] for the incoming variety at node "1" is sensitive enough to make possible detection of whether an incipient change is transient, or the beginning of more changes to come. We can distinguish two modes of operation of this variety filter. Take for example productivity and performance as two achievement indices of the level of production in the production line (x) of OEA. Assume that the computations of these two indices have the readings as shown in fig.10.6 below. Studying the evolution of the productivity index in (a) reveals that the system behaves normally, i.e. the fluctuations are within the tolerance limits. We can therefore conclude that the system, judged by its productivity index, is homeostatically stable. This implies that no information is passed over to MUA (fig.10.5).

However, the movements of the accompanying performance index tell a different story (fig.10.6). At time (ti) this index registers a substantial fall. Nevertheless, this decrease is seen as transient, therefore, no action is to be taken. The situation is different at (tj); here the forecast is that the system is faced with a steady decline in the near

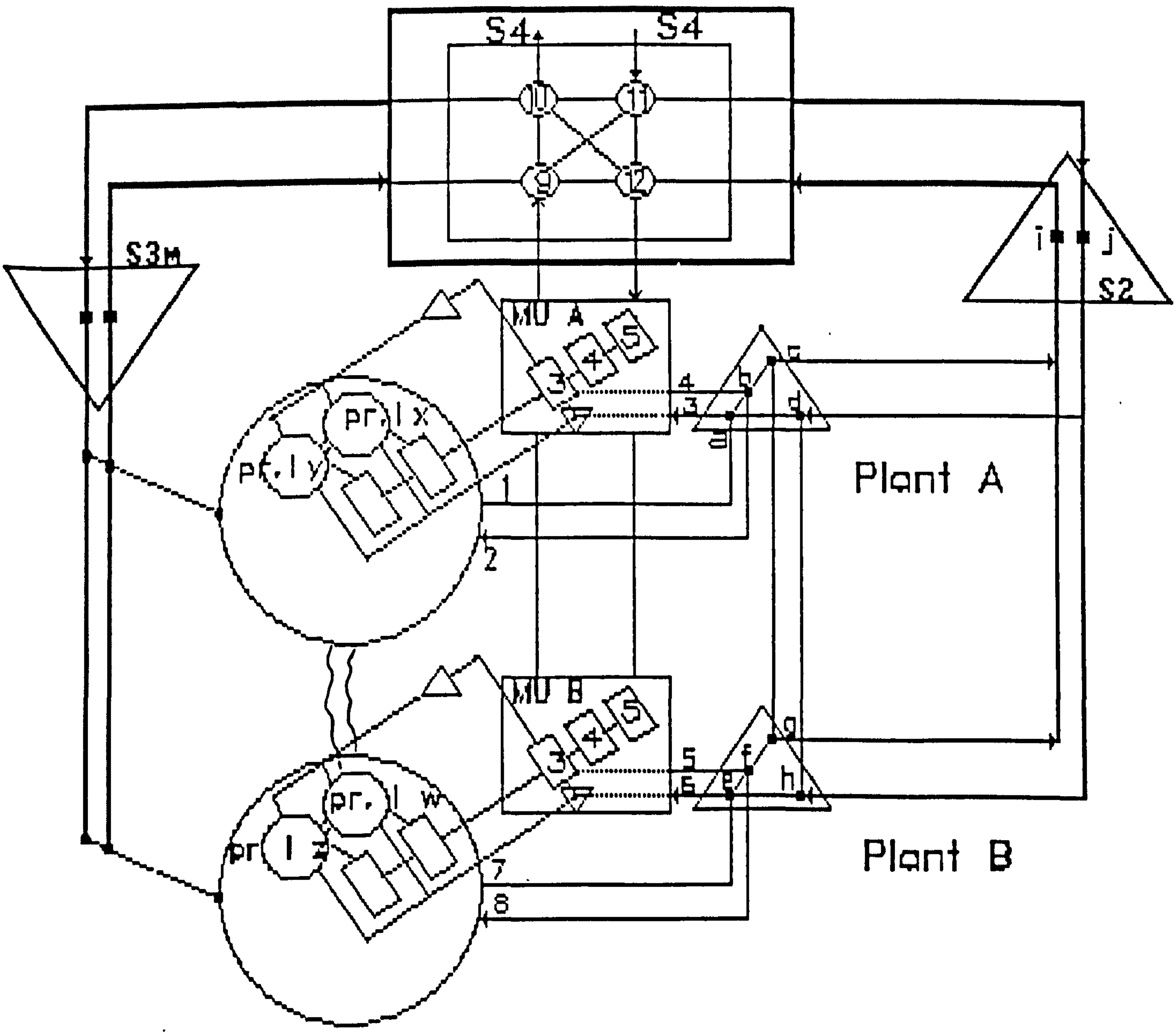


Fig.10.5. The hypothetical company's "internal milieu"

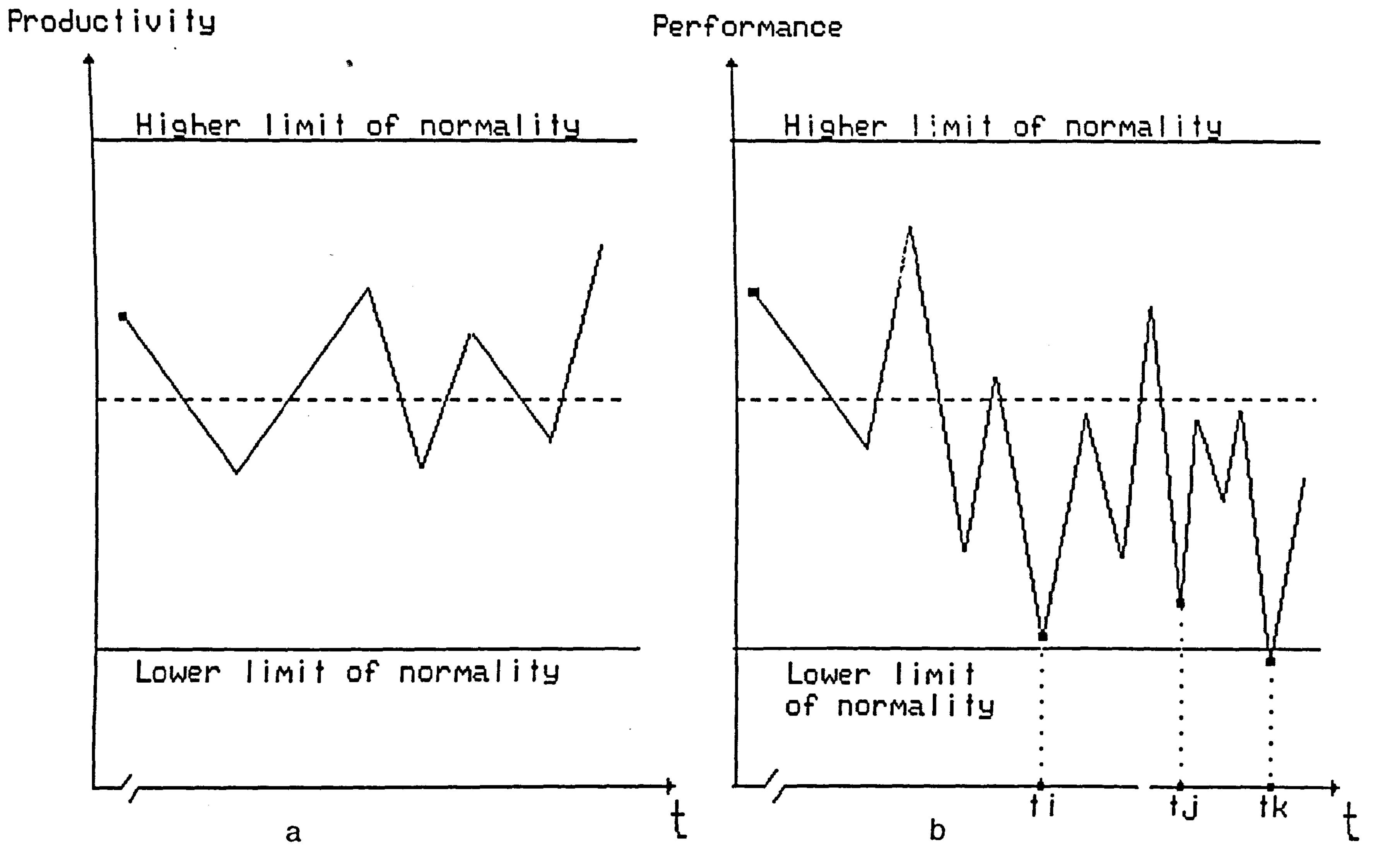


Fig.10.6. Evolution of performance indices

future, i.e. we have on our hands a slope change but still within the system's limits of normality. S2 of OEA will trigger the signal to MUA that something is going wrong on the production line. This information is sent well before reaching time (tk) (fig.10.6 (b)) in order to allow appropriate measures to be taken by management before it is too late. This information (regarding the incipient instability is also made available to OEB at node "d" (fig.10.5), through the regulatory centre (S2) of the latter.

It looks as if the situation presented by fig.10.6 above is contradictory, and that we should expect the decline in the performance index to be reflected by the productivity index. Here we see that contemplating the achievement indices of this production line will provide management with knowledge of the operations without actually diving into them. We remember:

Prod. = act./ cap.

Perf. = act./ pot.

Lat. = cap./ pot.

Now taking actuality as something given or "fact", it is possible to keep productivity steady in the face of declining performance by reducing the capability in the production line, since the latter does not enter into the calculation of the performance index. This can be done by tampering with latent resources, i.e. reducing the latency of the system without appearing to be unproductive. However, with the indices set up as they are, this will not now go undetected by the metasystem, where we have seen that S2 holds in store all the models of capacity and achievement indices. Thus management learns about its "black box".

Refer now back to fig.10.5. The response to the situation in the production line (x) comes back from the management unit, symbolised by node "4", (we will dispense with details of how the action has come to be taken, since this is the domain of the next level of recursion down). This is registered by node "b" in S2 of the OEA. If the magnitude of the problem is within the scope of the management of the plant, this response action will come in the form of new instructions, for example readjustment of the production schedule by introducing overtime work. The new instructions are sent back to the operations (the production line in question). However, these instructions need to be transduced, i.e. to be converted into a detailed programme for implementation on the shop floor. This transduction stage is symbolised by node "2".

However, the receipt of information at "b" does not always lead to action on the part of the MUA. It could be that local management is in no position to remedy or stabilise the situation in the production line above, for example, when the situation develops to become a major failure in some of the machines, and replacements are needed. At this stage, the message is sent to the metasystem of the company (S3 in fig.10.5 above). This is indicated by node "c" from which information is relayed to S2 of the company at node "i", which in turn, passes it over to S3 at node "12" for action.

System two of the company is not a relay station between S1 and S3 as might be understood from the example of the production line (x) above. The role of S2 can best be understood when particular variety is generated by an oscillating behaviour between the two plants (OEA and OEB of fig.10.5 above). Suppose now that due to lack of money, the company disposes of one warehouse , leaving only one to be shared by the two plants. As a result of a decrease of production in the production line (x) of OEA, material stock begins to build up for OEA, and starts to affect and crowd the space occupied by OEB. The linkages between the operations of the two plants as presented by the squiggly lines in fig.10.5, ensure that the foremen in charge at the production lines (w) and (z) in OEB know about the difficulties ahead before MUB is informed about them. In addition, this same information is also relayed via "d" in OEA's S2 to the point "h" in OEB's S2.

The management of plant B must act to avert the situation developing where the warehouse is overcrowded by OEA's accumulating stock. Given the existing constraints and the autonomy of both plants, it cannot force MUA to get rid of the accumulated stock.

At the same time, however, messages telling about the situation in the warehouse are coming from both regulatory centres of OEA and OEB, received at points "c" and "g" respectively. Since the flow of information is continuous and in real time, statistical filtration models stored in S2 of the company are expected to predict the difficulties in the warehouse before oscillation sets in. The process of instability detection at this level is exactly the same as the one explained above regarding the production line (x) of OEA (one level of recursion down). That is because the information is homogenous throughout the VS, since we are dealing only with pure numbers.

Having an overall view of the situation developing in the warehouse, S2 can provide a contingency plan to reallocate space temporarily. This is sent on the return channel to the regulatory centres (S2s) of OEA and OEB where it is received at "d" and "h" respectively. However, decisions are already taken on the part of MUB to prepare for the difficulties ahead. Reprogramming of the operations is undertaken which would allow for the predicted fall in material stock owing to the lack of warehouse space. This response action in OEB follows the route: "5"--> "f"--> "8", where the necessary transduction is undertaken at "8" to convert the adjustment in programme to detailed rescheduling. At the same time, S2 sends the message to S3 informing it of the probable course of events in the near future.

System three (S3) is informed about the state of affairs in S1 (the two plants) through three distinct channels. Refer again to fig.10.5 above. The bulk of the information comes through S2. The latter, as we saw in ch.8, is a high variety channel. The information it receives regarding the expected difficulties at the production line (x) in the plant A is automatically passed over, after appropriate filtration, to S3 at node "12".

Complementary information arrives at S3 (node "9") via the accountability channel (the command axis) from MUA informing the management of the company of the problems at hand. This information is a low variety statement saying, for example, that the machinery at the production line (x) is no longer capable of producing the quantities required of it, and that new machines are needed.

The third channel, i.e. the S3 monitoring channel (S3m) or the parasympathetic channel [Beer, 1981], is that through which S3 assumes its auditing function of the operations at the plants. The information carried through the S3m channel is not expected to be in continuous flow as is the case of S2 and the vertical channel of the command axis. The information received at node "9" coming through S3m provides the management of the company with that extra information necessary (not supplied by S2 nor the command axis) regarding the maintenance of the machinery, the state of the warehouse, etc. Also the level of activity at the production lines which can throw some light on the efficiency or otherwise with which the available resources are used, and whether they are congruent with the latency index as calculated by S2.

With this arrangement (of fig.10.5), i.e. having satisfied the first axiom of management [Beer, 1979, 1985], S3 has requisite variety vis-a-vis the two plants, and can take action to answer their immediate needs. The mechanisms by which S3 deploys variety towards S1 is explained in the following. Consider the box labelled S3 in fig.10.5 above. It receives appropriately filtered routine information from the two plants via the company's S2 at node "12". If extra information is needed regarding a particular aspect (which could have been filtered by S2), it enquires about it at node "11". The information coming through the command channel is received at node "9". The return instructions to S1 are sent from point "12". Node "9" also represents a point of reception of the auditors' reports. The outward channel of S3m emanating from node "10", carries the enquiries of S3 concerning its auditing needs (financial and non financial) at the plants. The network connecting the four nodes, "9", "10", "11" and "12", inside S3 symbolises the continuous informational transactions inside S3 itself. It is clear from fig.10.5 that these informational transactions must have a metasystemic input of high variety from S4, informing S3 of the market conditions for which it must prepare the company, S3 being its internal regulator. This information is received at node "11".

The continuous outflow of this informational transaction is forwarded to various destinations for action. Out of node "11" to node "j" in S2 flows a new strategy for production (as the case may be) in order to adjust to the situation arising from the difficulties at the production line (x) of OEA. This is converted to a detailed tactical plan by S2 and sent to S2 of OEA to be received at node "9". After due process, the plan is transduced into a programme of production for the future. Another transduction process takes place at node "2", where programmes are put into actual schedules for production.

We are back again at node "j". In view of the new strategy received from S3, the tactical planning of S2 includes OEB as well. We remember that the situation at the warehouse, if left as it is will cause oscillation to spread. It falls upon S2 to provide the remedy, at least for the near future, having had the metasystemic input from S3. OEB receives the required modifications to its production plans, say, an increase in production at node "h". These arrive eventually at the production lines (w) and (z) as production schedules after being transduced at point "8".

Meanwhile, information is flowing out of S3 on the vertical command channel towards MUA. This is to instruct the management of plant A to formulate an investment plan to replace gradually the ageing machines of the production line (x).

However, the management of plant A is not expected to have full knowledge of the technological advances relating to the proposed investment. The access to that knowledge is available at the next level of recursion, i.e. at the company level. It is provided by S4 (which is not made apparent in fig.10.5 above) to S3 at node "11". This know-how cannot be transmitted on the vertical command channel because of a lack in channel capacity. On the other hand, it is not of routine type to be sent through the S2 channel. This know-how is supplied by S3 to OEA via the monitoring channel S3m, and made directly accessible to those in charge of the production line (x). The last (not the least) channel carrying information out of S3 is the one emanating from node "10" to provide the link with S4.

II.2 VARIETY ENGINEERING AND ENVIRONMENTAL INTERFACES

In the above section we exposed the dynamics of the process of regulating the VS internally, as examplified by the hypothetical company represented by fig.10.5 above. For the sake of the presentation, we now make an abstraction of the autonomic system of the company, i.e. "the inside - and - now" and consider the question of engineering with variety at the metasystem level. Our vehicle for this task is the same hypothetical company of the example above. Fig.10.7 is a diagrammatic representation of the variety engineering at the metasystem level.

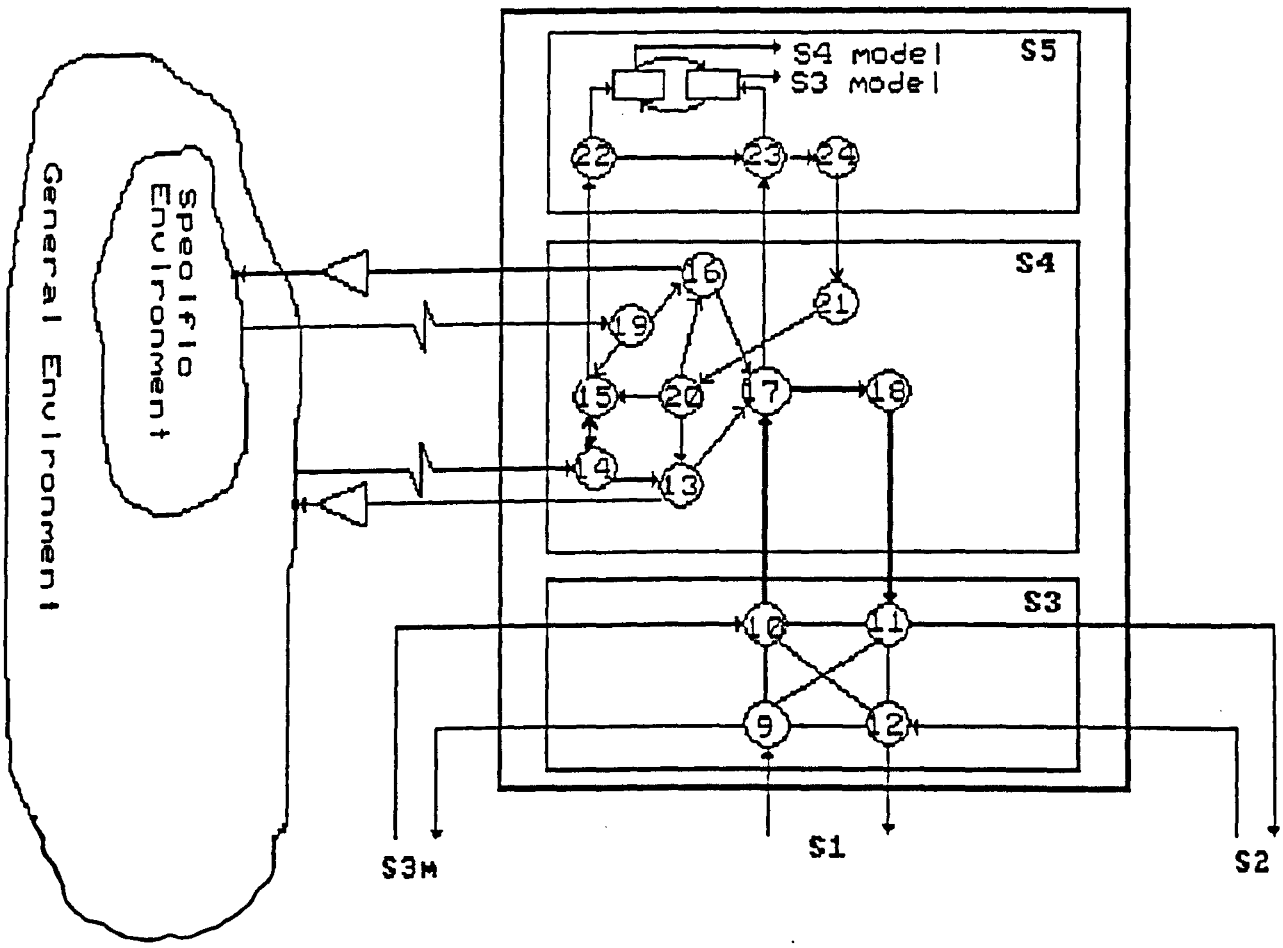


Fig.10.7. S3---S4 homeostat of the hypothetical company.

We return to the informational transactions inside S3 discussed above, but this time as they relate to S4. System three (S3) formulates a synergistic statement regarding the production situation of the two plants, which is the synthesis of its appraisal of the actual operations, and the predicted course of events in the future. This is accessible at node "10", and is then passed over to S4 at point "17". This synthesis is supplemented by separate appraisals, for each plant, from S2 (through S3). It is important that S4 gets the full picture (not all the information) of the evolution of the production situation in both plants, particularly the state of affairs in the production line (x) of plant A. This importance stems from the fact that for S4 to evaluate the impact of its findings regarding market opportunities for expansion and launching new products as gathered at node "14", it needs to know the production capacities of the plants, for which the predicted state of the production line (x) will prove an immense handicap.

We continue with the scenario at S4. Here we can see two loops connecting S4 of the company with the two components of the environment: the general and the problematic (or specific). It is assumed that S4 is engaged in only two activities, the one dedicated to the problematic environment is to do with research and development (R&D). The second activity is concerned with market research and is set to probe the general environment. From fig.10.7 we can see that each loop (each activity) is in continuous interaction with the environment.

The intelligence gathered by the R&D activity is related to technical advances and the latest innovations in the field of domestic appliances, and the chances of the company keeping at the forefront. This information is made available at node "19". Through the second channel, received at node "14", flows information regarding market conditions. For the sake of this exposition we assume that assessment of the market indicates that the company can seize an opportunity to increase its share of the market. The filtered information, regarding these two activities, is passed over to S3 through the route "17" --> "18" --> "11", to be despatched to S1 via S2 at node "j" (fig.10.5). Just as S3 provides a synthesis (for S4) of the two plants' operations A and B, so does S4 of its intelligence activities. At point "17", S4 formulates this synthesis, where it is received at node (11), via (18), in S3. The loop "17"--> "18" --> "11" --> "10" --> "17", being in continuous operation, implies that feedback information is available at both ends of the loop. It also implies that variety is continuously added at nodes "10" and "17", following a change of state in S3 and S4 respectively.

The high variety flow between S3 and S4 is continuously monitored by S5. Its task (see last chapter) is to keep the S3 -- S4 homeostat in balance, within the confines of the third axiom of management. This axiom states that: "The variety disposed by System Five equals the residual variety generated by the operation of the second axiom" [Beer, 1979: p.298]. We know that S5 cannot possibly deploy requisite variety to take in the colossal variety flowing in the S3 --- S4 homeostat. However, to accommodate Ashby's law, S5 houses inside itself models of S3 and S4, and of the homeostat.

Let us now consider the involvement of S5 in the dynamics of the VSM. We refer once again to fig.10.7. S5 is informed of the internal regulation of the VS from S3 at point "10" via point "17" in S4, to reach S5's model of S3 (in S5 box). At the same time S4 sends its messages regarding the company's position in the market, and the technological advances, as gathered by its two activities, at node "15". This is relayed by node "22" and linked to e S5's model of S4. S5's contribution is seen here to be absorbing that residual variety left unattended to by the S3---S4 interaction. Take, for example, a decision to embark on a new venture. S3 is expected to advocate the status-quo, and the necessity to concentrate on the modernisation of the existing facilities, particularly the renewal of the machinery of the production line (x). On the other hand, S4 will insist on taking the opportunity before it becomes common currency in the market. An issue of this nature can be settled only by S5, because of its metasystemic position vis-a-vis S3 and S4.

Another loop is operating linking S4 with S5. This is intended to supply feedback to S4, at the same time keeping S5 informed of the intelligence activities of S4. The information gathered by S4 about the outside world is made accessible at point "15" to be received by S5 at point "22". This, together with the filtered information flowing from S3 at node "23", leads to change of state in S5. This change of state is communicated on the return loop which starts at node "24" in S5's box, back to node "15", through "20" in S4. From node "20", S5's feedback information is communicated to the two intelligence activities of S4 at nodes "16" and "13".

The full picture of the overall dynamics of the VSM is presented by the diagram of fig.10.8. This diagram depicts

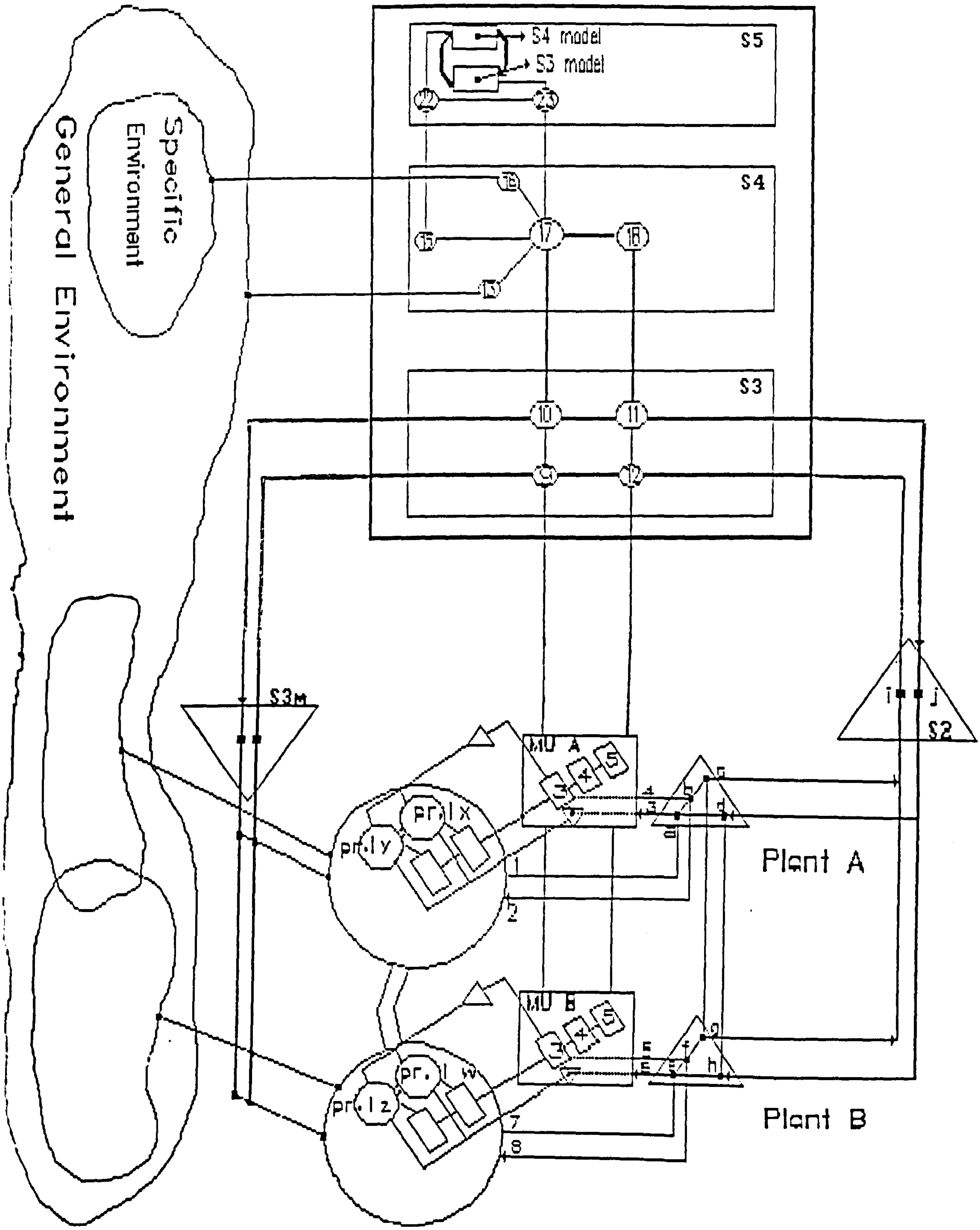


Fig.10.8. The full picture of the dynamics of the VSM.

the company (the VS) as a closed network of communication, where variety flows continuously with no beginning or end. It is clear that fig.10.8 is a simple joining together of fig.10.5 and fig.10.7 to produce the full picture of the VS with two recursions.

The same dynamics and network could be mapped, isomorphically, to the plant level, just by shifting our focus one level down. The noticeable difference would be the degree of detail involved. For example, the performance indices at the plant level will be specific to the machines in the production lines, rather than being relevant to the outcomes from the production lines themselves. The same argument is equally valid if the shift of focus was one level of recursion up, where the company in question is an OE in the industrial sector, or an OE in the region where it operates, depending on the recursive dimension opted for. Whatever the focus, according to the theorem of recursive systems [Beer, 1979, 1981], the VS structure is always recursive, in the sense that the organisation structure is exactly reproduced by its OEs.

PART III

CYBERNETIC DIAGNOSIS OF GCL

SUMMARY

We are now equipped with a theoretical background and a model with which we can embark on an empirical invesigation. In this last part of the research we attempt to map the VSM onto an actual organisation.

We begin in chapter eleven by presenting the historical background of the system to be modelled, namely GCL (Groupe Commercial), i.e. the Commercial Group. Through this evolutionary perspective we will gain the understanding of GCL which is necessary for the modelling process in the following chapters.

Chapter twelve is a discussion of the system in focus. It is included to clarify certain issues concerning the position of the organisation in question (GCL): on the one hand, the position of GCL vis-a-vis the parent organisation; on the other the identification of the would-be operating elements (OEs) of the system.

The whole of chapter thirteen is dedicated to S1 of the organisation. The approach adopted is to first describe the existing situation, then to give a proposed alternative structure, followed by a discussion of the corresponding information network.

The same logic is followed in chapter fourteen regarding

the internal regulation of the system modelled. Owing to the importance of the coordination channel, we will subdivide S2 into subsystems. However, these subsystems will remain under the umbrella of one S2. The same is true of the monitoring channel. The last section of this chapter will be dedicated to the control function (i.e. S3) of GCL.

We will end Part III with chapter fifteen, in which we will discuss the intelligence and policy functions of our organisation.

The purpose of part III is to demonstrate that only the VSM is capable of providing an organisational model suitable for guiding the complex task of information system design and information processing in GCL. The hierarchical thinking which completely governs the information flows in GCL causes many poroblems for the efficiency and effectiveness of this organisation. This hierarchical thinking is the product of the traditional model of the organisation.

We leave to part IV the conclusion and recommendations, the attempt to bring together the learning gained from the theoretical parts I and II of this thesis and the learning gained from our practical example in part III.

Chapter 11

SETTING THE SCENE:
THE GENESIS OF GCL*

This chapter is intended to provide background information for the remaining chapters of part III. With the objective of making it easier for the reader to follow the exposition of the chapter, it is thought appropriate to summarise the extensive data and material of the chapter in the following sections:

.Historical background. Knowledge of the evolution of GCL is important to an understanding of the conditions which led to the restructuring of the national economy. It also helps us to appreciate the pivotal role which GCL plays in the economy as a whole and in the steel industry in particular.

.Reorganisation of the Steel Industry. We try to explain in this section the important step taken by the Algerian government in relation to the management of the economy, involving a decision to switch from centralised to decentralised management of the economy. We deal with how decentralised decision making affects GCL.

.The organisation of GCL. An attempt is made here to describe the functioning of GCL. The basic tool for this description is the organisation chart. Particular emphasis is given to that part of GCL (the sub-directorate for the internal market, S/D MI) which supervises the operations of the regional outlets, i.e. the operational level of GCL.

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* GCL = Groupe Commercial (Commercial Group)

This section is necessary for later chapters,when we come to diagnose of the ills of GCL.

.The difficulties associated with the commercial activity. Owing to lack of space, only a few of the problems are highlighted. However, the reader will gain full understanding of these problems after reading the rest of part III.

.The GCL information system. It will be found in this section that GCL has two types of information system: general systems and specific systems. From their description it is hoped that one may appreciate the difficulties encountered by management with these systems, particularly at the operational level (the regional level).

Before we begin, it is worthwhile giving an indication of the volume of GCL activity [GCL/ EPO, 1984(a)]. This is summarised in table 11.1 below.

Item	1983	1984	1989*
Imports (tons)	2,614,511	2,511,699	4,600,000
No. of Employees	3,897	5,177	6,450
Dist Network (PSs)	33	40	60
Transport and weighing equipment (vehicles, cranes,)	650	-	1280

Table 11.1. GCL's resources and the volume of its activity.

* estimates

I. HISTORICAL BACKGROUND

In order to put the system, i.e. the object of our intended application, in its proper perspective, it is appropriate to go back in time and trace its origins and follow its evolution over the past two decades. GCL came into existence as part of SNS, which was an Algerian public sector company. It was one of the "big sisters" which made up the heavy industrial sector of the Algerian national economy, ever since its creation in 1964 [Decret, 1964]. These companies were:

SNS = Societe Nationale de Siderurgie (National Steel Company).

SONAREM = Societe Nationale de Recherche et Exploitation Miniere (National Company for Research and Exploitation of Minerals).

SONELEC = Societe Nationale d'Electronic (National Company of Electronics).

SONACOME = Societe Nationale de Construction Mecanique (National Company of Mechanical Construction).

SN METAL = Societe Nationale de Construction Metallurgique (National Company of Metallurgical Construction).

These companies were important parts and tools, of the strategy of the government in the process of economic development of the newly independent country. The explicit mission, as stated by the government, of SNS (and of the others, each in its own field) could be summarised as:

.Regain control of the driving seat of the economy in the field of steel production and commercialisation of steel products.

.Launch the industrial base of the economy, which was seen as a necessity in order to consolidate political independence with a true economic independence.

To achieve its objectives the government of the day invested heavily in the industrial sector of the economy, namely the five (relatively) big sisters. So, for SNS the period from 1964 to the early years of the seventies could be termed as the creation phase [SNS, 1980]. It was characterised by intensive investment to build up the steel industry. The resources were channelled towards the importation of technology and the construction of factories, particularly the steel complex of El-Hadjar in the east, which later became the cornerstone of the steel industry in the country. During this phase, little attention was given to the organisational aspects of SNS nor to its information system. Although the first attempt to introduce computerised data processing was made during the year 1969, the outcome was very modest. It consisted of a payroll of employees and a simple computerised accounting system.

The second phase in the development of SNS, i.e. 1972-80, can be distinguished as that of growth and expansion of activities. This is paralelled by an effort to provide the company with an organisational structure compatible with its increased size and complexity. This is reflected in the move of central management to allow a degree of financial autonomy to its operating units, i.e. "directions operationnelles", one of which was GCL. This is in line with the general rules set out by the government regarding the socialist management of any public company in the economy, i.e. the GSE (Gestion Socialist des Entreprise).

The diagram depicting the organisation structure of SNS appears as Appendix A. From this chart we can distinguish three levels of authority:

1.The Director General (i.e. le Directeur General, DG), who is the highest executive authority in the company.

2.The second level of authority is made up of the central directorates. These are subdivided into two types:

a.The Staff Directorates, i.e. "Directions Fonctionnelles".

b.The Operational Directorates, i.e. "Directions Operationnelles".

3.The third level of authority is that of the units, i.e. the organisational entities which carry out the actual tasks of the company. As can be seen from the chart (Appendix A), these are responsible directly to the operational directorates.

The standard structure of any productive unit in the economy, as set out by GSE (which applies to the units of SNS), can be summarised as consisting of the following [GSE, 1974]:

1.The manager of the unit (le Directeur d'Unite), who is appointed by the DG of SNS.

2.The board of management (le Conseil de Direction) of the unit. This assists the manager in carrying out the tasks of management. The number of people on the board varies between seven and nine members, depending on the size of the unit. Two of these are elected by the workforce.

3.The workers' assembly (l'Assemble des Travailleurs) of the unit. The number of members varies between seven and twenty five, depending on the size of the workforce. They are elected by the workers.

4.The permanent commissions of the units, for example hygiene, security, disciplinary, etc.

This same structure is reproduced for SNS as a whole, where the DG is appointed by the Minister of Industry.

The accelerated rate of economic development did not go as smoothly as the government expected. After some time, the costs of production proved to be excessively high. This fact had a direct effect on the financial equilibrium of the companies involved. The core of the economic strategy of the government was to form an industrial base for the economy, by concentrating on the industrialising industries (les industries industrialisantes). This strategy, necessarily, was totally dependent on the transfer of technology from the world market.

These two characteristics of economic policy, i.e. heavy investment in industry and total reliance on outside technology have resulted in two major side effects which subsequently led to the reshaping of the whole economic strategy at the beginning of this decade. One of the problems was that the public companies became giants, by local standards, and their control proved difficult. In addition to their growth in volume and in complexity of operations, the transfer of technology from the industrialised world brought with it managerial methods unadapted to the local conditions. It proved eventually to be the case that the technical know-how was far easier to absorb and master than the know-how related to the techniques of scientific management, owing to the social content of the latter. This has led to a certain rigidity in the functioning of the economy and to the bureaucratisation of management in the industrial sector.

A political decision was taken at the end of the seventies to look into the overall economic strategy. An "ad hoc" commission was set up at the highest levels of authority [FLN, 1980]. The recommendations of this commission were that reorganisation of the economic institutions and decentralisation of decision making constituted the essential means by which to solve the problems of the economy [ibid]. With this political decision to restructure the economy, SNS had entered the third phase of its evolution. This phase began in the early eighties and, in fact, marked the end of SNS as it was known.

II. REORGANISATION OF THE STEEL INDUSTRY

The reorganisation of the steel industry led to the disintegration of SNS into 14 independent enterprises* [CCRE, 1981]. Three of these do not strictly deal with steel products. Four specialise in the construction of steel works. Three other enterprises were created to supply consultancy services for those operating in the steel industry: one in the east, another in the centre, the third in the west of the country. The last four are strictly steel enterprises, they are:

.Entreprise de Promotion de Produits Siderurgiques (Enterprise for Promoting Steel Products).

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* Notice the new appelation of enterprise instead of company. This reflects the new emphasis of the government on the commercial viability of the newly created units.

.Entreprise de Tubes et Transformation des Produits Plats (Enterprise of Tubes and Transformation of Flat Products).

.Entreprise de Transformation des Produits Longs (Enterprise for Transformation of Long Products).

.Entreprise Siderurgique (production d'acier, laminoirs), (i.e. Steel Enterprise), which is now known as l'Entreprise Nationale de Siderurgie, ENS (the National Steel Enterprise). This includes the Commercial Group (GCL) of the old SNS.

II.1 THE NATIONAL STEEL ENTERPRISE (ENS)

The mission and scope of activity of the new enterprise is defined as: "within the framework of the national plan of social and economic development..., the enterprise (i.e. ENS) is in charge of research, development, production, import, export and distribution of steel and metallurgical products, and the elaboration and primary transformation of other metals such as zinc, copper..." [ENS, 1984(a)].

The organisation chart of ENS is almost an exact reproduction of the organisation chart of the old SNS, it is depicted in fig.11.1 below. In this diagram we find four staff structures (structures fonctionnelles) referred to as Directorates (Directions):

1. La Direction de l'Administration Generale, or DAG (The Directorate for General Administration).
2. La Direction du Personnel, or DP (The Personnel Directorate).
3. La Direction Financiere, or DF (The Finance Directorate).
4. La Direction du Developpement et de la Planification

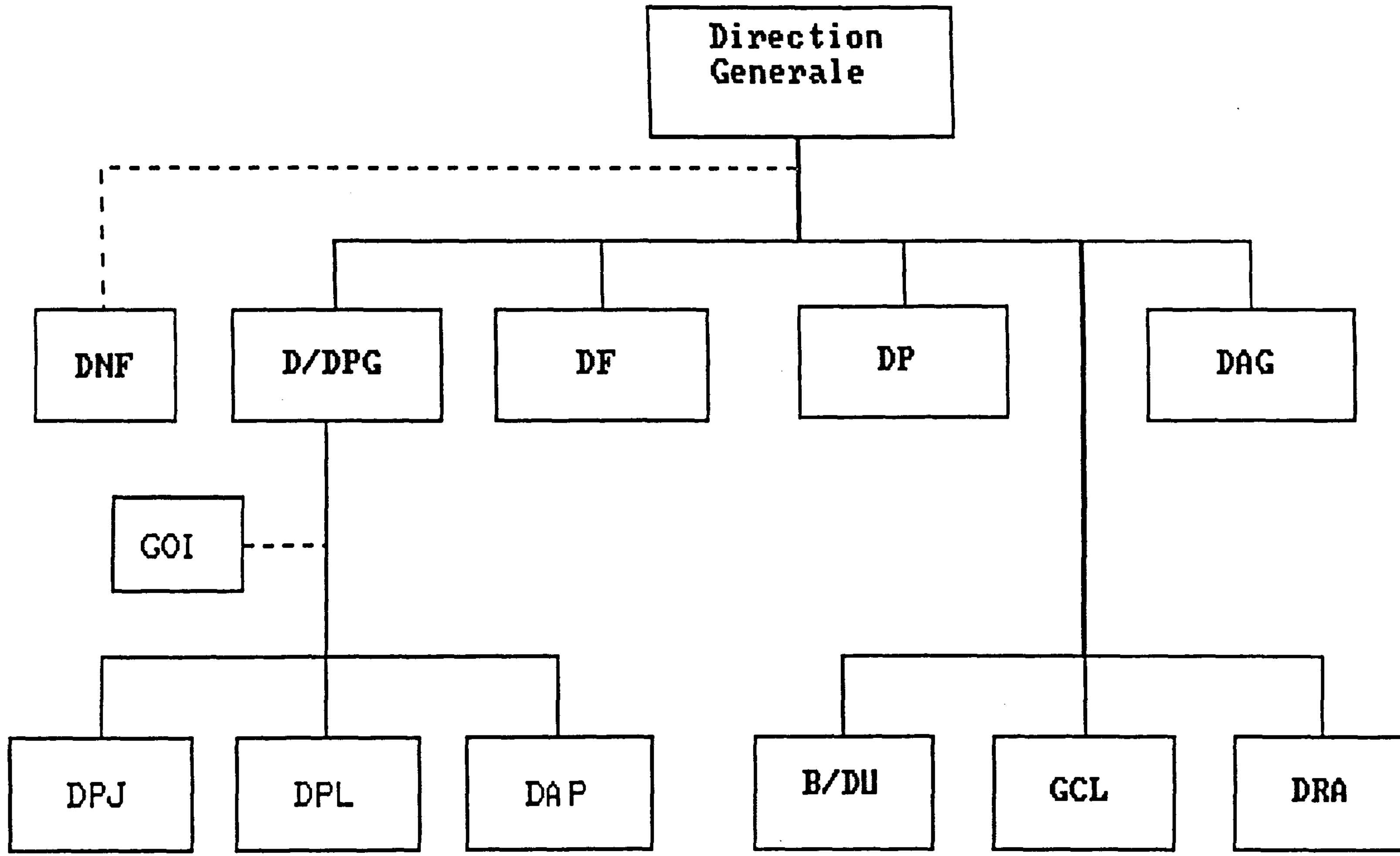

Fig.11.1. The organisation chart of ENS.

Generale, or D/DPG (The Directorate for Development and Planning).

The operational side of the enterprise constitutes the following directorates [ibid]:

1.Le Complexe Siderurgique d'El-Hadjar, or B/DU (The Steel Complex of El-Hadjar).

2.Le Groupe Commercial, or GCL (The Commercial Group).

3.La Direction de Recherche Appliquee, or DRA (The Directorate for Applied Research).

4.Three projects in the process of realisation (DPJ, DPL, DAP). These are considered as operational directorates, and will be treated as such once they become operational. However, at this stage they depend, organisationally, on D/DPG which also assumes organisational responsibility for the computer services group GOI (Groupe Organisation et Informatique) [MIL, 1984].

5.la Division des Non-Ferreux, or DNF (The Division of Non-Iron Products). This has now become an independent enterprise under the name of Entreprise des Materiaux Non-Ferreux. However, during the restructuring process in 1984 it was placed under the tutelage of ENS while awaiting a final decision for MIL (Ministere de l'Industrie Lourde, i.e. the Ministry of Heavy Industry).

III. THE ORGANISATION OF (GCL)

GCL is considered as an operational element of ENS (refer to fig.11.1 above), with explicit mission for:

a.The monopoly of import and export of steel and metallurgical products (SMPs).

b.The monopoly of the distribution of SMPs through its regional units all over the country.

III.1 THE ORGANISATION CHART OF GCL

As can be seen from fig.11.2 below (and Appendix C), the same logic of the previous organisation charts (SNS and ENS) was applied in the elaboration of GCL's organisation chart. The figure also makes explicit the pyramidal nature of the structure of GCL, characteristic of a bureaucratic organisation (refer to ch.3). Also like the old SNS, and like its parent organisation ENS (refer to section II above), GCL is organised in terms of staff and line functions.

As it will become useful later (chs.13, 14 and 15), it is thought appropriate here to describe in detail the organisation chart of GCL. This description will on the one hand allow us to appreciate the bureaucratic structure of GCL, and on the other hand, will assist the future diagnosis of the structural ills of the latter.

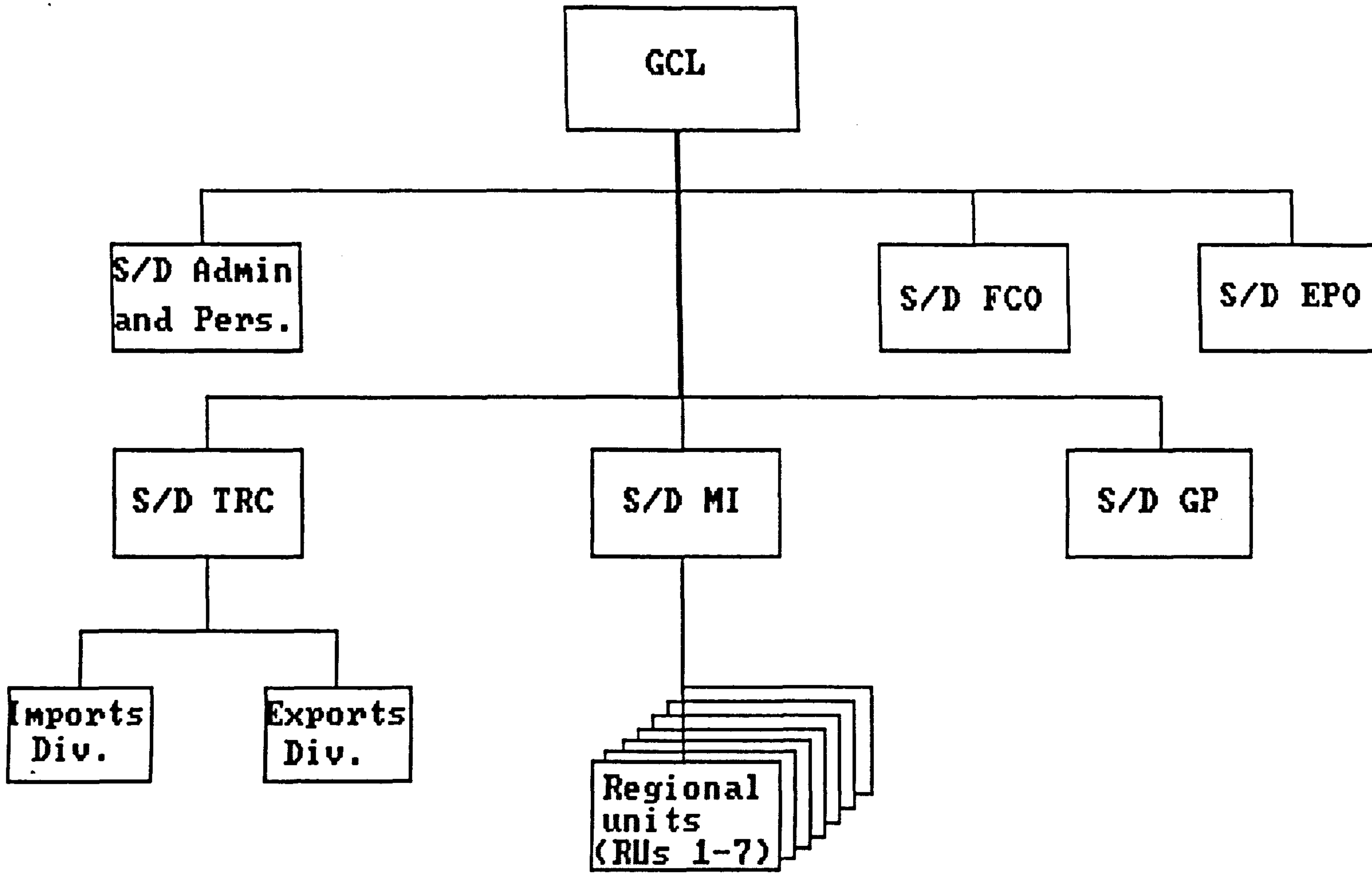

Fig.11.2. The organisation chart of GCL.

III.1.1 THE STAFF FUNCTION

The staff function is undertaken by what are referred to as "Structures Fonctionnelles". The function of these is that of "animation, coordination et control" [ENS, 1984 (b)], and it is divided as follows (refer to fig.11.2):

1.La Sous-Direction des Finances et Comptability, or S/D FCO (The Sub-Directorate of Finance and Accounting). This has the task of control and coordination of the budgeting, financial, accounting and fiscal activities of the operational side of GCL, also the legal dealings (legal suits, etc.) of GCL with suppliers and customers. The figure above shows that S/D FCO has five departments to allow it to carry out these tasks.

2.La Sous-Direction du Personnel et de l'Administration General, or S/D PAG (The Sub-Directorate of Personnel and General Administration). This looks after the administrative and personnel affairs of GCL through two departments: Administrative Department and Personnel Department.

3.La Sous-Direction Etudes, Planification et Organisation, or S/D EPO (The Sub-Directorate of Planning and Organisation). This sub-directorate has responsibility for planning the activities of GCL in relation to:

.Placing the orders for material stock at the factories of ENS or for imports from the world market.

.Consultancy in the area of computer applications to the other parts of GCL.

The tasks assigned to S/D EPO are carried out by three departments:

.Departement Etudes Generales et Planification, which could be translated as Market Research and Planning Department.

.Departement Programmation (Programming Department).

.Departement Organisation et Informatique (Department of Organisation and Computer Applications).

Added to these staff structures, we have the Department of Documentation and Statistics, which is attached directly to senior management.

III.1.2 THE OPERATIONAL FUNCTION

The operational structures are three in number:

1.La Sous-Direction des Transactions Commerciales, or S/D TRC (The Sub-Directorate of Commercial Transactions). This has the task of:

.Supplying the home market with steel and metallurgical products (SMPs) from outside markets.

.Exporting the surplus of SMPs to the world market.

.Looking after the supply to the factories of ENS and other companies of raw materials and semi-finished goods.

Organisationally, S/D TRC is made up of two divisions:

a.Division Importation (Imports Division). This has the mission of supplying the home market (from abroad) with the necessary SMPs. It is organised in four departments:

.Departement Achat Produits Siderurgiques, (Steel Products Purchasing Department)

.Departement Achat de Tubes (Tubes Purchasing Department).

.Departement Gestion des Achats (Purchasing Management Department)

.Departement Comptabilite et Suivi de Gestion (Management Accounting Department).

b.Division Exportation (Exports Division). The mission of this is to export the surplus of SMPs for the country. It is organised in three departments:

.Departement Ventes des Produits Siderurgiques (Steel Products Sales Department).

.Departement Ventes Non-Ferreux (Non-Iron Products Sales Department).

.Departement Gestion des Ventes (Sales Management Department).

In addition to these two divisions, there is the "Departement Approvisionnement des Matieres Premieres et Demi-Produits (Department of Supply in Raw Material and Semi-Finished Products) which is responsible to the manager of S/D TRC.

2.La Sous-Direction de Gestion des Projets, or S/D GP (The Sub-Directorate of Project Management). After the reorganisation of ENS (subsequently GCL), it was expected that GCL would have a depot in every local authority of the country. S/D GP is in charge of the realisation of this task.

3.La Sous-Direction du Marche Interieur, or S/D MI (The Sub-Directorate of the Home Market). This is by far the most important structure of GCL. Its mission is the distribution of the SMPs for the entire country. In order to fulfil this mission S/D MI has been given responsibility for [ENS, 1984(b); Boutine, 1987]:

.Creation and management of a data bank for all the commercialised SMPs.

.Carrying out market research of the home market.

.Launching and promoting nationaally manufactured products.

.Within the framework and guidelines of the pricing policy set out by the government, S/D MI has responsibility for setting and implementing the pricing policy of GCL regarding SMPs.

.Contributing to planning the distribution policy for the SMPs. In this respect, it has to:

.Liaise with S/D TRC regarding the programming of the orders placed by the regional units.

.Receive the ordered quantities at the ports.

.Deliver the products to the points of sale in the regions.

.Improve the relationship betwen GCL and its clients.

.Create new regional units when necessary.

.Elaborate and diffuse of the commercial documentation of GCL's activities.

.Represent GCL in international and national fairs and exhibitions related to SMPs.

III.1.2.1 THE ORGANISATION OF S/D MI

Given the importance of S/D MI to the overall mission of GCL, it is thought appropriate to elaborate on its structure and to consider its constituent departments individually. This is also necessary for the purposes of later chapters. Fig.11.3 below represent S/D MI's organisation chart. Once again the same organisational logic applies. All the departments are considered as staff structures and the regional units are considered as operational structures.

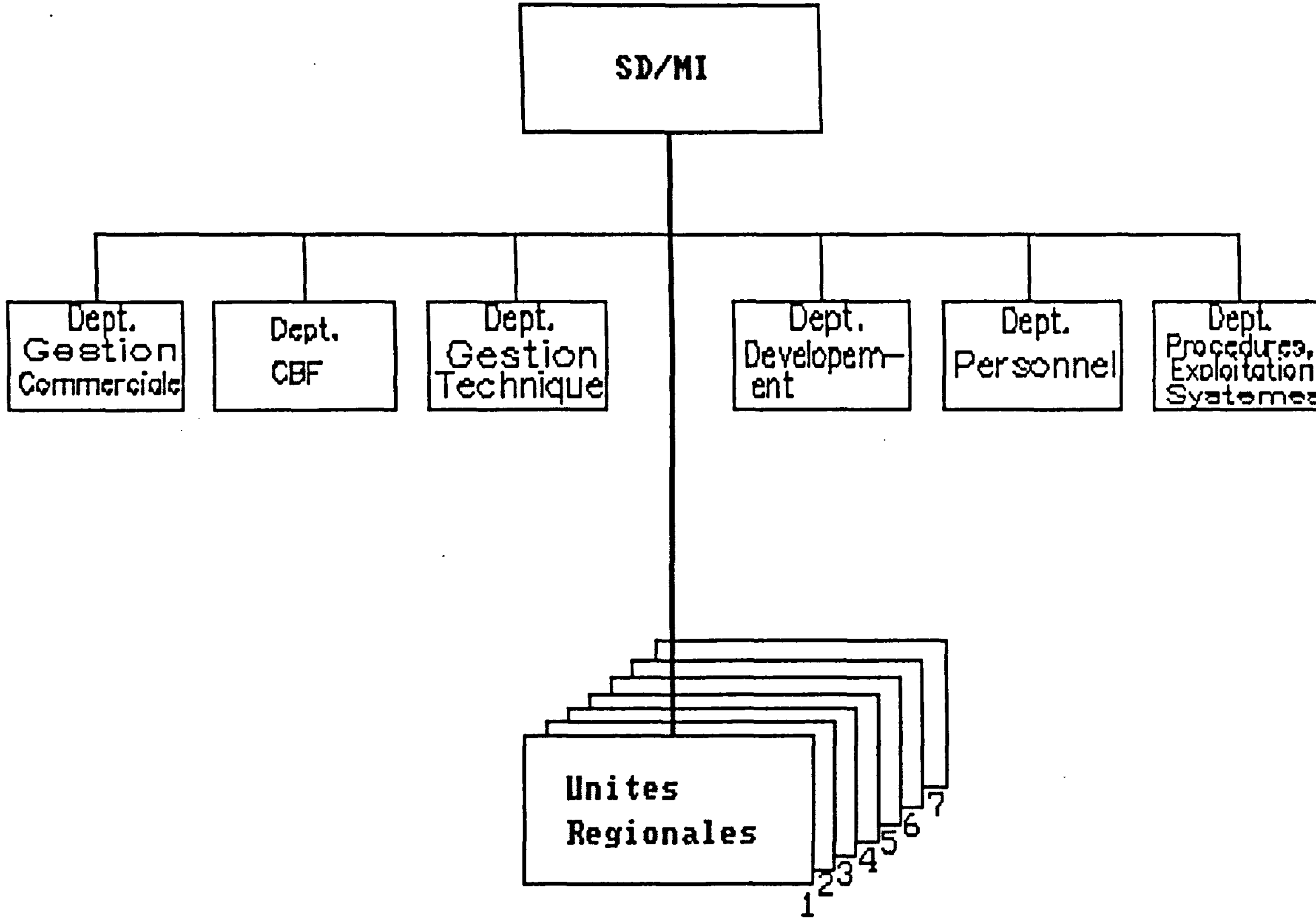

Fig.11.3. The organisation chart of S/D MI.

From fig.11.3 we can guess that S/D MI is heavily staffed. Let us consider the task of every department as laid down by senior management:

1.Departement Gestion Commerciale (Commercial Management Department). Its tasks are:

.Elaboration of the product catalogue.

.Determination of the products' prices.

.Analysis, orientation, coordination, development and control of the commercial activities of the regional units.

.Administering the "litiges" (disputes) with the business partners of GCL, i.e. (home) suppliers and customers.

.Carrying out research into the home market (see ch.15).

.Management of the transactions between the regional units.

2.Departement Comptabilite Budget et Finance, or CBF (Accounting Budgeting and Finance Department). This department has the following tasks:

.Coordination and control of the regional units regarding aspects of elaboration and presentation of accounts and budgets.

.Analysis and centralisation of the accounting data, taxes, and financial statements.

.Planning and control of the financial resources of the regional units.

.Auditing of accounts.

.Looking after the accounting function of S/D MI.

3.Departement Gestion Technique (Technical Management Department). This department assumes the folowing tasks:

- .Elaboration and implementation of procedures regarding acquisition and use of equipment by the regional units.
- .Management of spare parts of the regional units.
- .Inspection of the equipment in the regional units.
- .Assisting the regional units in the programming of equipment renewal.
- .Management of the central depot of spare parts.
- .Participating in the elaboration of the technical specifications of the projects for warehouse and depot construction.
- .Participating in the choice of proposed equipment for purchase by the regional units.

4.Departement Developpement (Development Department). This department has the task of planning the future development of the distribution network over the territory.

5.Departement Personnel (Personnel Department). This department is concerned with development, coordination and control of personnel aspects of the activities of the regional units.

6.Departement Procedures et Exploitation Systemes (Department of Procedures and Systems Implementation). This department has responsibility for the development and implementation of computer applications.

We come now to the operational side of S/D MI. This is assigned to the regional units (RUs), referred to as "Unites Regionales" (Directions Regionales or DRs in the days of the old SNS). The network for the distribution of steel and metallurgical products (SMPs) consists of seven regional units. They are scattered along the coastal line east - west, in the north of the country. Part of the logic behind this geographical allocation of RUs is the availability of ports in particular regions, since a large proportion of SMPs are imported from the outside market. Another factor is the heavy concentration of population in the north of the country. The RUs are, from west to east:

1. Unite Regionale de Mostaganem: URM (Regional Unit of Mostaganem).
2. Unite Regionale d'Oran: URO (Regional Unit of Oran).
3. Unite Regionale Centre: URC (Regional Unit of the Centre).
4. Unite Regionale de Blida: URBL (Regional Unit of Blida).
5. Unite Regionale de Bejaia: URB (Regional Unit of Bejaia).
6. Unite Regionale de Skikda: URS (Regional Unit of Skikda).
7. Unite Regionale d'Annaba : URA (Regional Unit of Annaba).

The organisation chart of any RU is standard (refer to Appendix B). The sales activity of an RU is handled through its points of sale (PSs) "Points de Ventes". The total number of these Points of Sale for all the RUs is currently 40. This number is expected to reach 60 towards the end of this decade.

The tasks of an RU are defined by senior management as follows (see ch.13 and ch.14):

.Billing and reception of payments from customers.

.Carrying out certain accounting, taxation and financial operations regarding their own activities.

.Reception of the imported merchandise at the ports and settling of the customs formalities.

.Inventory and stock control.

.Supplying the local retailers (revendeurs agrees) with SMPs.

.Preparing sales budgets.

.Maintenance of the equipment, warehouses, depots, etc.

III.1.3 MANAGING THE DISTRIBUTION OF SMPs

Having dealt with the organisational structure of GCL and highlighted the importance of S/D MI within it, it is worthwhile to deal briefly with the important question of how the sales (distribution) activity is carried out. The actual selling of SMPs is carried out by the regional units. However, as can be seen from the organisation chart of S/D MI, the central services of the latter are heavily involved. This point will become clear later in ch.14.

Two structures are directly involved in performing the task of selling SMPs. One of these is central, the other is regional. The central structure carries the name of "Le Service Central de Coordination Commerciale", or SCCC (The Central Service of Commercial Coordination). It is a service belonging to the Commercial Management Department (Departement de gestion Commerciale) in S/D MI. The regional structure is situated in every RU and is referred to as the "Division Regionale Commerciale", or DRC (Regional Commercial Division). It is organised in three services (refer to Appendix B):

1.Service Regional de Gestion de Stock, or SRGS (Regional Service for Stock Control).

2.Service Regional des Ventes Interieures, or SRVI

(Regional Service of Sales).

3.Service Regional de Recouverement, or SRR (Regional Service of Credit Management).

III.1.3.1 THE TASKS OF SCCC

The organisation chart of the "Service Central de Coordination Commerciale" or SCCC (the Central Service of Commercial Coordination) is depicted in fig.11.4 below. SCCC discharges its function in the following fashion:

.The centralisation of all the documents related to the movements of SMPs, i.e. these documents are verified (for mistakes, ommissions, etc.), processed, then passed over to the accounting service (in department CBF of S/D MI).

.Management of the central file of stock. This file is the aggregation of the files of the sales points in the regions.

.Control of stock of all the regional units. This control is carried out on the basis of the central file (2. above) compared with the monthly reports and periodic inventory reports from the regional points of sale. In the case of a discrepancy between the reports from the regions and its own file (which often occurs), SCCC is expected to initiate an investigation to find out the cause.

.Centralisation of stock ordering. SCCC receives regional orders for stock from SRGS (Service Regional de Gestion de Stock) of the RUs (see ch.14). These orders are accompanied by a copy of the calculation procedures for the Economic Order Quantity (EOQ), and for levels of stock. Before any decision can be taken, SCCC ensures that the parameters used in the calculation are in order (refer to ch.14).

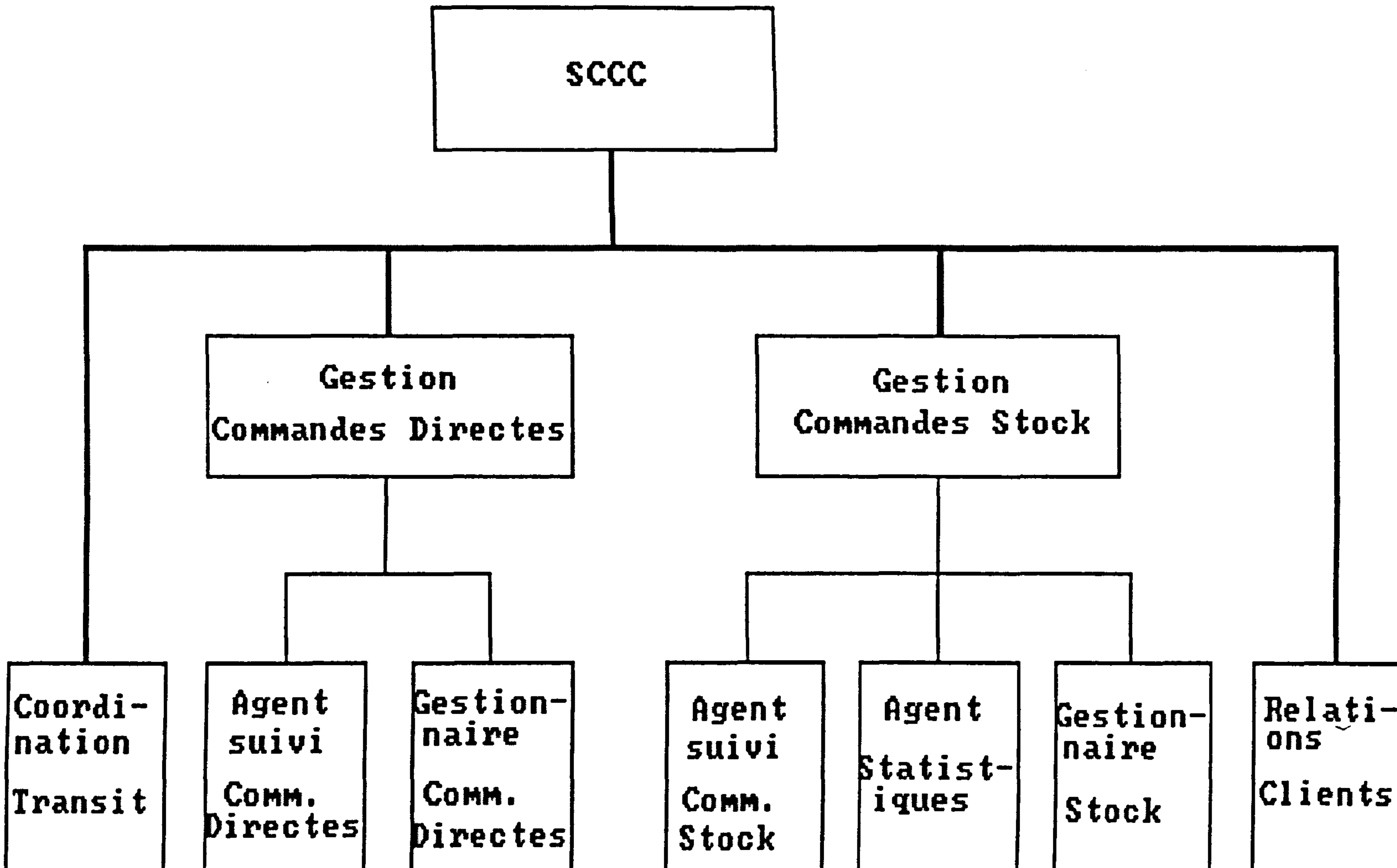

Fig.11.4. The organisation of SCCC.

After that, the order is either passed to EPO (refer to the organisation chart of GCL in Appendix C), or the RU in question is replenished from a neighbouring region. The procedures for stock ordering and the values of the parameters used in the formulas by the SRGS are provided by SCCC in an elaborated manual [GCL, 1976].

III.1.3.2 THE TASKS OF SRGS

Every RU has a SRGS. In carrying out its mission of supervising the PSs of the region it has to:

.Supply and replenish the local points of sale with SMPs, i.e. SRGS establishes with the collaboration of those in charge at the points of sale the sheet for replenishment (feuille de reapprovisionnement). On the basis of the monthly reports from these points, it establishes the need for SMPs at the regional unit.

.Control the monthly reports of the local points of sale, out of which it establishes a monthly report for the region, to be sent to SCCC. The report contains the stock required by the region, the stock run-outs, etc.

.Participate with SCCC in the elaboration of the rules of stock ordering and of the parameters used in the formulas (refer to ch.14). SRGS is in charge of the whole ordering process from initiating the order to its reception at the local sales points. It is informed of the arrival of the SMPs at the ports in the case of imports, or their expedition from factories, in the case of domestically produced SMPs. Following the reports it receives from the local points of sale, SRGS proceeds to the delivery of material from the ports and/ or factories to the relevant point of sale.

The regional unit's requirements for SMPs is calculated on the basis of the aggregation of the expected sales of all the points of sale in the region. We will come back to the question of sales management and customer demand forecasting in chapter 14.

IV. PROBLEMS ASSOCIATED WITH THE DISTRIBUTION OF SMPs.

Let us now recapitulate and consider some of the difficulties encountered by those structures directly involved in the commercialisation of SMPs. We have seen above that S/D TRC is in charge of transactions with outside suppliers of GCL. Within this sub-directorate there is a service (within departement Achat Produits Siderurgiques, the import division of S/D TRC) in charge of dealing with ships carrying SMPs when they arrive at the ports. However, in practice, more often than not, this service is not aware of the arrival of the ships. One of the consequences of this ignorance is that the merchandise is discharged without inspection. When it is received at the depots of the local points of sale, on many occasions the merchandise is found to be not up to expectations in terms of quality and/ or quantity. A combination of bad programming and external forces outside the control of the service makes it difficult to know when to expect the arrival of the ships at the ports.

Another major problem concerning the reception of SMPs at the ports is the failure arrival of the documents required for customs purposes to arrive in time this prevents the merchandise from being cleared by customs officials in order to leave the port. The transmission of these or any other documents between the structures involved takes an excessively long time.

A further source of the difficulties encountered in the reception of the imported merchandise at the ports is the difference in the timing of night working and break hours between GCL and EPAL (Entreprise Portuaire ALgerienne). For EPAL the night shift is 9pm - 3am, while for GCL it is 9pm - 5am. This incompatible timing results in considerable slack time for GCL, in that the two groups of workers take their breaks at different times. Also, the time spent by GCL's workers after the departure of the EPAL workers (i.e. 3am - 5am) is relatively unproductive.

In general terms, although the level of activity of GCL has increased considerably, its working procedures go as far back as the mid-seventies when GCL was part of the now-extinct mother company SNS. The restructuring process did not affect the bureaucratic logic of GCL's working procedures, in fact they were never questioned. The slowness of the system has led to people taking detours (or what they call "voies empiriques") around the formal channels. Some services, or even departments have become entirely redundant. As far as they have any purpose, they serve as big pigeon-holes. The consequences of this will be explored in later chapters.

V. THE GCL INFORMATION SYSTEM

We now come to the next step, which is the exposition of the parallel development of the information system of GCL. As we have mentioned above, during the early stage of the development of SNS (of which GCL was an operational part), the emphasis was on the productive side of the company. The information system available then was relatively simple and limited to the personnel payroll and the simple general accounting system (systeme de comptabilite generale simple) [SNS, 1980].

During the second stage of the genesis of SNS, there was a tendency, although limited, towards the decentralisation of certain managerial functions to the operational structures (les structures operationnelles). This was accompanied by a parallel development of specific systems of information for the distinct activities of SNS, i.e. a specific system for the activity of production, commercialisation and maintenance, in addition to the systems of a general character. However, the processing facilities were centralised at GOI (Groupe Organisation et Informatique).

GOI was organisationally attached to the planning directorate (direction de la planification generale) of SNS. Its "principal functions" were [ibid]:

.Management of the computer centre in the capital.

.Providing a service to answer the specific needs of those operational directorates which do not have their own SOI (Service Organisation et Informatique).

Fig.11.5 below shows the organisational structure of GOI [ibid]. It consists of the:

.Departement Operations et Projets Specific (Department of Operations and Specific Projects). Its function is to take charge of the operations which are specific to particular activities of certain directorates.

.Departement Systemes Generaux de Gestion (Department of

General Systems of Management). It has the function of providing services in the field of organisation and computer applications of a general character, i.e. applicable to SNS as a whole.

.Departement Traitement de l'Information (Department of data Processing). Its function is to ensure the efficient functioning and development of the facilities for input and processing of data, and the transmission of information.

.Departement Etudes et Developpement (Department of Development and Studies). This department acts as a consultant to the operational parts of ENS in the field of organisation and computer applications in conformity with the overall development plan of ENS.

In addition to GOI, two more structures were created in 1979 to look after the specific applications of their corresponding operational structures, namely, SOI (Service Organisation et Informatique) of GCL, and DOI (Division Organisation et Informatique) of the steel complex of El-Hadjar.

SOI, which is organisationally attached to EPO, has the mission of taking charge of the activities of organisation and computer applications specific to GCL. The same is true of DOI, which has the function of managing the computer operations and applications of the steel complex.

The evolution of SNS and its subsequent blowing up into various enterprises was not matched by development in its information system. Owing to heavy investment in hardware and accompanying software incurred during the seventies, and the time and resources necessary to build new information systems for every enterprise born out of the restructuring

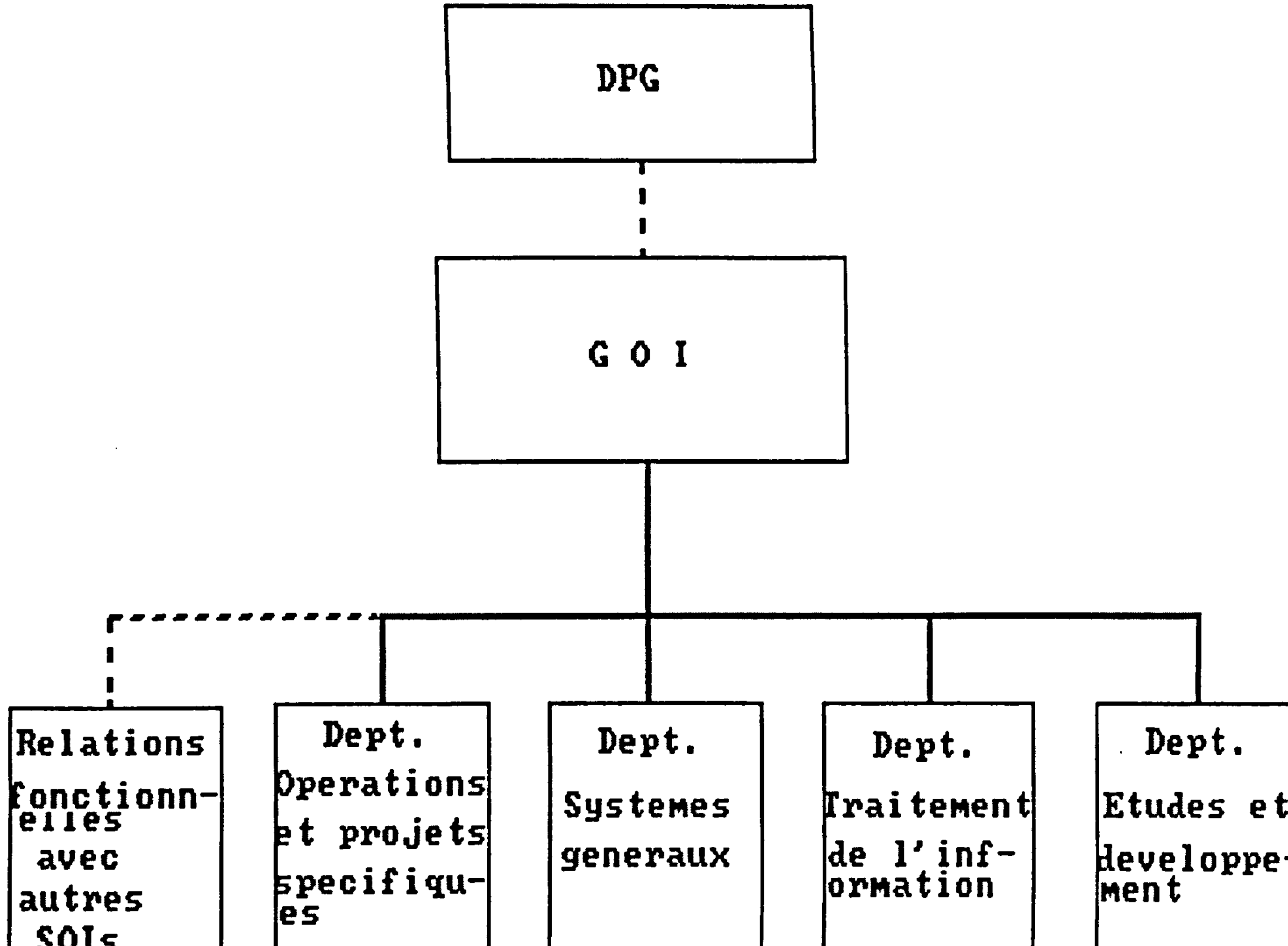

Fig.11.5. The organisation chart of GOI.

process, the old system largely continues to remain in service. As far as GCL is concerned (and other enterprises of the old SNS albeit in different degrees), this system is composed in two parts or systems: the General Systems (Systemes Generaux) and Specific Systems (Systemes Specifiques).

V.1 THE GENERAL SYSTEMS*

These systems were initially developed by SNS to cover the activities of all its units. They are four in number [GOI, 1984]:

1. Systeme de Gestion de Personnel (Personnel Management System). This is made up of two major subsystems:

- Le Fichier du Personnel (The Personnel File). This is a centrally managed file, updated every month. It contains all the necessary information for every employee of the company. It has the form of a database, available for consultation by the units (i.e. the newly created enterprises after the restructuring of SNS) on demand.
- Le Systeme de Paie (Payroll System). This allows the monthly computation of employees salaries, tax deductions, social security, family allowances, etc. It also allows the printing of reports for accounting purposes.

2. Systemes Comptables, Budgetaires et Fiscaux, or SCBF (Accounting, Budgeting and Fiscal Systems). This is a collection of the following interconnected subsystems:

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* System in this context means an integrated software system.

.Comptabilite Generale et Fiscalite (General Accounting and Taxation). This allows the accounting services to speed up their bookkeeping function and also permits the editing of detailed accounts as required by the units, as well as the monthly and annual reports required by the taxman and the "Plan Comptable National" or PCN (National Accounting System).

.Comptabilite de Gestion (Management Accounting). This subsystem allows monthly calculation of managerial indicators for the plant, the unit (like GCL) or ENS as a whole.

.Budget. This provides forecasts for the coming 18 months for the plant as well as the unit.

.Budget Physique (Physical Budget). This allows coordination and calculation of physical programmes of production and commercialisation by plant, unit and by family of products, etc.

3.Fichier des Tiers (File of GCL Business Partners). This contains information regarding the customers and suppliers of GCL.

4.Fichier des Produits Principaux (File of the Principal Products). This allows collection of necessary information about the commercialised products and semi-products (i.e. name of the product, dimension, type of steel, sale price, etc.) interchanged between the units. It is organised in such a way as to allow for the automatic computation of the scales of the sale prices (baremes des prix) of the steel products, and the publication of these scales every six months as required by the authorities.

V.2 THE SPECIFIC SYSTEMS

GCL remains dependent on the old centralised information system for the purposes of personnel management and, in particular on the need to use SCBF in management accounting and budgeting. However, the restructuring of SNS has given it scope to develop some information systems adapted to the specific character of its commercial activity. As could be expected, these systems are destined in their totality to be used by S/D MI (refer to section III above) [GCL, 1983; GCL/EPO, 1984(a); GOI, 1984]. Before going into a detailed account of these systems and files, we should note that they are operated at the central level. They include:

1. Fichier Produits (Product File).
2. Fichier Clients (Clients File).
3. Systeme Facturation (Invoicing System).
4. Systeme des Flux Physiques (Physical Flows System).
5. Systeme de Gestion de Stock (Stock Control System).
6. Systeme Recouvrement (Client Credit Management System).

We take each of the above systems in turn and find out about their characteristics.

1. THE PRODUCT FILE: CODE C99.

a. Objective: the aim of creating this file is to allow management (S/D MI) the identification of all the SMPs commercialised by GCL. The total number of these products is approximately 19000 (1983). They are organised into 11 categories called families of products (refer to ch.13). At the same time, C99 can serve as a catalogue for the clients of GCL.

b. The processing cycle: the information from this file is made available in two different ways:

- .On request by management or regional units for updating purposes.
- .Periodically. It allows monthly and six monthly printing of the products' price scale (bareme des prix), to the regional units, points of sale and GCL dealers.

c. Relationship with other systems: C99 is used as input by other systems of S/D MI, namely, invoicing, physical flows and client credit management systems. Fig.11.6 below shows this relationship.

2. THE CLIENTS FILE: CODE C91

a. Objective: the identification of all the clients of GCL (approximately 25000 in 1983).

b. The processing cycle: data processing for this file, like the previous one, is carried out in two phases:

- .On request by the regional units, points of sale, dealers, etc.
- .Periodic editions, monthly and six monthly.

c. Relationship with other systems: this file is used for input by the same systems which use C99. Fig.11.7 below shows the connections of C91 with other systems.

3. THE INVOICING SYSTEM: CODE C93

This is the most important element in the battery of computer software of GCL. In 1983, this system processes around 306,000 invoices. These are transmitted to the centre by the points of sale, or by the regional units (RUs) when the transaction or the sale is made direct to the customer

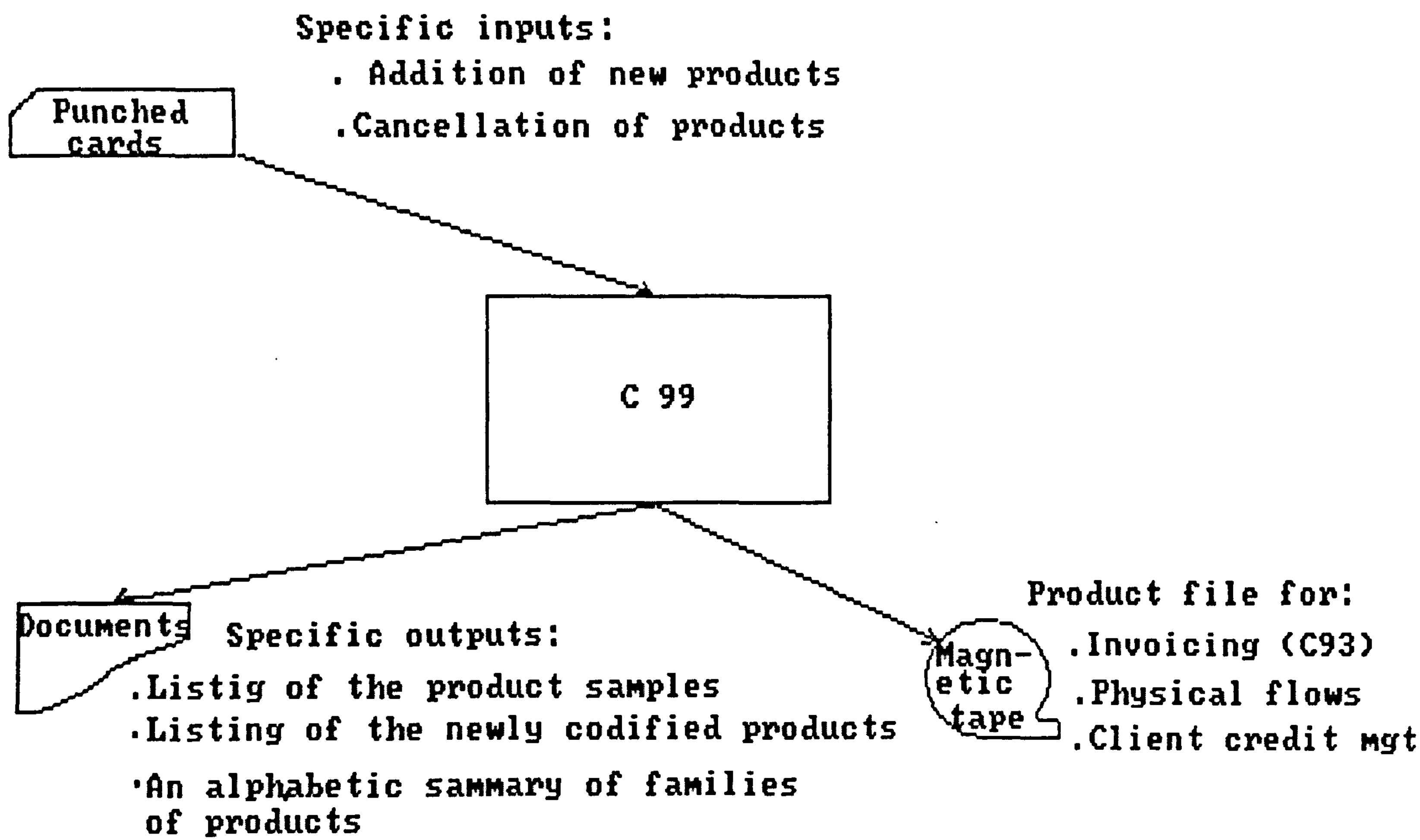

Fig.11.6. C99 relationships with other systems.

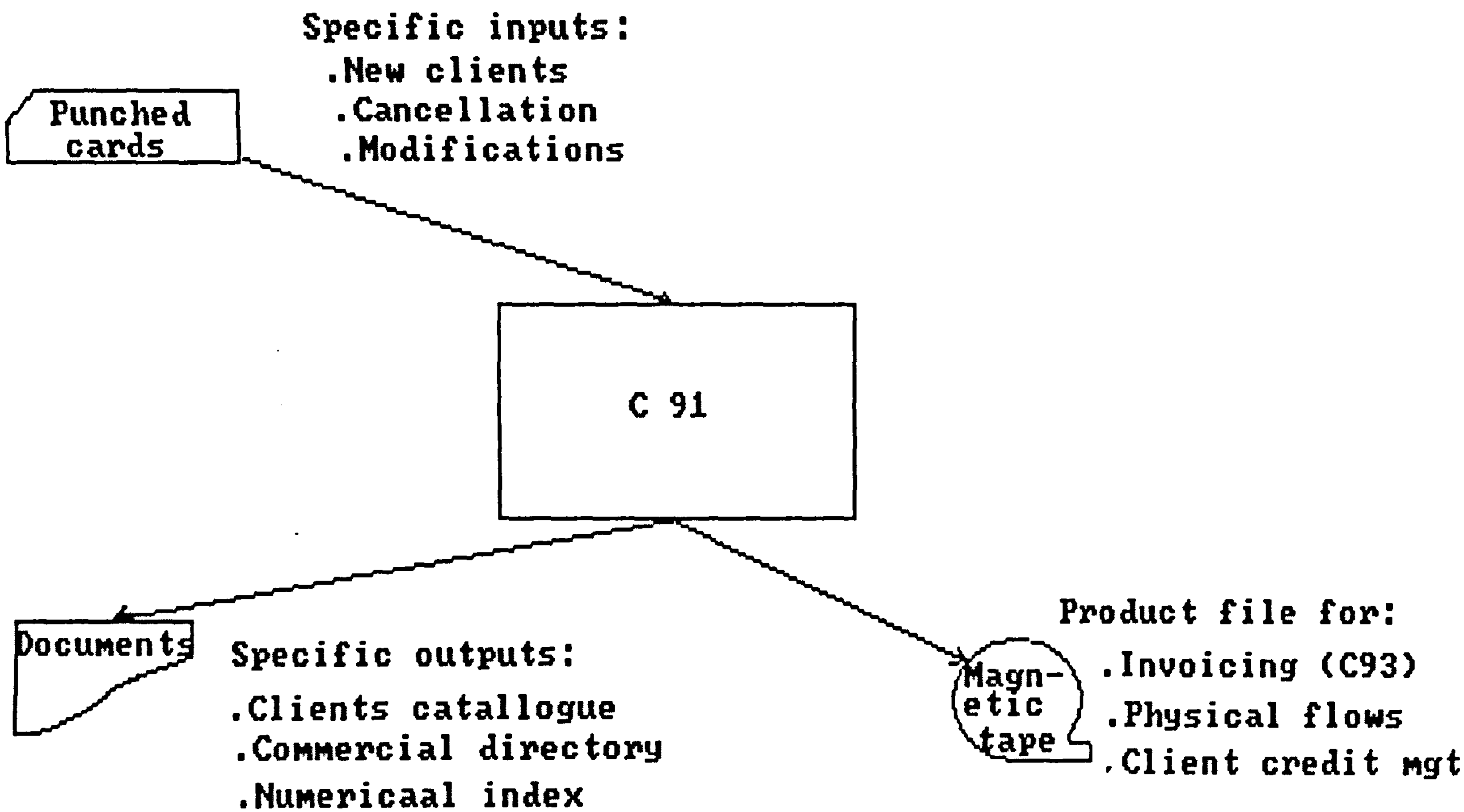

Fig.11.7. C91 relationships with other systems.

(for example one of the newly created enterprises) from the port and not from the stock in the depots.

a.Objective: the stated objectives of this system are as follows:

.A rigorous a posteriori control of the documents of invoicing (i.e. to ensure a strict adherence to the price scale):

.Constitution of a database of the national consumption of SMPs.

.Automatic generation of reports to be used by SCBF.

b.The flow of documents: the invoice is prepared by a point of sale in the case of a transaction from stock, or by SRVI (Service Regionale de Ventes Interieures) at the RU in the case of direct sales. These two types of invoices are then transmitted by the RU to S/D MI for correction. After that they are sent to the computer centre for processing. The outcome of the processing from the computer centre follows the same channels on its way back to the point of sale. The full journey of the invoice, from the date of issue to the time of its reception by the point of sale takes on average, 35 days [GCL/ EPO, 1984(a)]. Fig.11.8 below is a graphic representation of the movement of the invoices.

c.The processing cycle: the results arrive, as we have said, from the computer centre to the point of sale, where the invoice was initiated, after 35 days, sometimes even longer. The consequence is that people at the local level hardly get the information when it is needed. All they can do is manage their past. The reason behind these permanent delays is the centralising character of the whole process. Apart from the manual issue of the invoice at the point of

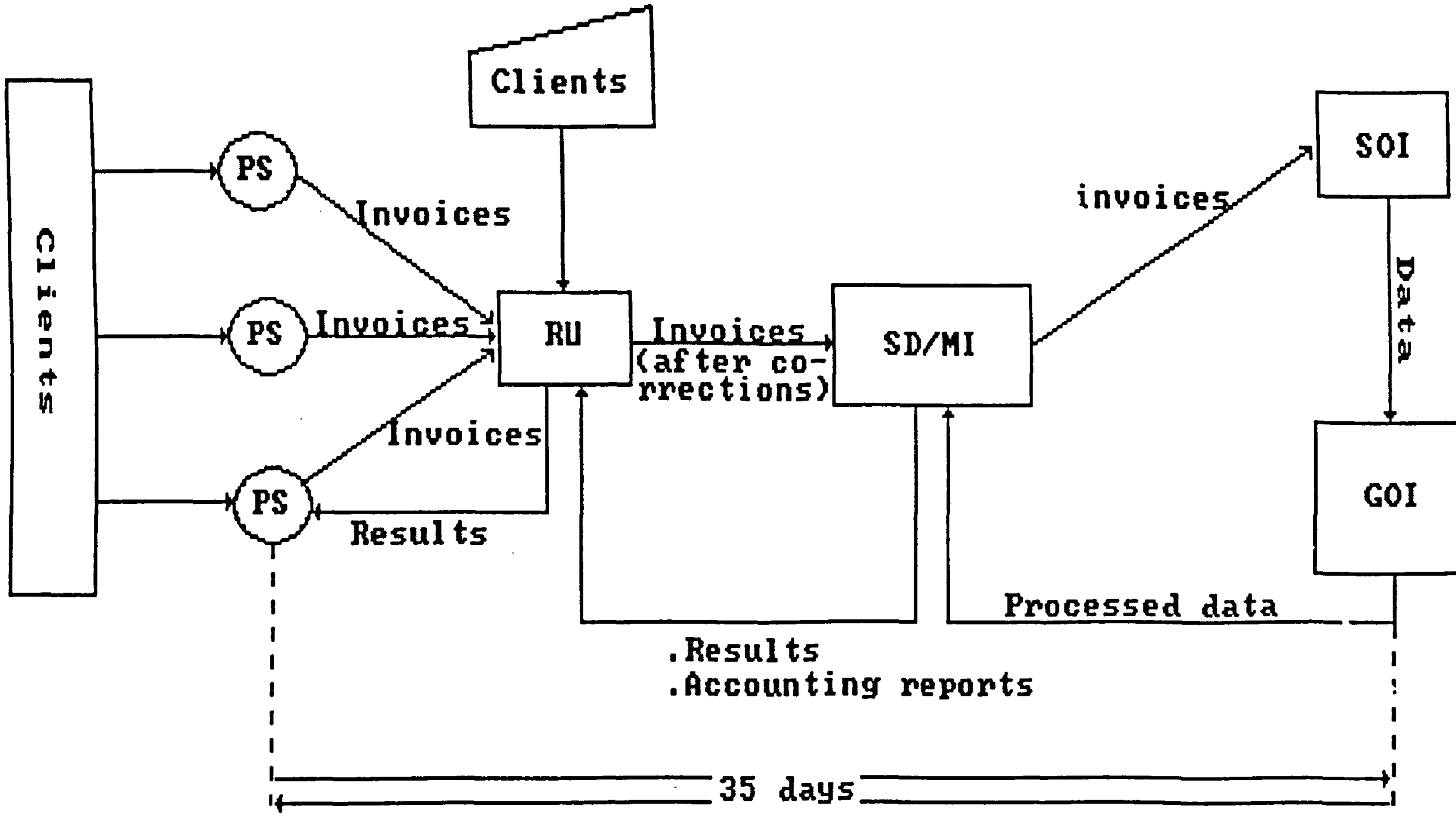

Fig.11.8. The invoicing system.

sale, and the correction for conformity and accuracy carried out at the RU, everything else is performed centrally. This includes codification of the invoice (saisie) to be readable by C93, correction of errors made in this process and the processing of data.

d.Relationship with other systems: C93 uses for input other information from C91 and C99. It supplies information on magnetic tapes to SCBF for accounting purposes, to C19 for follow up on clients' credit status, and to C17 on the situation in the ports and depots. These relationships are shown in fig.11.9 below.

4. CLIENT CREDIT MANAGEMENT (RECOUVREMENT): CODE C19

This system controls all the transactions with the clients of GCL.

a.Objective: It has for its aim:

.Rigorous control of the documents regarding clients credit management.

.Following the progress of the clients credit worthiness.

.Following the progress of the credit situation of GCL.

.Generateing, automatically, the accounting reports for SCBF.

b.The flow of documents: fig.11.10 below gives a graphic picture of the flow of documents regarding the clients credit management through the hierarchy of GCL. Having the same flow circuit as the invoicing system, C19 suffers from the same ills, i.e. living in the past. Managers at the regional and central level are unable to know with accuracy the credit worthiness of a particular client at any one point in time, or that of GCL for that matter.

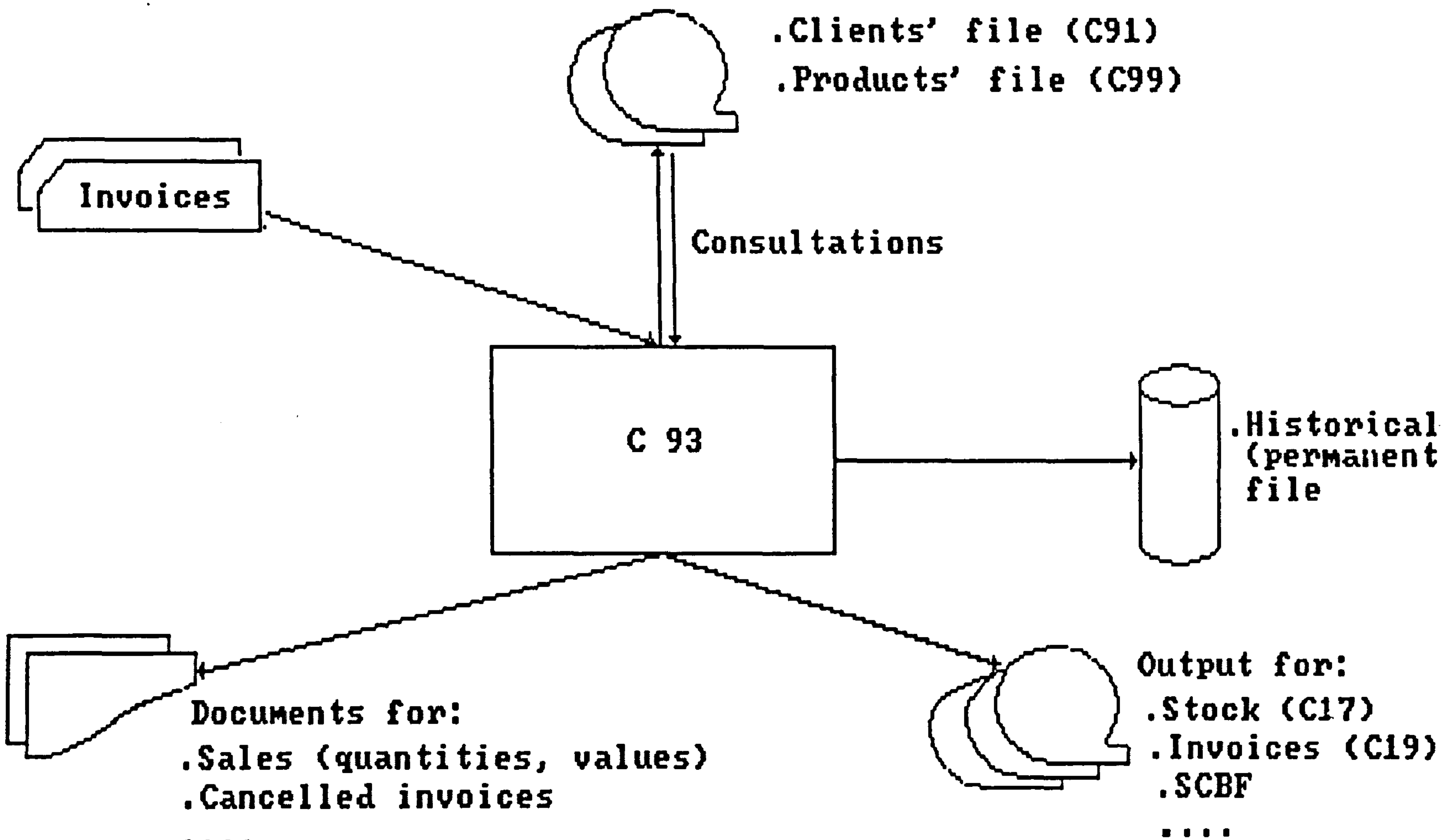

Fig.11.9. C93 relationships with other systems.

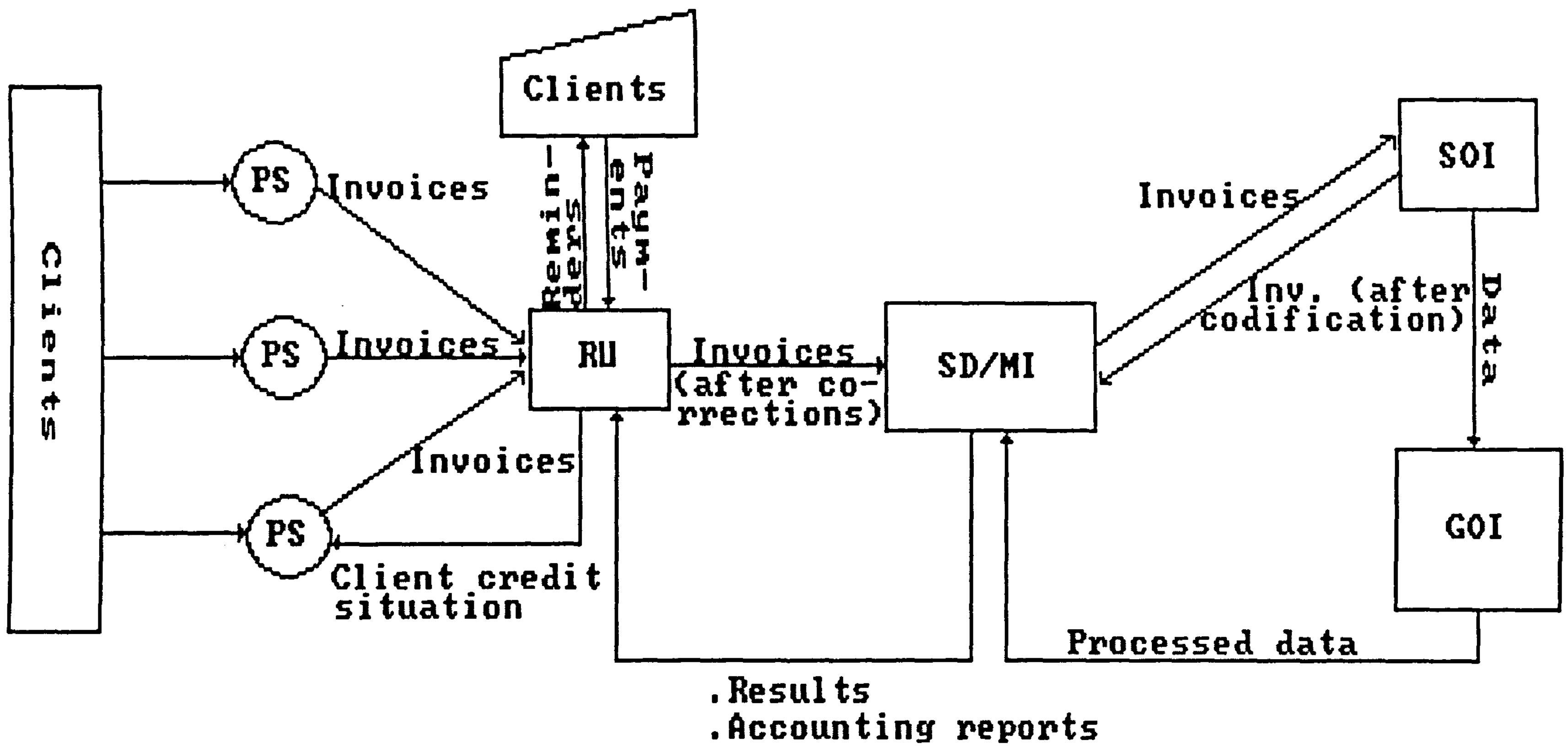

Fig.11.10. The flow of documents for C19.

c.Processing cycle: it is expected to run every 10 days, but given the errors made during the process of converting or coding (saisie) the data to be read by the computer, and the time it takes to correct these errors, this is not possible. The reports from this system (C19) come out monthly.

d.Relationship with other systems: for its inputs, it receives information from C93, C99 and C91. Its output goes to SCBF and C91. These relationships are depicted in fig.11.11 below.

5. MANAGEMENT OF THE PHYSICAL FLOWS: CODE C17

a.Objectives:

.Control of the movement of SMPs, from the placement of the order to its reception. i.e.:

.Flows from factories, i.e. the nationally produced SMPs.

.Flows from the ports, i.e. all imported SMPs.

.Flows inter-region, or inside the same region, from one point of sale to another.

.To provide an historical file for statistical use.

.To provide input information for the inventory control system.

.Automatic generation of accounting reports for SCBF.

b.Flow of documents: like the other systems above, the documents carrying data regarding the movement of SMPs are initiated in the depots, ports and RUs, then sent to S/D MI, which transmits them to the computer centre for processing. The outcome is sent back, on the same channel, to those who initiated the document. Fig.11.12 below depicts the circuit of the movement of documents concerning the physical flows of the products, from and back to the point of emission.

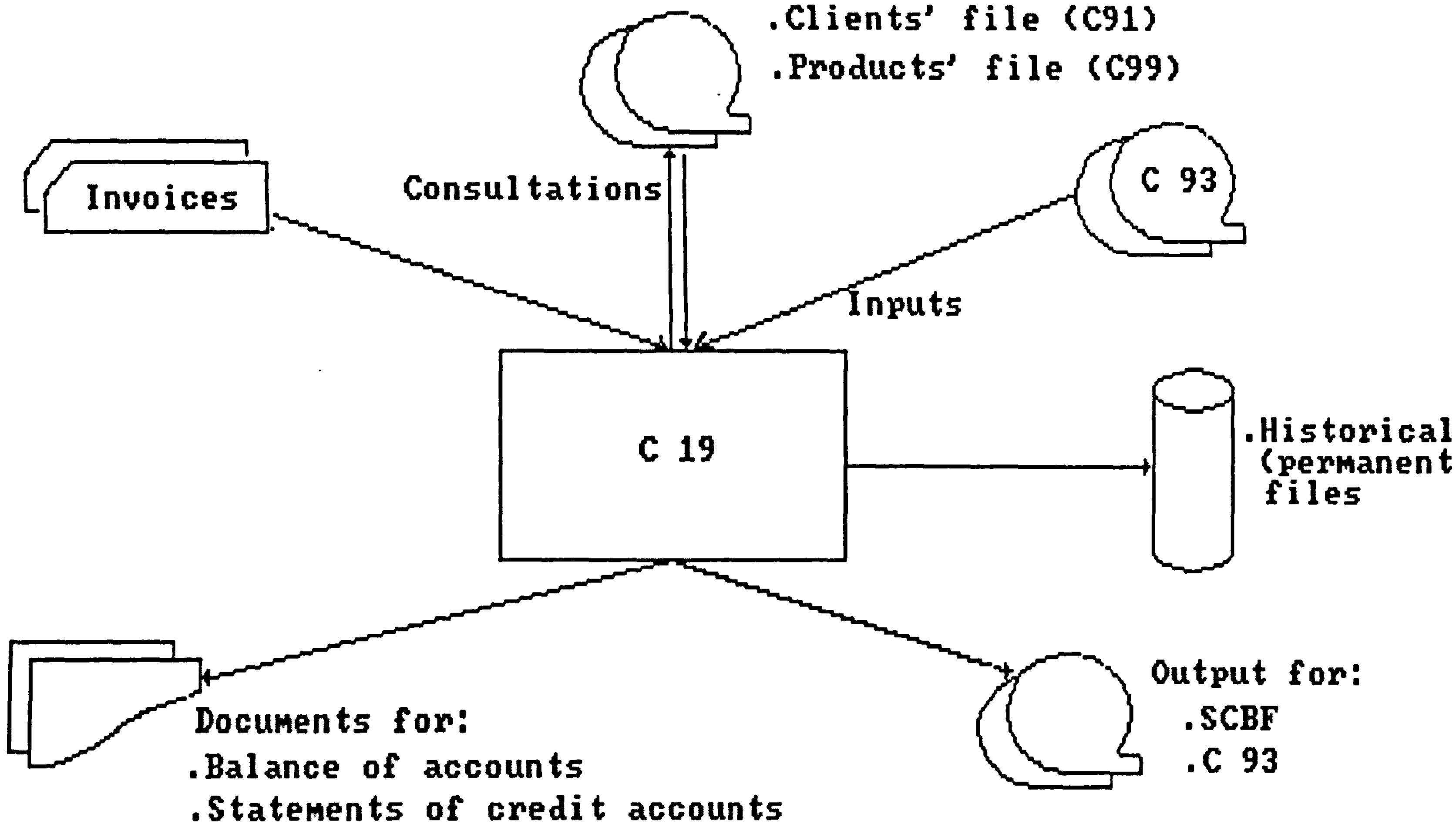

Fig.11.11. C19 relationships with other systems.

c.The processing cycle: C17 is installed to run every 10 days to process data emanating from the RUs. However, in actual fact, as the correction of errors takes so much time, it becomes necessary to re-run previous data. Reports from C17 are monthly. These are situation reports on stock at the ports and in the depots.

d.Relationship with other systems: it uses for its inputs the outputs of C91, C99 and C93. Its output is used by SCBF and C15 (Inventory Control). These relationships are shown in fig.11.13 below.

6. INVENTORY CONTROL: CODE C15

This system is, in a way, a continuation of C17.

a.Objective: the aims of C15 are:

.Manipulation of inputs from C17 to provide information necessary to establish orders at the points of sale.

.Delay analysis.

.In the second stage of its development (not yet operational) it should allow an automatic ordering by computer at the central level.

b.Processing cycle: entries to this system are exclusively from C17, apart occasionally from changes in the parameters for the calculation of the economic order quantity (EOQ). The output from C15 is essentially destined to SRGS (Service Regional de Gestion de Stock). Data processing is carried out monthly (like the rest of the systems) at the centre GOI (Groupe Organisation et Informatique). For the relationship with other systems refer to fig.11.14 below.

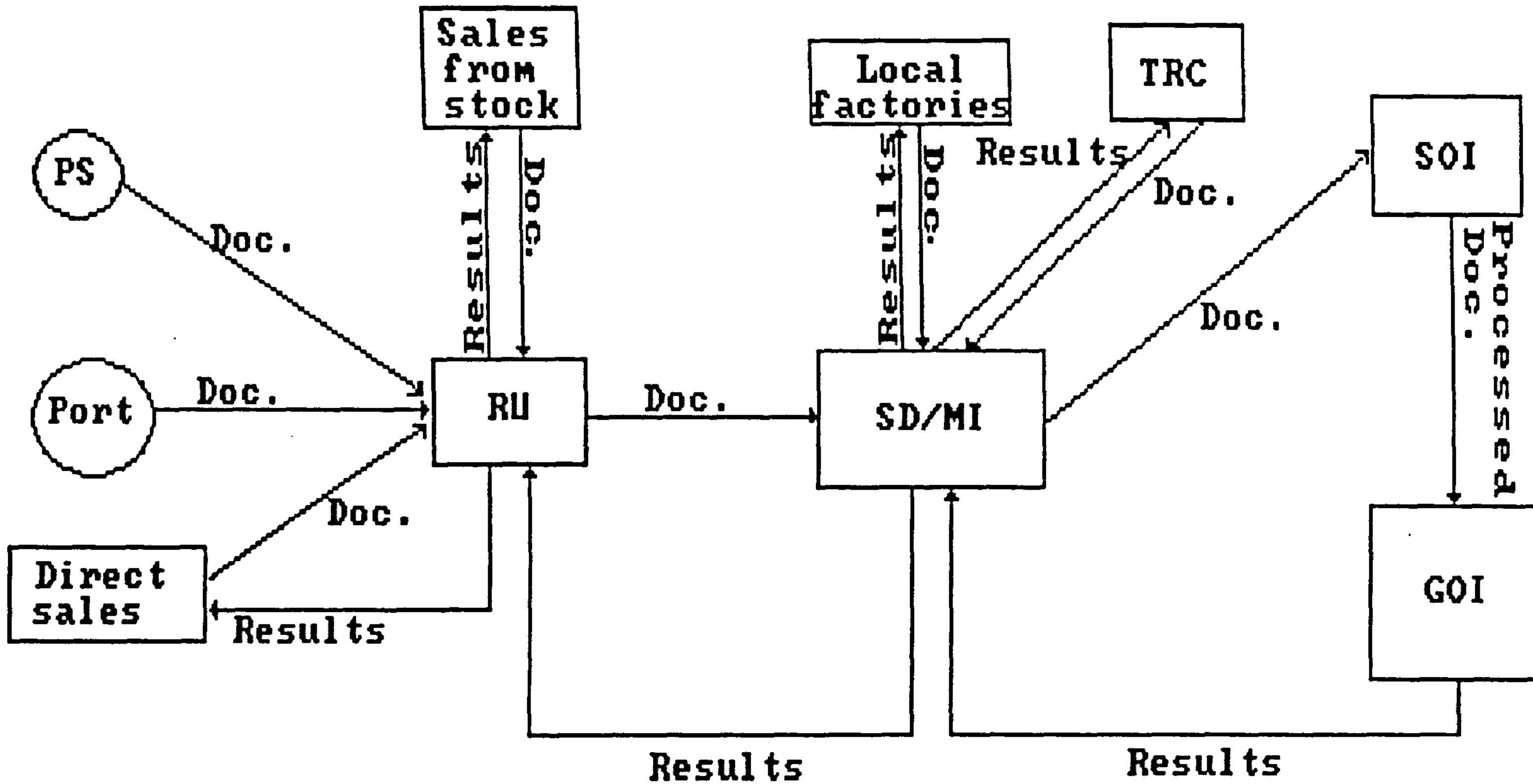

Fig.11.12. The flow of documents for C17.

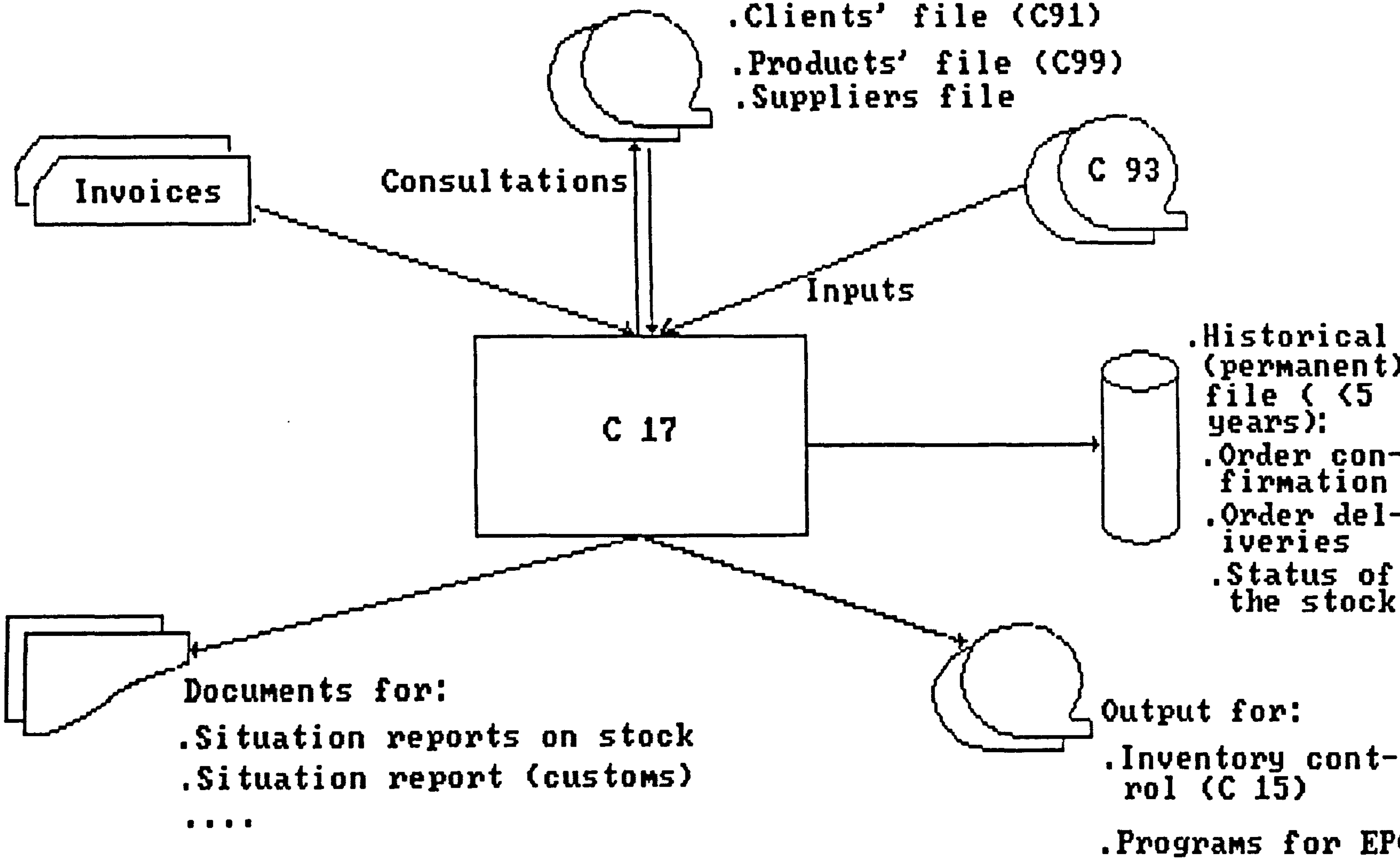

Fig.11.13. C17 relationships with other systems.

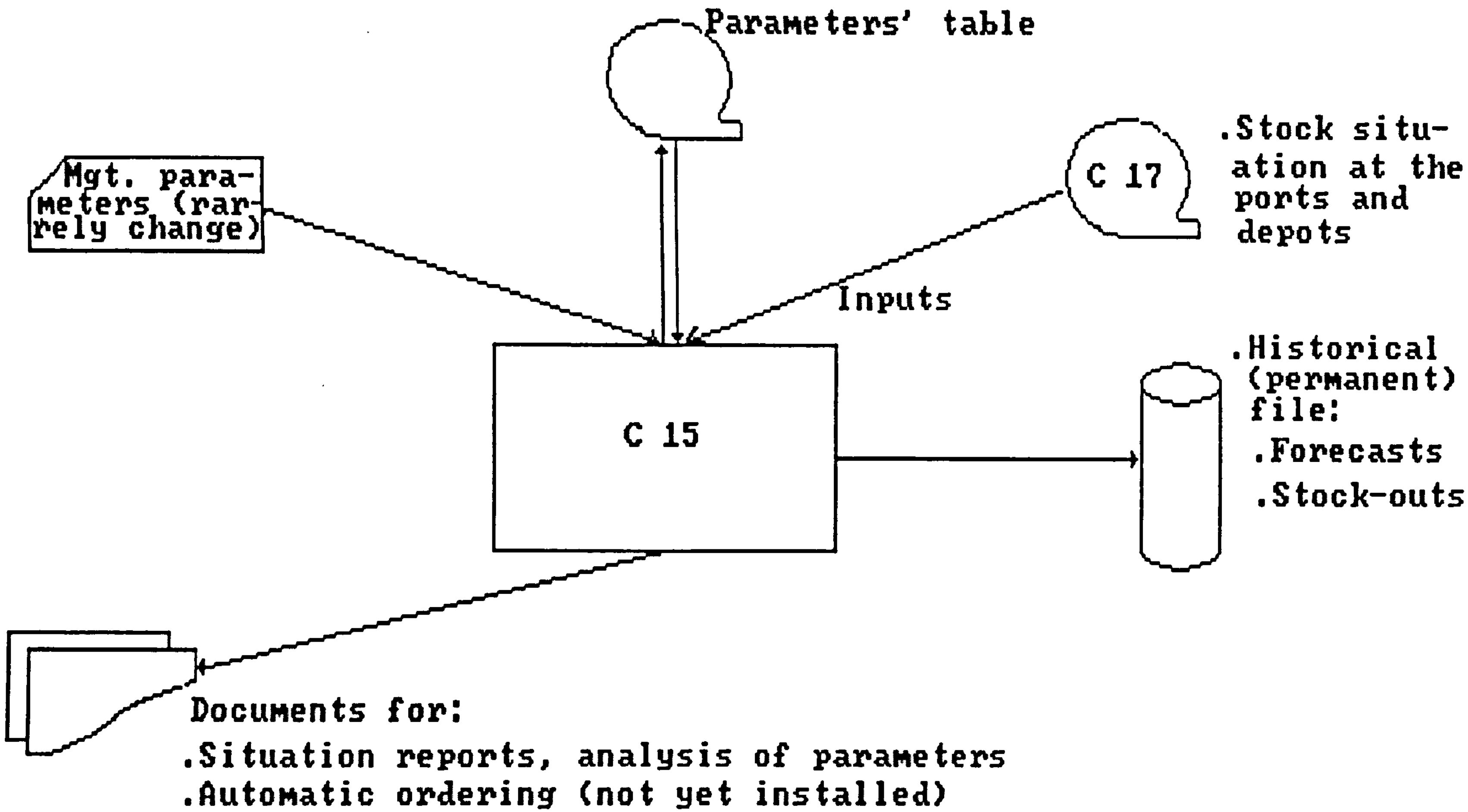

Fig.11.14. C15 relationships with other systems.

As a summary for section V, fig.11.15 below gives the general articulation of all the systems which make up the information system of GCL. This information system has not lived up to the expectations of the management of GCL, particularly that of the regional units. This is due, to a large extent, to the fact that it is heavily centralised. This centralisation has led to continuous delays in the reception of information where it is needed, i.e. the regional units (RUs) and the points of sale.

Although GCL is equipped with its own SOI (Service Organisation et Informatique), it does not have the computer hardware for data processing. The only task it performs, in the network of data processing and information transmission, is that of "saisie", i.e. converting data into codes on punched cards and/ or magnetic tapes. This state of affairs leaves GCL totally dependent on GOI of ENS. In fact 70% of computer time of GOI is allocated to the operations of GCL, or more specifically S/D MI. Within the existing mode of organisation, where GOI belongs to a different hierarchy, the situation is not expected to improve. Let us do some cybernetic diagnosis on this situation, in the remainder of part III.

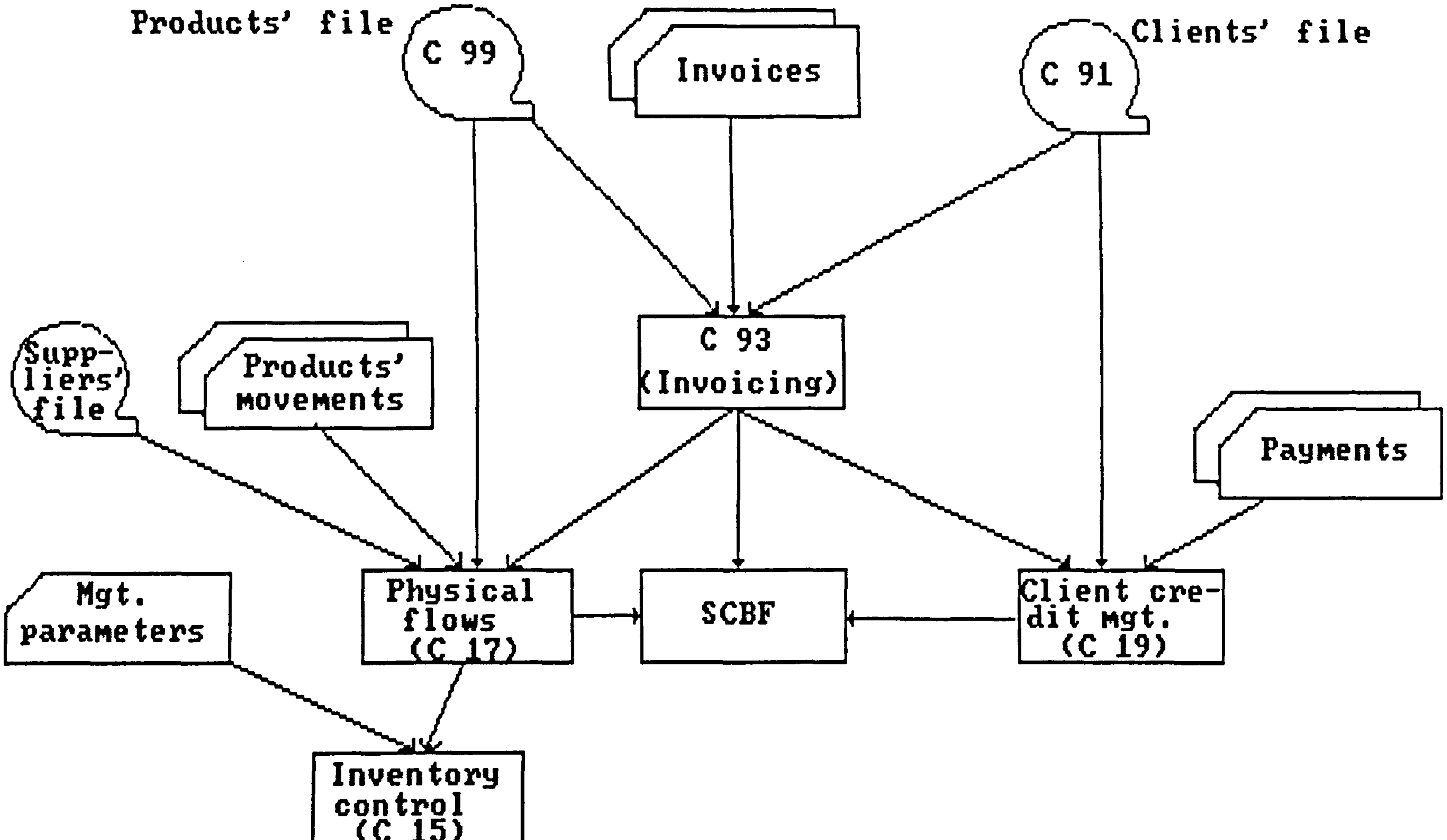

Fig.11.15. Overall articulation of GCL's information systems.

Chapter 12

THE SYSTEM IN FOCUS

It has been suggested that cybernetic analysis of organisations can be carried out in two distinct modes, depending on the situation under consideration [Espejo, 1987]. The first mode, which is diagnostic in character, is applicable to on-going organisations, whereas the second mode is adopted when we are faced with system design situations, i.e. where the organisation to be studied is undergoing a fundamental change of identity, or when we are considering a new organisation.

The aim of our present cybernetic application, as can be deduced from the previous chapter, is not the design of a new system it is, rather, diagnostic in character. Our intention is to induce structural adjustments to improve the effectiveness of the organisation (i.e. GCL) from the view point of communication and control. The approach followed here is totally divorced from the conventional dichotomy which often brings swings from centralisation to decentralisation, as has been the case of the system of our consideration, and possibly back again to centralisation when the new arrangement proves too loose or lacks "discipline".

The tendency in the management of the Algerian economy, within which our system operates, is to move towards openness and to offer a certain autonomy to the newly restructured economic entities. However, the central authorities in the form of the relevant Ministries (les Ministers Tutelles) still exert considerable influence on the policy making and task definitions of the economic agents in the country. The climate remains that of a centrally-planned economy, albeit with less rigour and with less political overtones than in the sixties and the seventies.

This knowledge of the prevailing climate in the management of the economy is particularly relevant when it comes to discussion of the identity of GCL, and its task as a socio-technical system. We have seen from the previous chapter how GCL evolved to its present organisational status. It was created, and continues, to serve as part of another organisation. Previously it was part of SNS (see organisational chart of SNS in Appendix A), now it is an "operational structure" of ENS (refer to ch.11) with the mission of commercialising the steel and metallurgical products (SMPs) in the country. The monopoly to carry out this mission was reinstated by decree at the time of the restructuring of SNS [ENS, 1984(a)]. The prevailing organisational culture in GCL, as the rest of the economy, is that the mission of the organisation is part of the national plan, where the autonomy of management is confined to the means for carrying out the task, and does not extend to the definition of the task itself. However, in theory, GCL members, or those of any other organisation, are invited to participate in formulating the overall economic strategy in so far as the activity of GCL is concerned. Nevertheless, for all practical purposes, the GCL mission is formalised at the upper levels of recursion. For a particular period, i.e. the time horizon of the national plan in progress, the mission of GCL has to be taken as a given fact.

Within this context, and given our aim which is to define the structural prerequisites for an effective management information system (refer to ch.2), the identification of GCL as an organisational entity, i.e. the "Direction Operationnelle" (operational directorate) of ENS, should not present practical difficulties. However, the evolution of GCL as an economic agent can take another turn. The reorganisation or restructuring taking place in the other sectors of the economy may affect directly or indirectly the tasks and the existing organisational arrangement of GCL. It is possible that in the future it will be transferred altogether from the tutelage (la tutelle) of the Ministry of Heavy Industry to the Ministry of Commerce, after which the recursive dimension of GCL would be different. The only way, in fact, to keep GCL under the auspices of the Ministry of Heavy Industry is to keep it part of ENS.

It is also possible that the monopoly of GCL in commercialising the SMPs will be reduced. Another, equally likely, possibility, is that GCL itself will be the subject of restructuring. Given its growing importance as an economic agent in the country (total sales in 1983 were 2,809,203 tons) [GCL/EPO, 1984], it is reasonable to consider the possibility that GCL will be taken outside ENS and be restructured in two or more enterprises for commercialising SMPs. We must bear these possibilities in mind in starting our diagnosis of GCL.

I. GCL'S RECURSIVE DIMENSION

Given the possibilities, it is appropriate to consider GCL, as a system in focus, in more than one recursive dimension. We begin by considering the present situation. At present, GCL is an operational unit,i.e. "structure operationnelle" of ENS. The latter is under the tutelage (la tutelle) of the Ministry of Heavy Industry.

The operational units which make up ENS are (refer to fig.12.1 below):

a. GCL: Groupe CommerciaL (the system in focus).

b. B/DU: le Complexe Siderurgique d'El-Hadjar (the steel complex of El-Hadjar).

c. DPJ: Direction du Projet Jejil* (the mill project of Jejil).

d.DPL: Direction de Projet Laminoirs (rolling mill project).

e.DAP: Direction d'Autres Projets (other projects). The nature of these other projects is not particularly relevant to our study. However, they are all concerned with the production of different types of steel products. DAP refers to projects which are newly initiated and have not reached the stage where they may be individualised, as in the case of DPJ and DPL.

The projects DPJ, DPL and DAP are not yet operational, but they are expected to become fully operational in the near future. The fact that they are under the organisational responsibility of D/DPG (Direction du Developpement et de

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* Jejil is a name of a city in the east of the country.

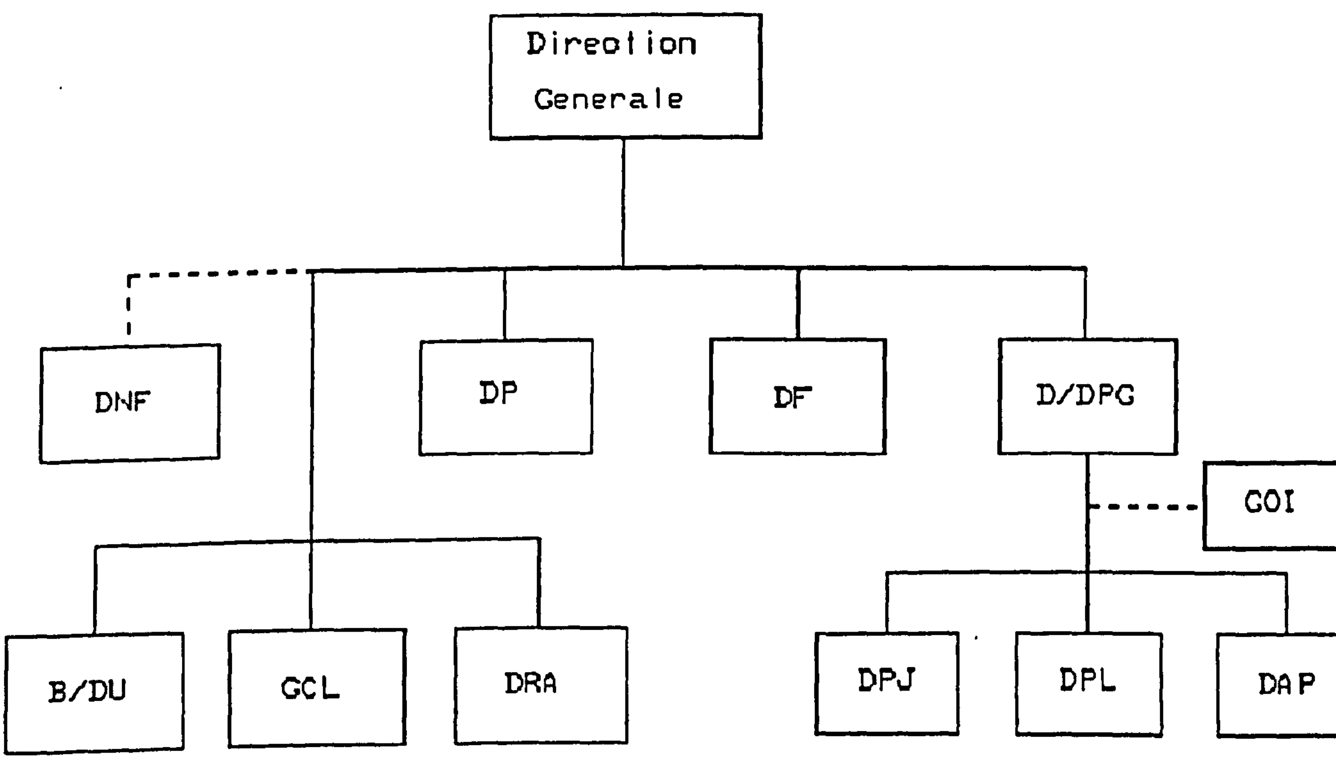


Fig.12.1. The organisation chart of ENS.

Planification Generale), which is the staff directorate of ENS does not alter their nature, only that they are not fully operational (not yet viable) and do not have a separate organisational existence. Nevertheless, if ENS were the subject of this modelling exercise, these projects would be included as operational elements of ENS. Modelling them, however, would require a systems design approach rather than the diagnostic approach adopted here.

From the organisation chart of ENS (fig.12.1 above) we have omitted DRA (Direction de Recherche Appliquee), i.e. the Directorate for Applied Research. Currently, this directorate is considered as an operational unit. However, subjecting it to the cybernetic criteria of viability shows straight away that DRA cannot have a separate existence and maintain itself. The research expected to be carried out by DRA (which is negligeable at present) is to serve the other operational units, namely B/DU and the projects (i.e. DPJ, DPL and DAP) when they become operational. In this sense it cannot be part of system one (which produces the organisation); it is instead a subsystem of the metasystem of ENS. How it is to be integrated in that metasystem is not the focus of our modelling here.

We will now come back to GCL itself. We must take it as an operational entity of ENS, therefore, a viable system, not simply because its status in the organisation (ENS) is a "structure operationnelle" (refer to fig.12.1 above), but because if hived off from ENS, GCL could remain in existence as a distribution enterprise, especially as it has by decree the monopoly to commercialise steel and metallurgical products (SMPs). GCL does not commercialise only the products produced by the steel complex B/DU; it markets all the SMPs produced by enterprises other than ENS. Also, it is the sole importer of SMPs for distribution in the country, whether these imports are destined to public and private companies, or imports on the account of other public enterprises (of the old SNS) which are delivered directly without going to the regional units. TRC (Sous-Direction des Transactions Commerciales) of GCL deals directly with outside suppliers and customers. The only relationship it has with ENS (in practice B/DU) is as a supplier or as a customer.

The status enjoyed by GCL creates a certain imbalance inside ENS. Formally it is an operational entity of the latter, but the management of GCL, which is itself appointed by the Minister, does not see itself as junior to the management of ENS. However, in a centrally-planned economy such as that within which GCL operates, formal structures cannot be ignored. This implies that, although ENS has little influence over the workings of GCL, the fact that the latter belongs to the former cannot be written off, and GCL cannot decide, on its own, to go it alone. This type of decision is taken at the second level of recursion up, i.e. at the ministry level.

If the degree of autonomy enjoyed by GCL (which is manifestly great) and the organisational constraints imposed on it as being part of ENS leave some scope for debate, the mission of GCL within the economic system does not. Its task is explicitly and formally stated at higher levels of recursion. This task is managing a monopoly for marketing SMPs in the country. It seems, therefore, that there is no ambiguity in the identification of GCL as a system in focus with a separate identity and clear mission, and with ENS as the next level of recursion up.

However, there are other expectations worth mentioning. Given the tendency of the government to restructure big organisations, GCL is a likely target. The speculation is that it may be taken out of the tutelage of the Ministry of Heavy Industry, to be incorporated in the distribution sector of the economy under the responsibility of the Ministry of Commerce. Fig.12.2 below embodies the two possible recursive dimensions of GCL.

This second alternative (i.e. the recursive dimension X of fig.12.2 below) is not mere speculation. It is the likely fate of GCL in the future, since the restructuring process of the economy is still in progress. Nevertheless, it will not be pursued here any further, as to do so would be, from the practical or implementation point of view, a futile exercise. An effective implementation of the VSM of GCL requires taking into account the existing organisational constraints. In other words, we need to consider GCL as part of ENS and build on its actual organisational structure by a careful and systematic diagnosis. In any case, given the distribution network of GCL at present, and the logic of the geographical allocation (which is not altogether economic) of the points of sale, the final model (VSM) of GCL will not be greatly affected by any one particular recursive dimension. Unless it is blown up into more than one unit, i.e. restructured, the next level of recursion down is practically unaffected whoever the controller of GCL.

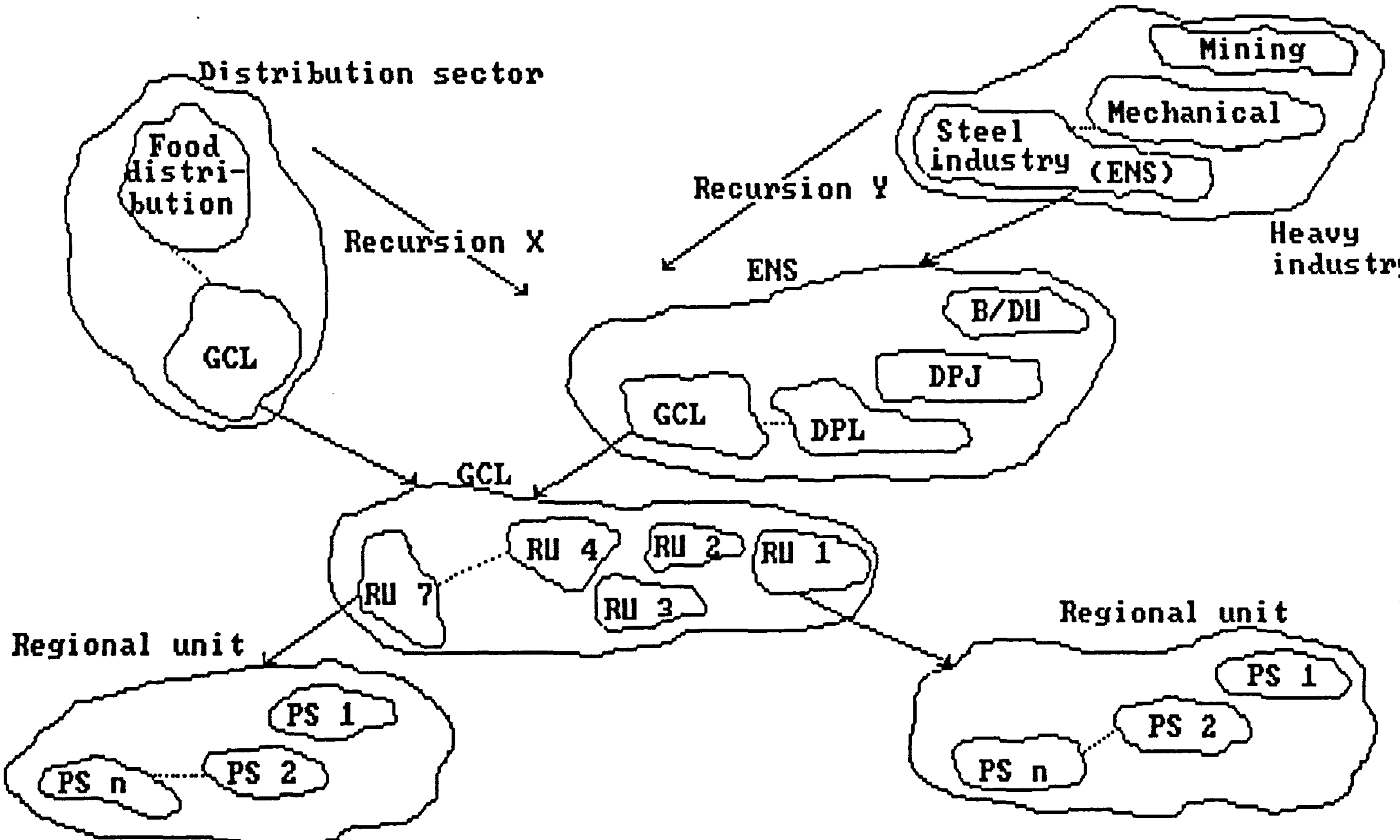


Fig.12.2. GCL's possible recursive dimensions.

We now come to the lower level of recursion. Reference to fig.12.2 above will show clearly that whatever recursive dimension we opt for, the end result is that the next level of recursion down is made up of the regional units, i.e. "les Unites Regionales". It is in fact through these regional units that the actual distribution of SMPs is carried out. They have become part of the economic set up of the country, to the extent that their geographical location follows the administrative division of the national territory. GCL's plans submitted to the Ministry of Heavy Industry must include plans for establishing, if not new regional units, at least new points of sale (Points de Ventes) in localities which are far from the existing points.

This amounts to saying that the next level of recursion down is geographically organised, with clearly delineated boundaries. These boundaries follow the administrative divisions of the country, which is organised into "wilayas" (i.e. local authorities). However, there are not enough regional units of GCL for every local authority. The working arrangement at present is that a particular regional unit serves more than one local authority provided that they are adjacent to one another. In the event that the possible restructuring of GCL becomes a concrete reality, any of the actual regional units could become an independent regional enterprise in its own right. The existing points of sale would become the next level of recursion down.

As it stands (refer to fig.12.2 above) GCL, as the system in focus, can be embedded in more than one metasystem, but lower down, along both recursive dimensions, we can perceive only the regional units as its viable parts. They are the elements which perform the primary activity of GCL, namely, the distribution of SMPs in the country. The detailed discussion of the regional units as the OEs of GCL will be the subject of the next chapter.

Before we go any further with this modelling exercise, it is essential to stop for a moment and reflect on the notion of the viability of GCL. It cannot be taken for granted that profit making is the means by which GCL ensures its existence. As we have mentioned above, it operates in the context of a centrally planned economy; part of its mission is to satisfy the needs and requirements of the development process of that economy for SMPs by imports from the world market, even to the detriment of its own financial gain. Like other public enterprises of course, GCL has budget constraints and is not encouraged to make unnecessary losses. Nevertheless, its raison d'etre is not the drive to make profit from its commercial activity. The price scale (bareme des prix) of its products has not been created at its own discretion, it has been established under guidelines from higher authorities. The prices of its SMPs are under continuous review, not only by GCL, but also by the price commission at the Ministry of Finance.

It follows that GCL's performance in carrying out its task cannot be judged appropriately in conventional terms of profitability alone. It is better to look at this performance in terms of the effective distribution of SMPs, i.e. getting the product to where it is needed. On the other hand, GCL also has the task of promoting nationally produced SMPs (not only those of ENS) in the country and abroad with the aim of alleviating the burden of the imports bill. In another sense, GCL is expected, like the rest of the public sector to rationalise its imporets and contribute to the balance of payments of the economy. However, we have to be careful about the idea of preserving the foreign currency reserves of the country. This is not a task for GCL to assume. The responsibility for doing so lies somewhere else, at the higher levels of recursion. As far as GCL is concerned this can be regarded as a metasystemic ethos prevailing throughout the economy.

If past experience is any indication, GCL is not a profitable enterprise. Nevertheless, it has maintained its existence and has grown considerably. It is in fact expected to double its imports by the 1990's [Boutine, 1987]. Its contribution to the development process of the economy, however, not surprisingly since it has the monopoly of commercialising SMPs was, and still is, important, i.e. by satisfying the needs of national demand for SMPs. It is in this context that we have to consider the viability of GCL; how efficient is it in getting the product to the customer through its existing network?

Remember that a level of recursion is "... a level at which a viable system is in operation, as an autonomous part of a higher level viable system, and containing within itself parts which are themselves autonomous viable systems" [Beer, 1974: p.72]. Our system in focus, then, will be considered as follows:

- The next level of recursion up is ENS, and is denoted as recursion level 0 (R0).
- This level of recursion or the system to be modelled is GCL, which will correspond to recursion level 1 (R1).

. The next level of recursion down is the totality of the regional units, which will correspond to recursion level 2 (R2).

Diagrammatically, this arrangement appears as in fig.12.3 below.

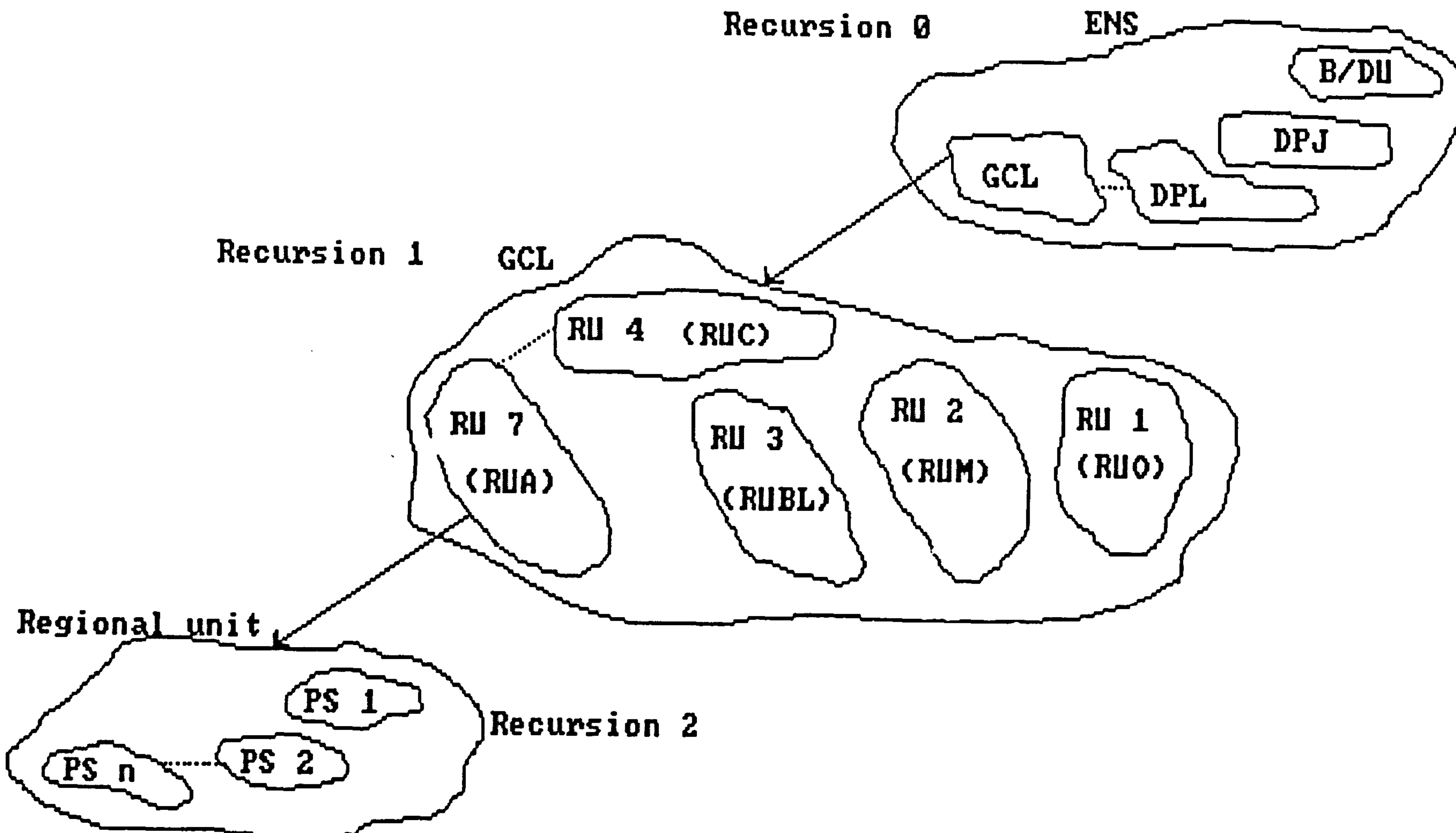


Fig.12.3. The appropriate recursive dimension for GCL.

Chapter 13

SYSTEM ONE OF GCL

We came to understand in chapter 11, relating to the genesis of GCL (the system to be modelled), that the management information system operating at present is geared largely towards supplying the upper echelons of management with information in ever increasing quantities. Given its limited capacity (like any other management) to process the information supplied, the outcome is necessarily that many information loops generated at the operational level remain without closure. This implies that many aspects of GCL's commercial transactions must remain unattended and uncontrolled.

The answer to this information overload, and the lack of control of some of GCL's tasks, is to recast the organisational structure. That is to say that the implementation of the tasks at the regional (operational) level should be accompanied by real discretion and autonomy. An effective organisational structure for GCL, in the cybernetic context, is that which can filter information and allow through only that amount necessary for control; i.e. management at a distance, in contrast to the present practice where the information system proliferates upwards data which, in many situations, is only of operational significance. The meaning of real discretion and autonomy, as compared to the present decentralisation of decision making, will be the subject of this chapter.

In the first section we shall identify the OEs that make up S1 of GCL, after which we discuss the constituent parts of an OE. However, the identification of the OEs will not be sufficient to understand the actual operation of selling SMPs. This understanding requires a drop of one level of recursion down, i.e. to R3, and this will be the subject of section II. In section III we tackle the question of variety flow across the vertical plane of R2, i.e. environmental, operational and managerial.

I.THE OEs OF GCL

It was stated in part II (elaboration of the VSM) that an operational element (OE) is the fundamental building block of the VSM. The collection of OEs (S1) defines the ground on which the organisational task is carried out. However, we cannot take our OEs directly from the organisation chart. We have to remember that the identification of the viable elements (OEs) of GCL should be a cybernetic recognition of the situation and not a mere translation of the existing organisation chart.

Refer to section III.1.2 chapter 11 and the organisation chart of GCL (Appendix C) synthesised in fig.13.1 below. We find, in the existing organisational structure, the "structures operationnelles" of GCL, namely S/D Commercial Transactions (S/D TRC), S/D Project Management (S/D GP) and S/D Internal Market (S/D MI). From a cybernetic stand-point, all the nominated sub-directorates (sous-directions) above, and the other three staff sub-directorates, are engaged in metasystemic activity. Subjecting to analysis any of the sub-directorates considered as "structures operationnelles", we will soon discover that not one of them answers the cybernetic criterion of viability, i.e. the ability to maintain a separate existence.

Let us take each of the so called "Structures Operationelles" in turn and consider the chances of any of them becoming a viable element. Take S/D TRC. Its "raison d'etre" is as an intermediary between the Regional Units (RUs) which carry out the task of selling the SMPs in the country (the RUs have no access to the outside market), and the outside suppliers, and as exporter of some of the SMPs produced in the country. The organisational task of S/D TRC, as far as the selling of SMPs in the country is concerned, is in fact reduced to that of servicing the RUs by acting as a buyer for them from the world market. So it is hardly a viable element in its own right.

Consider S/D GP. The organisational task as explicitly defined by the senior management of ENS (i.e. the next level of recursion up, or R0) is, again, to service the RUs by providing them, when necessary, with depots for stock holding of SMPs in the localities they serve. The logic of autonomy of the RUs would imply that this particular sub-directorate is totally redundant. In other words, the service it provides, i.e. the construction of depots, should be included in the organisational task of the RUs. That is to say not only can S/D GP not be a viable element of GCL, but it has no reason to exist once the RUs assume their autonomous existence vis-a-vis the metasystem (the central management) of GCL.

We come now to the third structure, which is seen as directly responsible for the RUs, namely S/D MI (Marche Interieur; it used to be referred to in the past as Ventes Interieures or VEI). The relative importance of this sub-directorate does not make it any different as far as the question of viability is concerned. Hierarchically it is responsible for the operations of the RUs, i.e. it controls their operations, but it does not actually carry out the task of selling SMPs to customers, which is what the mission of GCL is all about. Its position in the organisational structure is metasystemic vis-a-vis the RUs. This position will become clearer when we consider the control function in GCL in the next chapter.

Thus, in terms of the VSM, the structures referred to as operational in the existing organisation chart of GCL (fig.13.1) cannot have the status of operational elements of the viable system (GCL). They are all involved in metasystemic activities, at least one of which has no reason to exist.

The true operational elements (OEs), which implement the task GCL is expected to do, belong to the next level of recursion down (i.e. R2). They are the Regional Units (RUs). The RUs are the structures, out-there, involved directly in transactions with the environment. However, their action in the environment is heavily constrained. At present, dealing with the foreign suppliers is a task assigned to S/D TRC, as mentioned above. As to the national suppliers, this is the domain of S/D EPO (see ch.11). We will deal with this constraint shortly.

Fig.13.2 below contains a summary of the above arguments. The order of the OEs (i.e. RUs) from the top down, corresponds to the geographical location of the units in the national territory from west to east.
The particular ordering of the RUs in this way is not without significance. On the one hand, it reflects the physical contiguity of the territory, where the RUs are situated one next to another, i.e. the demarcation between the RUs is

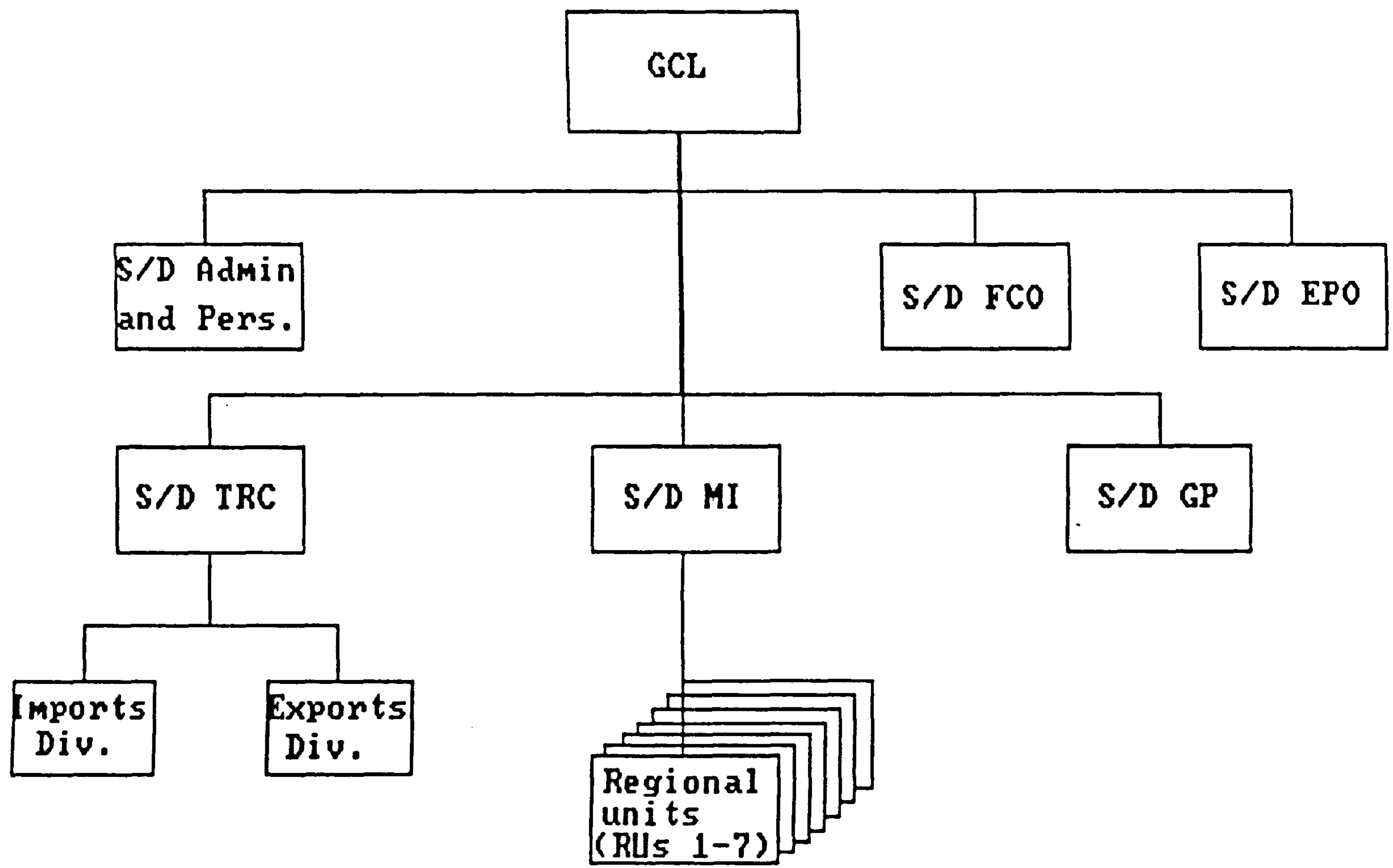


Fig.13.1. The organisation chart of GCL.

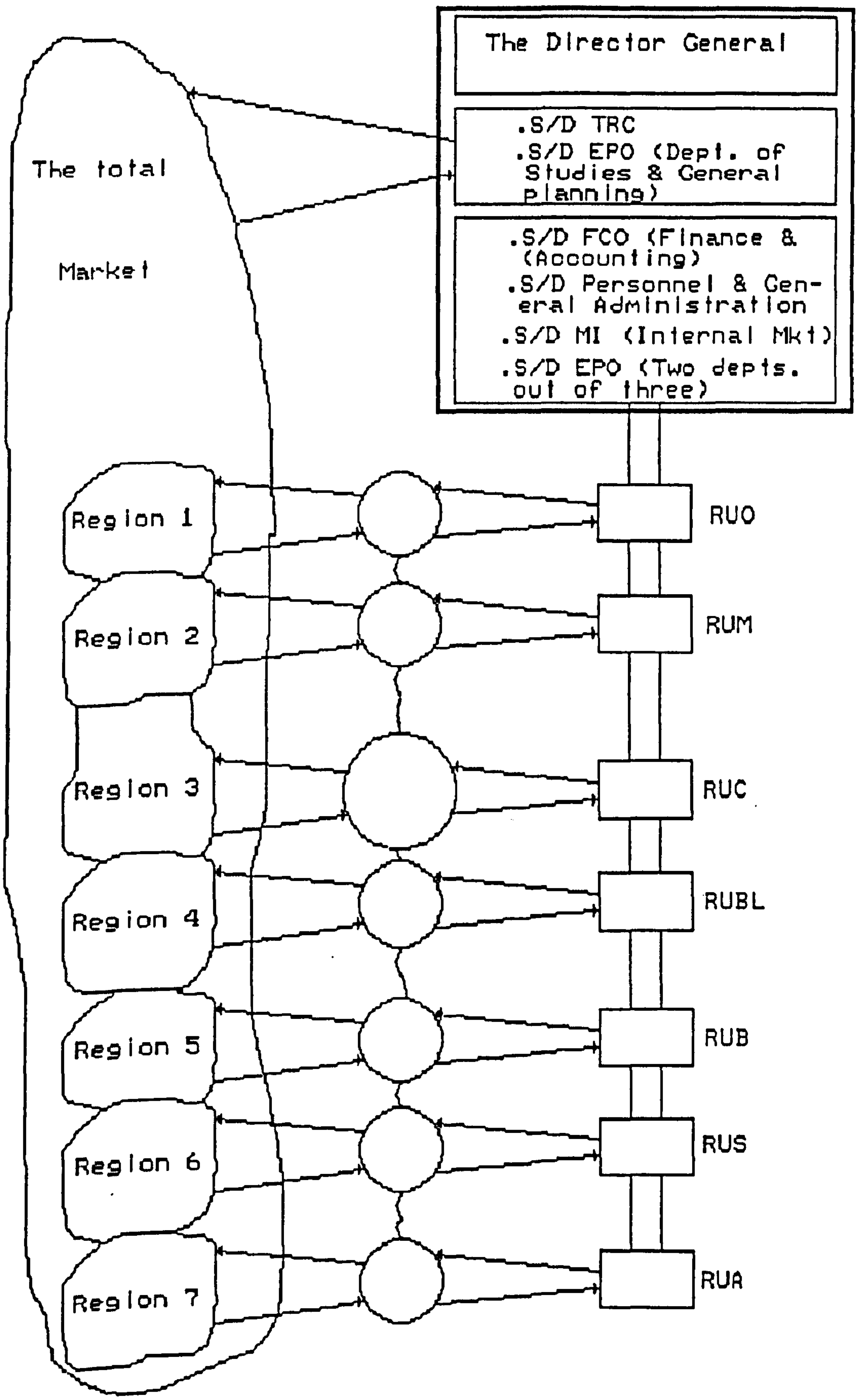


Fig.13.2. The operational elements (OEs) of GCL.

geographical. On the other hand it shows the actual and possible interactions (the squiggly lines) between the operations of the neighbouring RUs.

The difference in the size of one of the circles representing the operations is deliberate, to reflect the relative importance (in terms of turnover) of RUC (Unite Regionale Centre). The volume of operations of this regional unit is by far the greatest of all the units.

Studying closely fig.13.2, one discovers that it is a literal translation of fig.13.1 above. The purpose of fitting the organisation chart of GCL inside the VSM of fig.13.2 is to bring to light the gross imbalance in GCL's structure. It is obvious that this structure is in a pathological state. The relative weight of the metasystem (i.e. the number of sub-directorates, dependent divisions and departments and dependent services) vis-a-vis system one (the RUs) is manifest in the VSM of fig.13.2. This imbalance is bound to occur, owing to the centralised character of the organisational structure of GCL and lack of real autonomy of the RUs. The increase of complexity of the operations over time (the multiplication in the number of customers, increase in the number of commercialised products, type and changes in prices, addition of new points of sale, etc.) has the consequence of increasing the need of the system (i.e. GCL) to process information. This implies an increase in its capacity for processing which is reflected by an investment in computerized data processing systems (refer to ch.11). Given the actual practice of reporting everything to the upper echelons of the hierarchy (refer to section III below), the increase in the information processing capacity has taken the form of a cancerous growth in the activities of the metasystem (hence the multiplication of departments, services, etc.).

Another diagnostic outcome from the model above (fig.13.2) is that system three (S3) is dominating the scene at the metasystem level. This reflects the fact that GCL is an inward- looking type of organisation. The activities of system four (S4) are relatively few and these are by metasystemic edict (from the Ministry level). They correspond to the activities of S/D TRC and S/D EPO. The expected activities of S4 (refer to ch. 9) are almost nonexistent. The near absence of S4 in the organisation structure is reflected in the difficulties GCL has in adapting to its environment, let alone controlling it (refer to ch.15).

A further outcome of this is that the role of system five (S5), in fig.13.2 above is ambiguous. As seen by the RUs the role of S5 is confused with that of S/D MI (the real S3 as we shall see later). From a cybernetic standpoint, however, the ambiguity of the role of S5 in the organisational structure of GCL should not come as a surprise. As we have seen in chapter 9, S5 is expected to manage the variety engineering of the S3--S4 loop. Since this role is practically absent we find that the S5 role is reduced to that of S3 (this argument is deferred to ch.15).

Also, the VSM of fig.13.2 above shows how prominent are the command channels as a means of communication between the senior management and the operational (i.e. regional) level.

We shall need to bear all these diagnostic points in mind. Now, however, we move on to further elaboration of the OEs. Identifying the RUs as the viable sub-parts which produce the viable system (GCL) is not sufficient. We need to specify the constituent parts of the RU as an OE, i.e. the environment, the operations and the management of the regional unit. This we do now.

I.1 THE ENVIRONMENT OF AN RU

The relevant environment of an RU is formally defined in geographical terms. The area served by any one RU follows a well delimited administrative division. In other words, the customers of an RU are those resident in the localities delimited by the administrative boundaries of the region. In this sense there is no recognised overlap between the neighbouring environments of the units, as fig.13.2 above demonstrates.

Following this parcelling out of geographical areas to the RUs, the determination of the level of complexity of the relevant environment of any one RU should become a fairly straightforward matter. In so far as the operational task at this level of recursion is concerned, the part of the environment mapped by the intelligence function is reduced to the number of customers and the type of demand expressed by them.

In terms of type of demand either the customer is served from stock (commande stock), or the customer is provided with the merchandise directly from the supplier (factory) or from the port (in the case of imported SMPs); this is referred to as "Commande Directe". This latter type of customer service (Commande Directe) is normally associated with big order quantities [GCL/VEI, (G11), 1974], or when the demand is for a product not commercialised (not in the catalogue) by GCL. The limit beyond which an order is considered a "Commande Directe" is determined by the Central Service of Commercial Management (Service Central de Gestion Commerciale, SCGC) after consultation with the Regional Service of Internal Sales (Service Regional des Ventes Interieurese, SRVI) and the Regional Service of Stock Control (Service Regional de Gestion des Stocks, SRGS).

As stated in chapter 11, GCL has a monopoly of selling SMPs in the country. This means that there are no competitors for the RU in the environment.

As to the supply side, RUs are provided with SMPs by R1 (i.e. S/D TRC and S/D EPO). They lack any discretion here. Yet another aspect for which the RU lacks discretion and autonomy is in the management of the financial matters relating to its operations. The granting of credit facilities to customers is mainly the prerogative of the metasystem (through S/D FCO).

To recapitulate, the management of an RU views the complexity of its relevant environment along two dimensions (see fig.13.3 below):

.The quantitative dimension, i.e. the number of customers. This number can be identified but is unknown at present.

.The qualitative dimension, i.e. the type of customer demand, of which the number of possible states is limited to two: orders from stock and direct orders.

I.2 THE OPERATIONS OF AN RU

The activities of exporting and importing SMPs are dealt with at the metasystem level (i.e. R1). The rest of the operations relating to selling SMPs are undertaken by the RUs, each in its designated part of the territory.

The operations of an RU can be enumerated as follows:

.Reception of customer orders, i.e. only those related to "Commandes Directes". These orders are then aggregated and passed up to the metasystem, namely the Central Service of Commercial Coordination (Service Central de Coordination Commerciale, SCCC).

.Reception of SMPs at the port (in the case of imports) where every RU has a Transit Base (Base de Transit). From there the merchandise is sent to the point of sale (PS). In the case of direct orders (Commandes Directes) the merchandise is collected by the customer without it being included in the stock of the RU.

.The actual selling of the SMPs to customers. This in fact is the main activity of the PSs (which together make up the RU). Other activities are merely derivatives of the selling operation.

.The client credit management (Recouvrement). This activity is not fully at the operational level of the RU. An important part of the management of clients' credit is seen as managerial. To appreciate the extent to which "Recouvrement" is an operational matter, we have to drop another level of recursion (i.e. to R3).

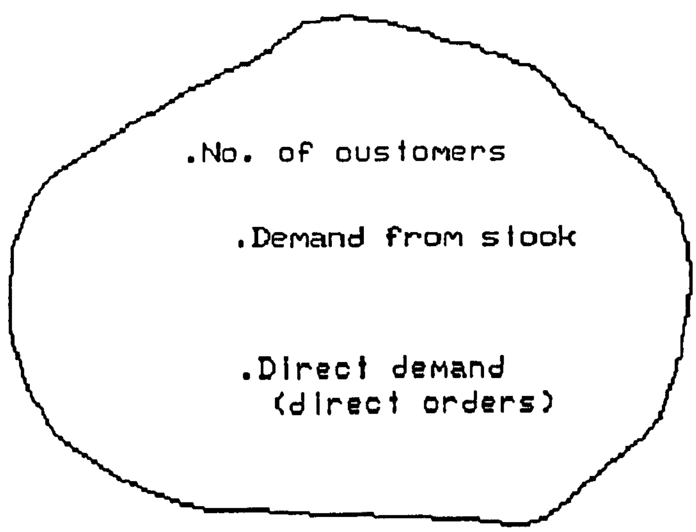


Fig.13.3. The environment of an RU.

I.3 THE MANAGEMENT OF AN RU

The managerial activities of an RU represent all that is necessary for the control of the operations in the region. The centralisation practice referred to above, in relation to the central management of GCL, is reproduced at the regional level. If we take the RU as the system in focus we will see that too much control is exercised by the management over its PSs. The activities that make up the domain of management can be summarised as follows [ENS/GCL (S/D MI) 1985]:

.Through its Systems and Finance Division (Division Systemes et Finance), the management centralises the financial and fiscal aspects of its operations in the region.

.It assumes direct responsibility, through its Division of General Administration (Division Administration Generale), over all aspects relevant to the social activities of the personnel of the RU.

.It is responsible for proper maintenance of the buildings, depots, weighing machines, transport vehicles, etc., of the PSs in the region. Also, it ensures the supply of spare parts for the vehicles, weighing machines, etc. This task is assigned to the Technical Division (Division Technique).

.It manages the sales of the region on the basis of the monthly reports provided by the PSs. In addition, the management of the RU controls the clients' credit management (Recouvrement). This task is carried out by the Commercial Division (Division Commerciale).

.It controls all the bureaucratic paperwork through its transit base at the port of the region and handles all the customs procedures. The transit base also looks after relationships with the port authorities regarding the unloading of ships carrying SMPs for GCL from abroad.

This identification of the environment, operations and the management function of an RU is deliberately kept at the general level. The contention is that the presentation should be compatible with the necessity of not confusing the two levels of recursion (R1 and R2); this enables us to contain the proliferation of variety exhibited by the organisation chart of the RU. The three constituent parts of the RU (OE) are shown diagrammaticaly in fig.13.4.

We do now, however, have to move down another level of recursion. The presentation so far, however insightful, is not sufficient to give full understanding of the variety transactions taking place at the regional level. Another step down in the recursive dimension is required to understand the operational reality of the RU.

The means by which to try to understand this operational reality is to study in detail one of the seven regional units, namely the regional unit centre, i.e. RUC (see fig.13.2). The selection of this particular regional unit is justified by the fact that it is the most important (in terms of level of activity) of the seven. The outcome of the cybernetic analysis can easily be extended to any of the units of fig.13.2 above. The only real difference between them is the number of PSs operating in any one region. The outline VSM of the RUC appears in fig.13.5 below. From this figure we see that the operation of selling SMPs is implemented by seven points of sale (A through G). The figure also shows that the division of the regional environment into parts is, again, geographical.

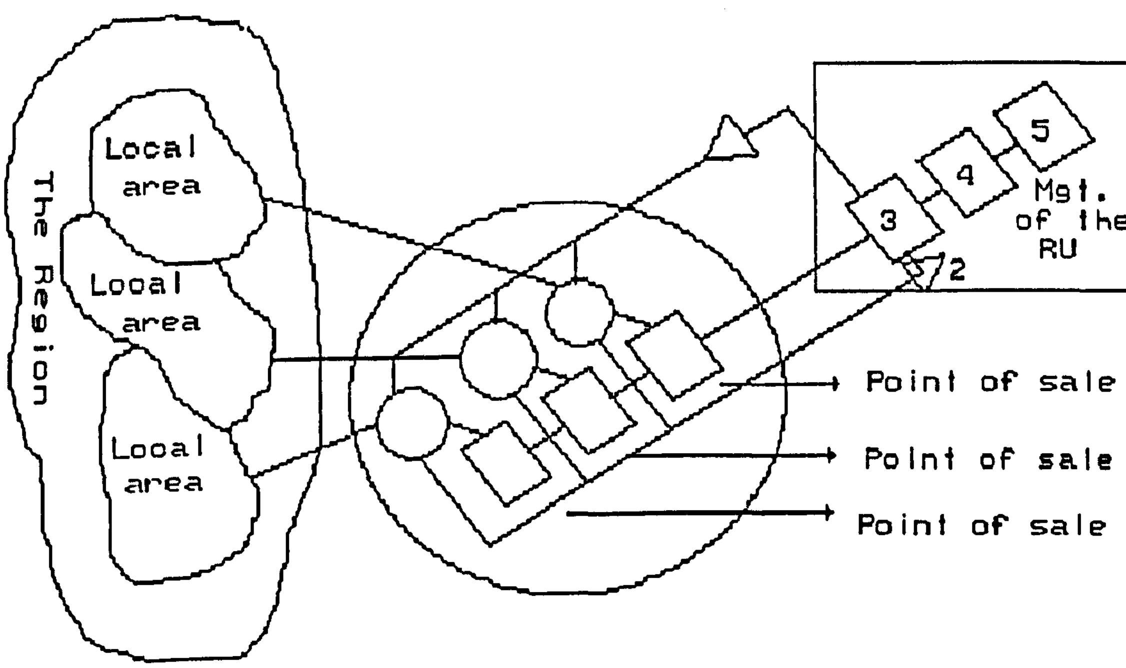


Fig.13.4. A regional unit as an OE.

The localities served by the PSs are called "Dairates". For the customer to be served by a particular PS, he is required to provide formal evidence of his residence in the locality of the relevant PS. In reality, however, the bureaucratic procedures are rarely observed, especially with regard to products for which the demand is low or infrequent. This trespassing over the environmental boundaries is shown in fig.13.5 by the interactions between the neighbouring local environments. The part of the environment marked "specific environment" is a domain reserved to system four (S4) of the RUC (i.e. S4 at R2).

The sales operations of the RUC correspond to the totality of S1 of fig.13.5. In other words, these operations are exhausted by the seven PSs. However, the selling activity is not equally shared by the points of sale. To understand the mechanisms of the sales operation we consider one point of sale separately, then generalise to the others since they perform the same operation. Here we undertake the variety engineering as if the PS were a black box. The very detailed analysis required is the subject of the next section.

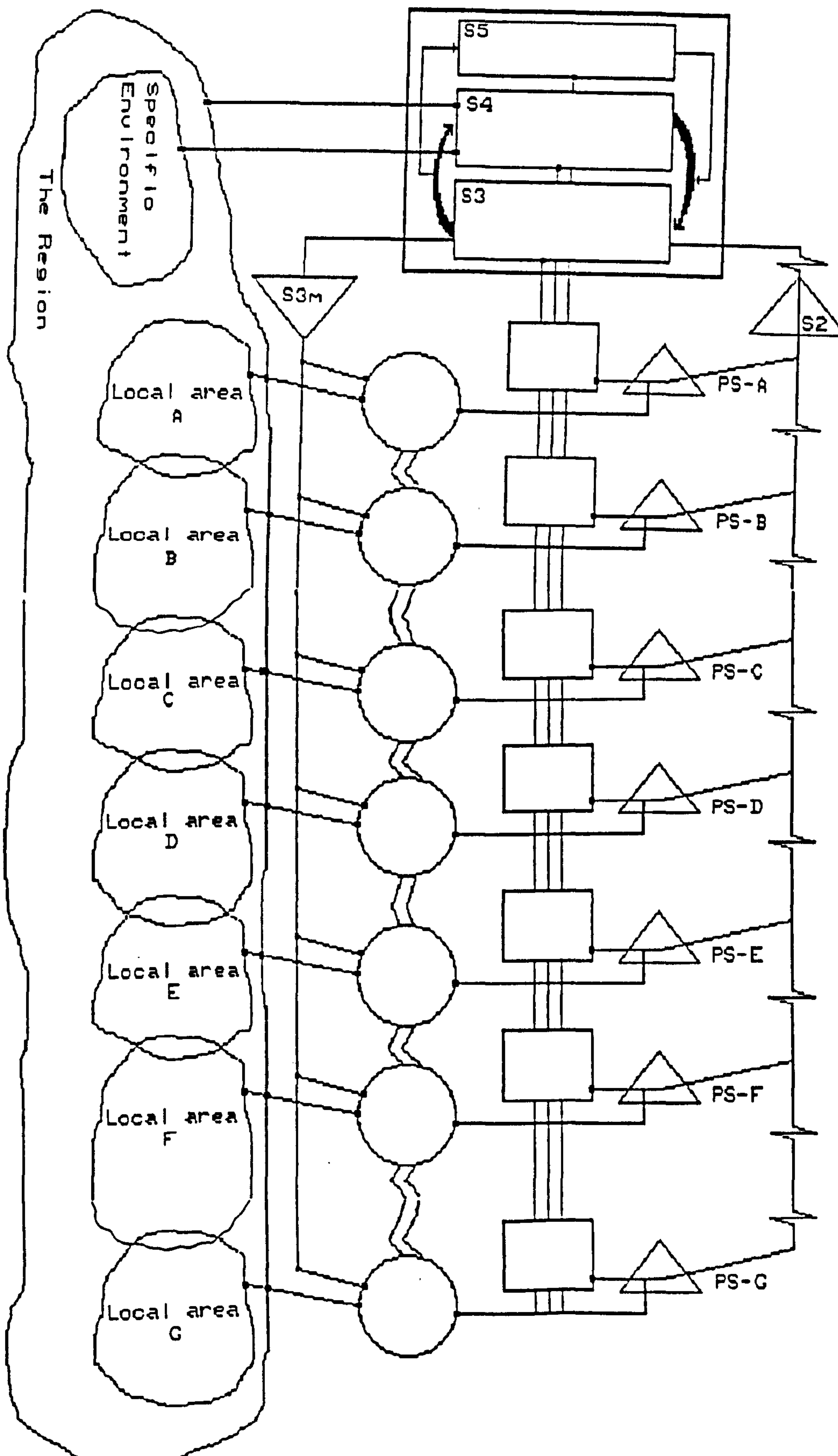


Fig.13.5. The VSM of RUC.

II. VARIETY ENGINEERING AT R3

A diagrammatic presentation of a PS would look like fig.13.6 below.

We are now in a position to analyse and understand the variety flows relevant to the actual selling of SMPs. To do so we need to take the two loops of fig.13.6 individually. The discussion will include the identification of the amplifiers and the filters on the loop.

II.1 THE ENVIRONMENT <----> OPERATIONS LOOP

There is no need to redefine the environment at the PS level. It is the local area within the region, and it is viewed along the same dimensions (see section I. above) except that the direct orders are referred to and dealt with at the regional level (R2). The flow of SMPs from the ports and local factories, customer orders, financial transactions, etc., between the environment and the operations of fig.13.6 is the "raison d'etre" of the PS (and of GCL). However, it is difficult to judge or appreciate the degree of balance between the two sides of the loop. The variety flow is almost entirely determined at the upper levels of recursion (mostly R1). Customer orders for a product can rarely fall outside the catalogue established at R1 [GCL/VEI (A01), 1974; ENS/DF, 1985(a,b)] long before the restructuring of the old SNS (refer to ch.11). This catalogue is destined to serve as a means of communication between the internal services of GCL as well as between these services and the customers. "Il (the catalogue) doit permettre on premier lieu d'etablir un langage commun et

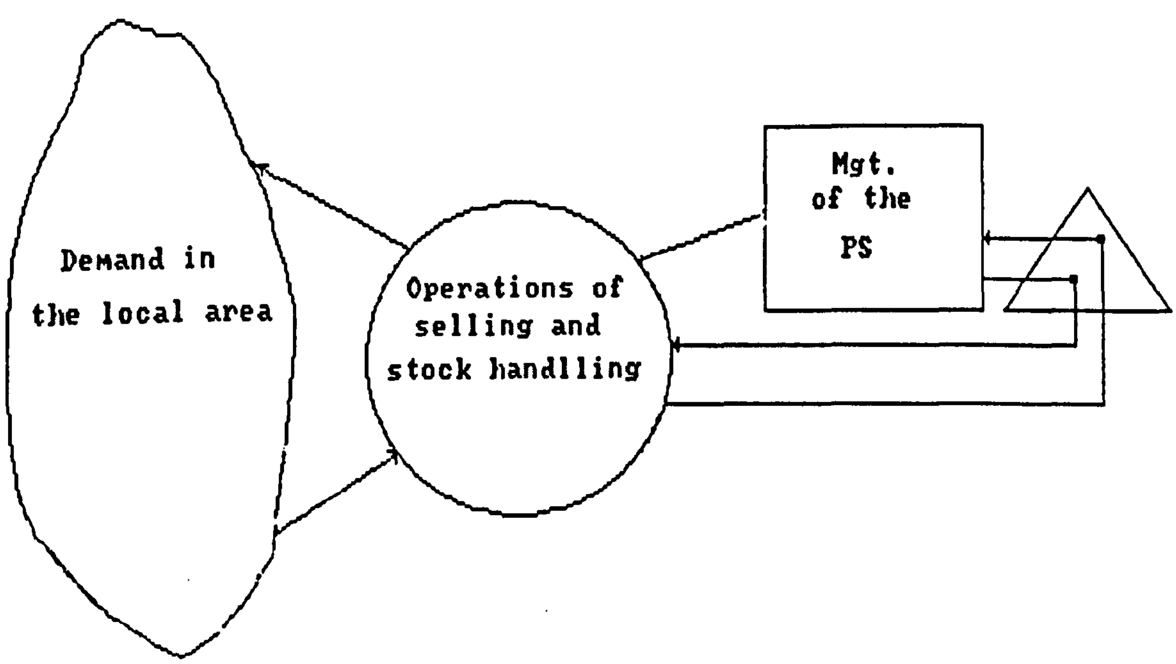


Fig.13.6. A Point of Sale (PS) as an OE.

precis entre les clients nationaux de la SNS (i.e. GCL) et tous les services SNS concernes par leur consultations et leur commandes ainsi qu'entre les unites et services SNS eux memes" [GCL/VEI (A01): p.3].

Given its importance, it is appropriate to digress a little and explain the logic of this language (i.e. the product catalogue). The basic unit in it is referred to as a Sample (Echantillon) to which is attached a code (a letter followed by five digits) for identification by the computer system (Product file). The Sample is distinguished by :

.Product. This is defined by its final state i.e. the stage of elaboration and form or profile (for example sheet-metal, girder, corner-iron, etc.).

.Dimensions. For example for sheet-metal the dimensions would be: thickness x width x length.

In other words, a product having particular dimensions, defines a Sample. As well as these physical attributes, the Sample is also identified by weight, sale price (taxes included) and status (in stock, withdrawn from stock, etc.).

With this product catalogue we encounter a powerful amplifier of operational variety; where the SMPs in stock are organised into families and subfamilies of products, with necessary specifications to meet customer requirements, reduced to those given in the catalogue. Refer to fig.13.7 below.

The first filter to deal with is that relating to the size of customer orders for certain products. It is known as the Limits of Distribution (Limites de Distribution [GCL/VEI (R52), 1975]). The "raison d'etre" of the limits of distribution is to rationalise the utilisation of SMPs in the country, particularly imported SMPs: "les limites de distribution ont pour objet l'utilisation rationnelle... des ventes depuis les stocks et les ventes directes" [GCL/VEI (G11): p.5]. It appears, at first sight, that this is contrary to what we expect from an organisation like GCL; we expect it to encourage and increase demand rather than limit it. The limits of distribution are designed to curb demand for those types of products which are imported and costly in terms of foreign currency. The metasystem at higher level (Government) wants to regulate the consumption of these products in the economy.

The Limits of Distribution are determined by the metasystem at R1 after consultation with the RUs. They are determined as follows [ibid]:

code	class (tons)
0	no limit
1	0 ----< 5
2	5 ----<10
3	10 ----<15
4	15 ----<20
5	20 ----<25
6	25 ----<30
7	30 ----<50
8	50 ----<70
9	70 ---<100

Beyond 100 tons the customer order becomes a direct order and is referred to recursion 2 (the management of the RU).

These limits are implemented as set out below:

.The limit of Distribution is set for a given period of time for all classes. However, this period can vary (by a

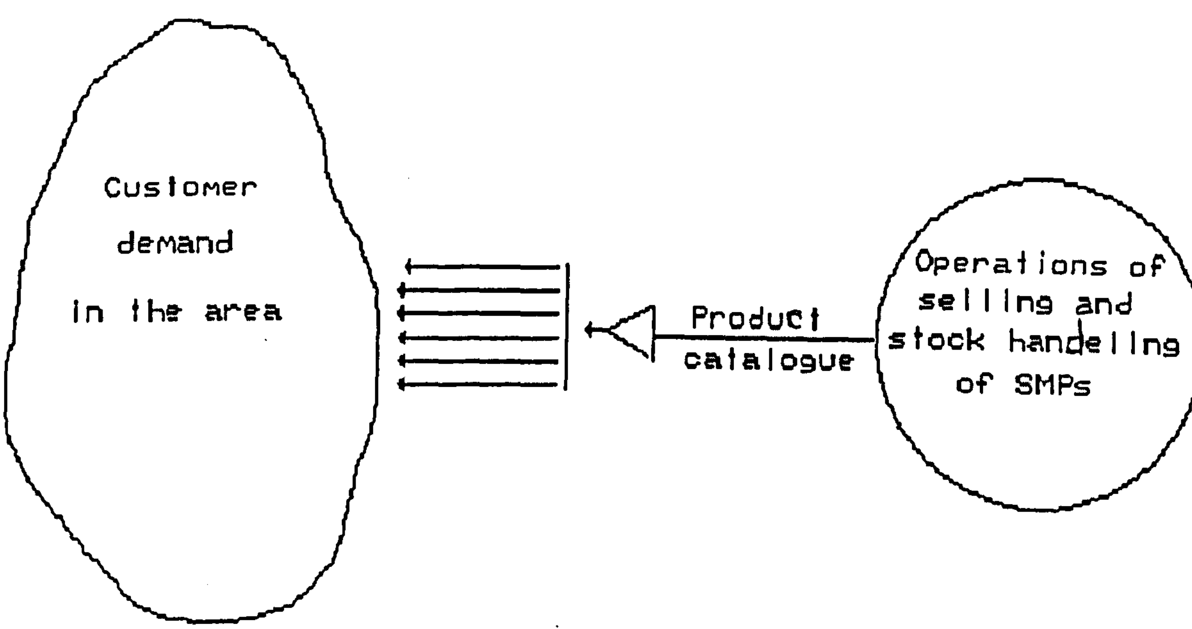


Fig.13.7. The product catalogue as an amplifier.

metasystem of R1 edict) depending on the economic climate prevailing in the country. A customer's accumulated orders during the period in question should not exceed the limits as specified by the classes above. When the customer's order goes beyond the limit he is referred to the manager of the PS.

.All the regular clients in the area of the PS are on file (at the PS). New ones are added as they come. Each must have formal proof of residence in the Dairate of the PS in question.

.The product samples are arranged in stock according to the classes above.

Diagrammatically, the Distribution Limits act as a variety filter as is depicted in fig.13.8 below.

Another filter of environmental variety is in the form of the payment conditions applied to customers (which are restrictive). The design of this filter (i.e. the elaboration of the payment conditions to customers) is a task carried out at the metasystem level (R1). The concern of the PS is limited to its implementation, closely monitored by the RU. Fig.13.9 below gives a graphic presentation of this filter.

The variety filters sketched here have relevance only to the specific environment of the PS. The general environment (relevant to the metasystem) also has a direct bearing on the operations of a PS, in so far as the replenishment of its depots with SMPs is concerned. The bulk of information concerning the flow of SMPs into a PS is processed at higher levels of recursion, namely R1 and R2. The information loops regarding such flows (of SMPs into the depots of a PS) are initiated at the Transit Base at the port in the case of imports, or at the factories of the old SNS. These loops are closed mainly at R1. Let us find out how this takes place.

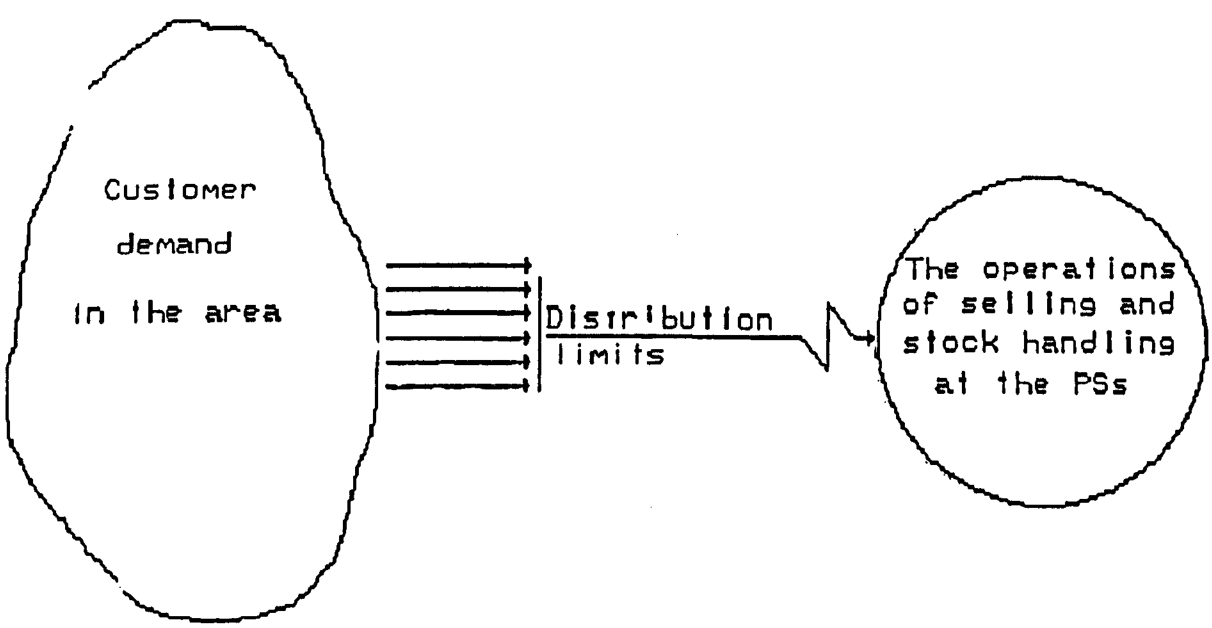


Fig.13.8. The distribution limits as a variety filter.

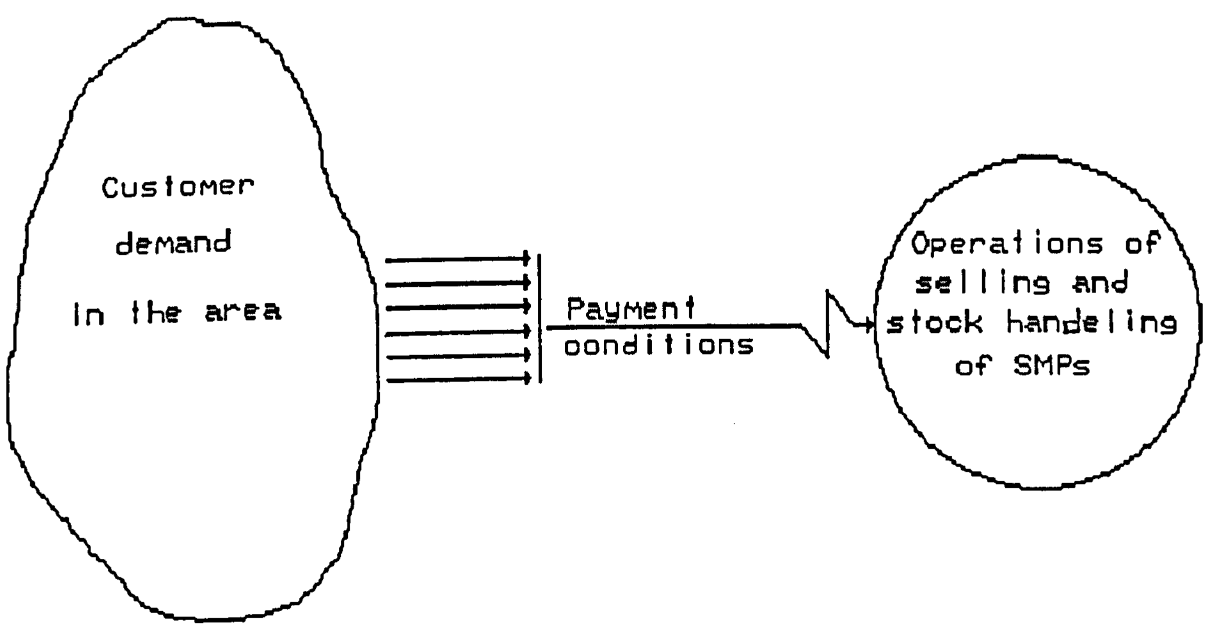


Fig.13.9. The payment conditions as a variety filter.

II.1.1 SMPs ARRIVING FROM LOCAL SUPPLIERS

On arrival of the merchandise at the PS, it and the accompanying documents are checked and then an information loop is initiated [GCL/VEI (E19), (E21), 1973]. A special document for the purpose (Bon d'Entree SNS, in short BE SNS) is issued, with four copies. One copy is kept at the level of operations (depots) for inventory control purposes, another is passed up to the manager. His approval is necessary to start serving customers from any new arrival of SMPs. The third and fourth copies are sent to the metasystems of R2 and R1.

II.1.2 IMPORTED SMPs [GCL/VEI (E23), 1974]

As with the case of the locally supplied products, on arrival of the SMPs at the PS, the accompanying documents (Bon de Sortie Port, BS PORT) are transduced into another document, i.e. Bon de Transfert Port (BT PORT). This document follows the same route as BE SNS above. The difference between the two information loops (locally produced, and imported SMPs) is that in the latter case the loop is initiated at the Transit Base which is an organisational structure of the RU, whereas in the former case it is initiated in the general environment of R1.

II.1.3 INTER-TRANSFER OF SMPs [GCL/VEI (E29), 1974]

The transfer of SMPs to and from a PS can be operated in two ways:

a. Between the PSs of the same region as shown graphically by the squiggly lines between the circles of fig.13.5 above.

b. Between PSs of different RUs.

In the first case, the instruction for the transfer is initiated at the regional level. In the second case, the instruction comes from the metasystem of R1. In other words, and in either case, the information loop is initiated and closed beyond the PS. However, in the first case, the PSs involved in the transfer must acknowledge to the metasystem of R2 that the transfer is carried out. The acknowledgement is made to the metasystem of R1 when the transfer is inter-regional.

A graphic summary of variety filtration and amplification on the Environment <----> Operations loop is included in fig.13.16 below.

II.2 THE OPERATIONS <----> MANAGEMENT LOOP

In discussing this loop we adhere to our initial assumption that the PS is to remain a black box. Variety engineering remains at the horizontal level. Consider fig.13.10 below. The bulk of variety flow associated with the activity of selling SMPs is seen as carried through the channels of the regulatory centre.

The first filter to be found on this loop is one associated with the product catalogue. The possible Samples (Echantillons) normally in stock at a PS are rearranged into:

.Samples in stock which management (of R1) has decided not to market any more, i.e. they should be taken out of the catalogue. The code for this class is HC (Hors Catalogue), followed by a digit (0 - 9) designating the Limit of Distribution of the class (refer to section II.1 above).

.Samples in the Product Catalogue i.e. in stock. These are organised into five classes: A, B, C, D and E. Each of these is followed by a digit (0 - 9) to designate the Limit of

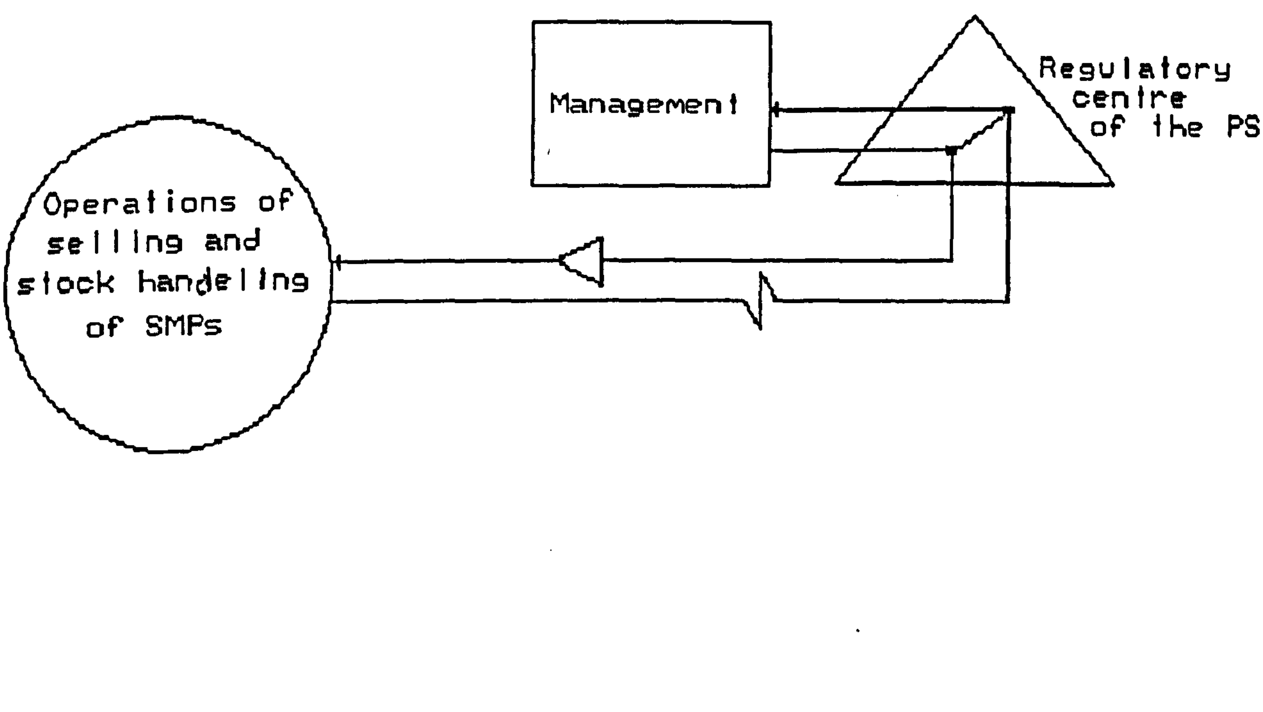


Fig.13.10. Variety engineering on the management <---> operations loop of a PS.

Distribution.

The replenishment procedure for the Samples in stock is a function of customer demand: one month for classes A and B, once every three months for classes C, D and E, thus:

C months 1, 4, 7,...

D months 2, 5, 8,...

E months 3, 6, 9,...

All movements of product samples in and out of the depots of the PS go through a Weigh-Bridge (weighing machine). A systematic verification is carried out, to check for comformity of the incoming products quality and quantity, with the accompanying documents (BESNS, BSPort, BTPark, etc. see above). The same procedure applies to the products going out to customers. These operations are summarised at the end of the day by what is known as a Weighing Day (Journee de Bascule, JB) [GCL/VEI (E24), 1974]. With the accompanying documents the JB is passed over to the management of the PS (in this case the Verifier, i.e. "le Verificateur") in the regulatory centre (fig.13.10). This Weighing Day or "Journee de Bascule" is an effective filter of operational variety. Management of the PS cannot possibly go through the detailed documentation of all the products coming into the PS, or supervise all the sales to customers.

The variety of the documents accompanying the movement of the products in and out of the depots is attenuated to two:

- .Weighing day for incoming products, i.e. "Journee de Bascule Entree" (JBE).
- .Weighing day for outgoing products, i.e. "Journee de Bascule Sorties" (JBS).

This is shown diagrammatically in fig.13.11 below.

Another type of variety flow between the operations (circle) and the management (square) of fig.13.10, concerns the financial aspects of sales activity. In GCL two types of bills made out to customers are distinguished:

.Cash, i.e. "Bon de Sortie au Comptant" (BSC)

.Credit, i.e. "Bon de Sortie a Terme" (BST)

All the operations of the day are summed up in a special document called: Statemant of Bills and Credit, i.e. "Releve des Factures et Avoirs" (RFA). The daily operations are recorded in a chronological order then passed over, at the end of the day, to the regulatory centre. Fig.13.12 gives a graphic presentation of this filter.

Like the previous loop, where most of the amplification of operational variety vis-a-vis the environment was carried out at higher levels of recursion, in this loop, Operations <---> Management, we find some returning amplifiers. The first of these is the Price Scale. It is an elaborate manual containing the prices of all the samples stocked at the points of sale. The second amplifier of managerial variety is to do with inventory. People in charge of the stock system are expected to carry out inventory checks for every class of the product samples A, B, C, D and E, following a preestablished programme. The objective of these inventory checks is to supplement the demand forecasts and the stock-outs provided by the management of the regional unit. Fig.13.13 gives a graphic presentation of the two amplifiers.

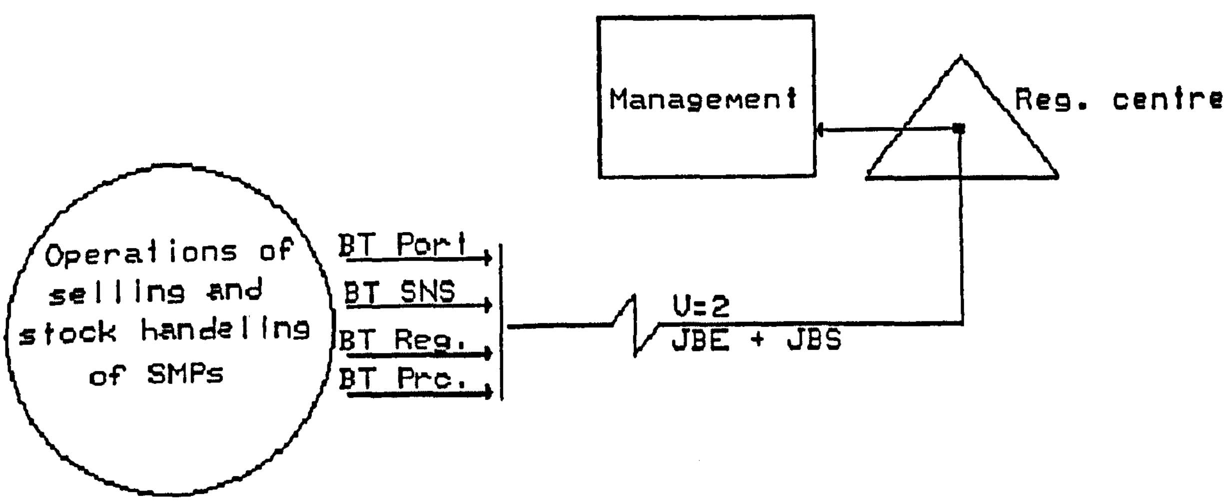


Fig.13.11. Operational variety filter.

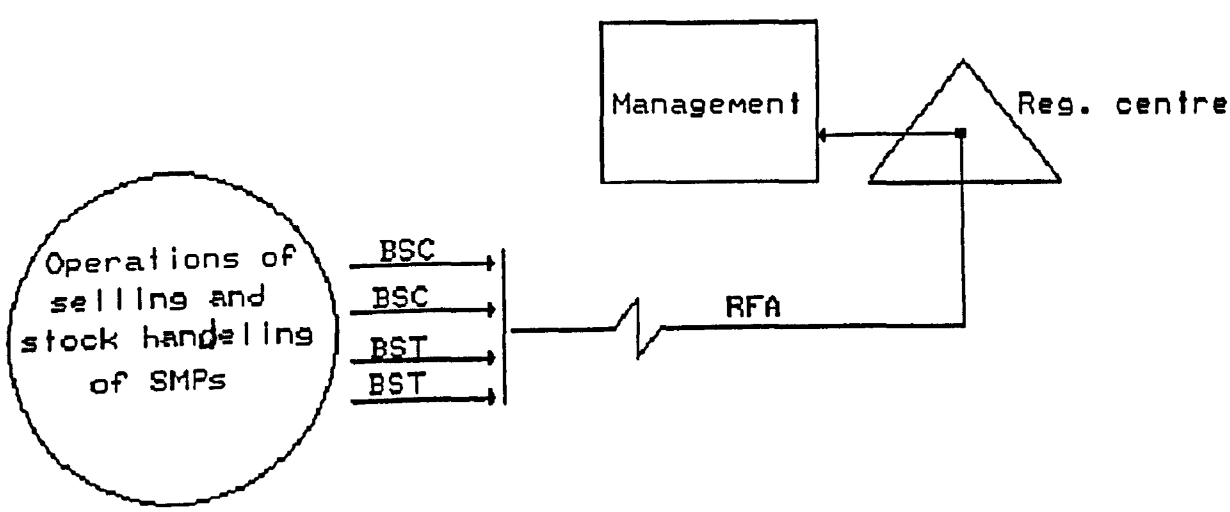


Fig.13.12. Operational variety filter.

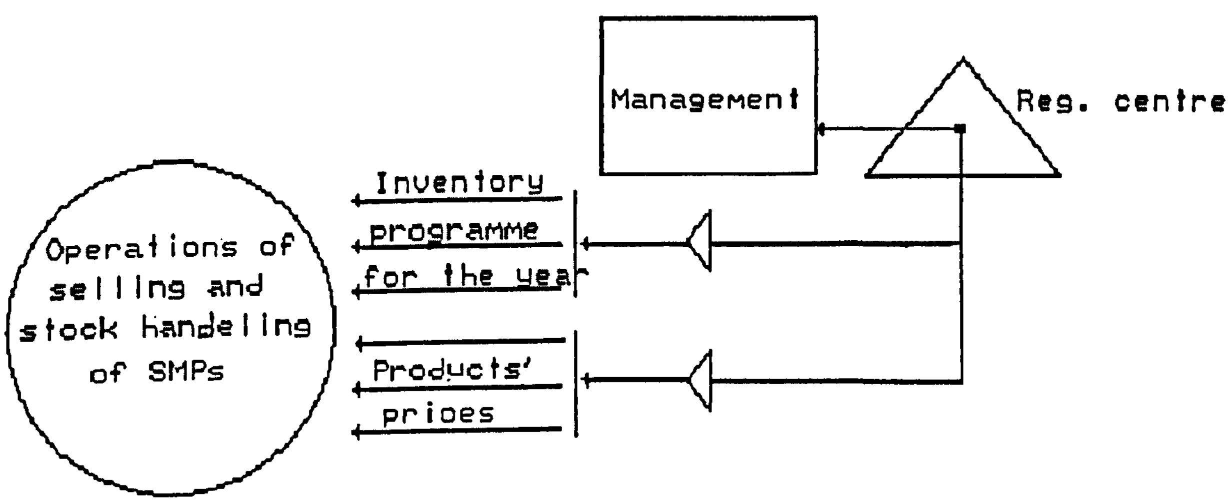


Fig.13.13. Managerial variety amplifiers.

In addition to variety flows of the routine type (information emanating from the regulatory centre of the PS to the foremen in charge of the depots) there is another type of variety which takes the form of instructions that come directly from the manager of the PS (le chef du point de vente). These instructions are related to operations of an unusual character, for example, action to be taken regarding withdrawing or degrading (declassment) of certain types of product samples from stock; also instructions concerning the transfer of products to another point of sale (see fig.13.14).

The communication mode at a PS, i.e. between the manager and his subordinates, is in fact different from the one existing between the management of the regional unit (RU) and the PS. Whilst the latter operates at a distance (telephone, telex, post) the interactions at the PS are direct, as all people work at the same location. Thus the manager has only to call a meeting (the amplifier of fig.13.14) of his subordinates in order to transmit instructions from higher levels of recursion [ibid].

To recapitulate, the diagram of fig.13.15 gives a graphic summary of the variety flows between the operations of selling and stock handling and the management at a point of sale (the organisation structure of a PS is standard for all the PSs of GCL).

Before we leave this level of recursion (R3, or the PS) to return to recursion level 2 (RU), let us briefly consider whether the cybernetic principles of organisation [Beer, 1985] and the law of requisite variety [Ashby, 1964] are being adhered to.

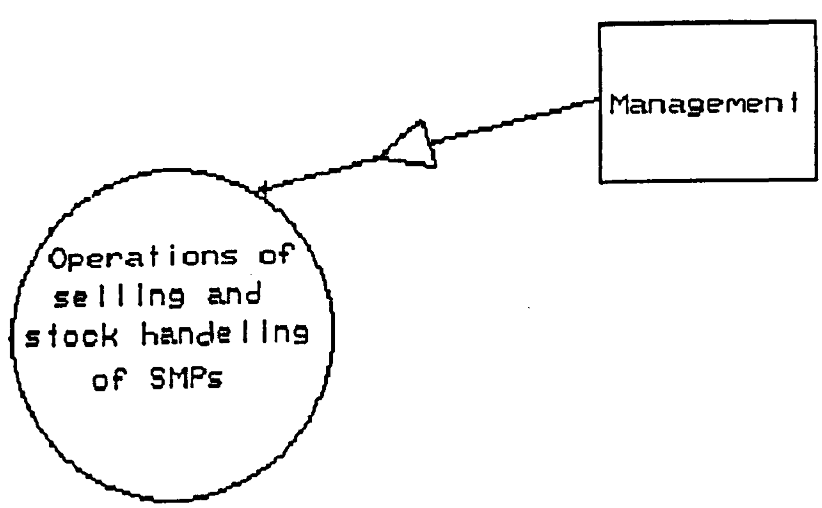
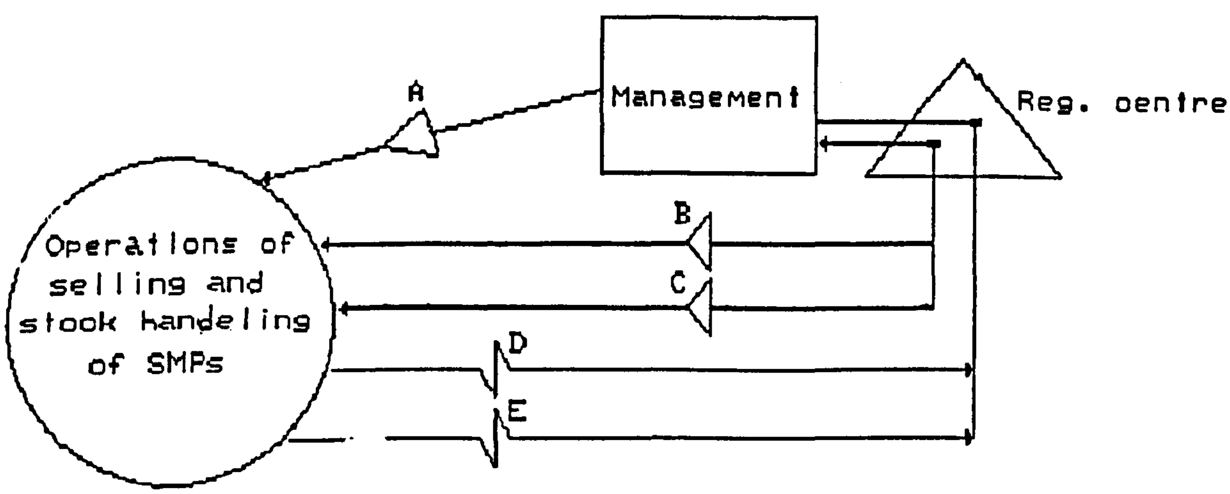


Fig.13.14. Managerial (command) variety amplifier.



A: Instructions regarding transfer, degrading and withdrawing product samples from stock.

B: Inventory programme for the coming period.

C: Price Scale manual for all the sample products.

D: Weighing day in and out (Journee de Bascule: Entree + Sortie, i.e. JBE + JBS).

E: Daily statement of bills and credit (Releve des Factures et Avoirs, i.e. RFA).

Fig.13.15 Variety engineering between management and its operations.

II.3 CHECK ON THE LAW OF REQUISITE VARIETY AND THE PRICIPLES OF ORGANISATION

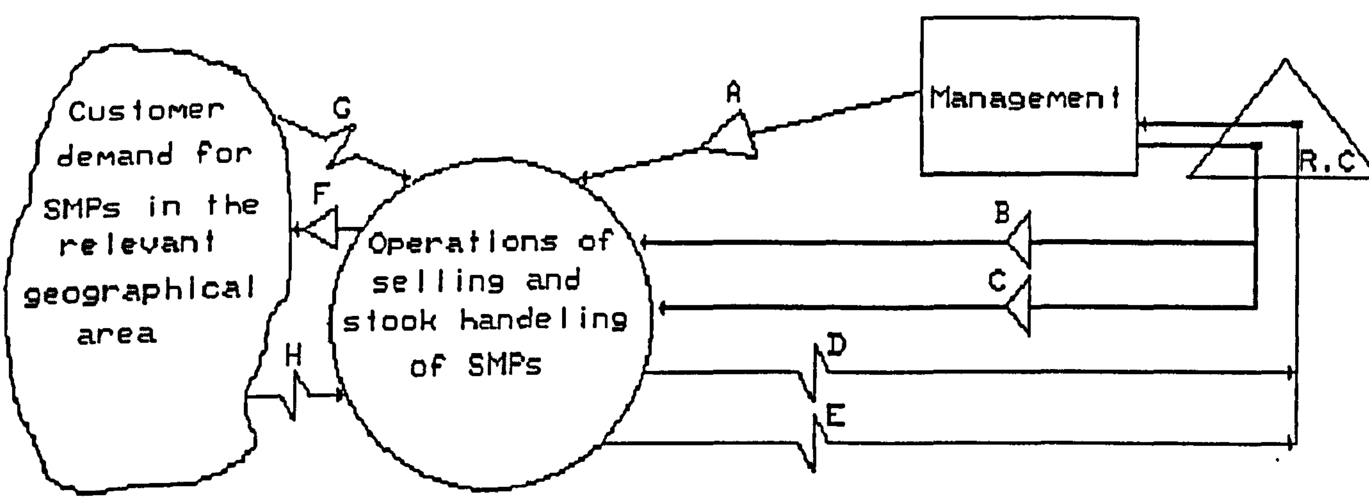
We begin by checking on the requirements of the law of requisite variety (which implicitly covers the first principle of organisation).

II.3.1 THE LAW OF REQUISITE VARIETY

Consider the overall diagram of a PS, fig.13.16 below. Let us take the loops of this horizontal variety engineering in turn and see if the requirements of the law of requisite variety are satisfied. It is thought appropriate to look into each loop separately. We consider the problems each of the two loops might have, then put forward appropriate recommendations which might alleviate the existing problems.

II.3.1.1 THE ENVIRONMENT <---> OPERATIONS LOOP

We notice that variety amplification towards the environment gets less attention than variety filtration. Apart from the one amplifier (product catalogue) which is designed by the metasystem (R1) most of the effort is geared towards containing customer demand rather than inducing it. This state of affairs gives an indication of the metasystemic interference in the activities of the PS. Information sent out or distributed to customers or dealers (revendeurs) regarding new samples in the PS's stock, samples withdrawn from stock, revised price scales, etc; all this is the prerogative of the metasystem (R1). As we mentioned in chapter 11, GCL has a computerised central file of all its customers which it uses for this. Further, the very limited publicity (in the



A: Instructions regarding transfer, dgrading and withdrawing of product samples from stock.

B: Inventory programme for the coming period.

C: Price Scale manual for all the product samples.

D: Weighing Day in and out (i.e. JBE and JBS).

E: Daily statement of bills and credit (i.e. RFA).

F: The sample products catalogue.

G: The distribution limits (les limites de distribution).

H: Payment conditions.

Fig.13.16. Overall variety engineering of a PS.

national newspapers) which is meant to inform the public of GCL's marketed or newly introduced products is also centralised (refer to the discussion of system four in chapter 15).

The design of the variety filters G and H (like the amplifier F) of fig.13.16 is carried out at the metasystem level (R1). The drawback of having these filters and amplifier designed by the metasystem is that the latter lacks requisite variety vis-a-vis local conditions. This is particularly relevant to the design of the filter H. The level of affluence of the population, and the level of economic activity, is not uniform throughout the regions. For example, the type of demand in the mostly urban areas served by the points of sale of the regional unit of the centre (RUC) differs from the demand in the rural areas of, say, Annaba (RUA). To have the same payment conditions apply indiscrimately to all localities in the country is in sharp contrast to the principle of serving all customers equally.

Apart from the fact that environmental variety filters are designed elsewhere, does the existing arrangement provide the PS with requisite variety vis-a-vis its customers? The answer is that it does not. Consider the case of customer returns of unsatisfactory goods. This type of situation is anticipated by the system and is referred to as "rendu client" [GCL/VEI (E35), 1974]. When the customer brings back the commodity to the PS, because of non-comformity to specifications or damage etc., he/ she expects to be received and dealt with at the PS. When the merchandise originates from the PS itself, people operating the depots are in a position to take action. The problem to the customer in this case the lengthy procedures which must be gone through before he/ she gets his/ her money back. This he/ she will get by a cheque from the metasystem (R1) since financial matters are centralised. The lack of requisite variety of the management of the PS here is manifest. It cannot satisfactorily deal with the customer without referring the matter to the metasystem.

The second case, which is even worse in terms of requisite variety, is when the merchandise rejected by the customer has been delivered to him/ hre directly from the factory or from the port (i.e. direct orders or "Commandes Directes"). At the operations level of the point of sale (fig.13.16 above) it is those in charge of reception at the depots who initiate the documents (BE SNS, BE Port) for the entry of the merchandise. However, in most cases, direct deliveries are related to SMPs not stocked at the points of sale. This means that the receptionist of customer complaints and rejects is dealing with product samples with which he/ she is not familiar.

In addition to this administrative difficulty, the rejection might be due to damage. In this case, to establish the rights of the customer according to the procedures, the merchandise has to undergo inspection by an expert appointed by the metasystem.

Whatever the reason for the customer's rejection of the merchandise, the final settlement in the case of direct orders resides with the metasystem (R1).

Customer rejection is, in fact, frequent and this is a direct consequence of the centralised nature of the processing system for direct customers' orders. The overload caused at the central level (EPO and TRC, refer to the organisation chart of GCL) by the flow of orders from the regional units, has made the system vulnerable to confusion in order specifications for the different customers of the different regions.

Another aspect of the variety imbalance in the loop Environment <---> Operations (of fig.13.16 above) is the total lack of control by the PS over the arrival time of SMPs at its depots. Owing to the lengthy information circuit, the time lags between the placement of stock replenishment orders and their arrival from factories, and particularly from the port (in the case of imported SMPs), is considerable. All the management of the PS can do is inform management at the regional level and wait. Meanwhile, the management information system in place makes no provision for the transmission of customer complaints about delays to the upper levels of recursion. It is left to the management of the PS to deal with the complaints and keep the peace with customers.

It is not very difficult for the manager of the PS to explain his/ her position to complaining customers. They know, from experience, the bureaucratic character of the system. However, this does not stop the manager himself (or herself) from complaining. He/ she is managing a system over which he/ she has no effective control. Too much of the variety flowing across the OE (PS), of fig.13.16, is supplied by the metasystem. More often than not the management of the PS functions simply as a transmitter of instructions (for example amplifier A in fig.13.16).

Having made this brief review of the problems encountered on the Environment <---> Operations loop, we now try to give some recommendations which we consider helpful to alleviate some of the problems.

To bring this operational element (PS) to a satisfactory equilibrial state, the management of a PS should be able to design amplifiers and/ or modify filters it considers appropriate to its local conditions, rather than simply using the standard filters put in place by the metasystem. In other words, the PS needs to:

.Have direct access to and be able to manipulate its relevant environment. It is not possible to have access to the outside (world) market because of government policy on foreign currency exchange. However, the PS could at least deal directly with the national suppliers.

.Manage its own credit recovery (recouvrement) from customers within the guidelines set up by the metasystem (R1). By having a more flexible credit policy, the PS could amplify its variety vis-a-vis its customers. This would make it easier for the management of the PS to sell those products of which there is an overstock.

.Possess true autonomy to carry out the sales activity in its local area the way it sees fit. This means that the management of a PS must be able to provide delivery facilities free of charge if the need arises. Also, the PS must have the freedom to mount publicity campaigns to complement the (rare) publicity provided by the metasystem, so as to let customers know more about the existing stock, delivery and credit facilities offered. These amplifiers would undoubtedly enhance the requisite variety of the PS vis-a-vis the local environment.

.Be allowed to carry out investigations into its own market and to forecast of local demand. It is true that the PS needs the expertise and the resources for such activity, but the current situation, in which the forecasting of demand and the determination of stock-outs is operated at recursion two according to a (lengthy) manual [GCL, 1976] dating back to the mid-seventies, does not filter adequately the local market tendencies, and in particular, does not reflect the delay times in delivering SMPs to the depots of the PS.

II.3.1.2 THE OPERATIONS <---> MANAGEMENT LOOP

We continue our check on whether the law of requisite variety is being observed on the operations <---> management loop. At present the PSs deal with deliveries from the domestic suppliers as they arrive. The information announcing their arrival often comes later, in some cases it never arrives, getting lost on its way through the hierarchy. The same applies to the SMPs coming from imports, when the delays are, in fact, even longer. It also happens sometimes that the telex informing the PS, emanating from the metasystem (R1) through the regional unit (R2) comes to the wrong PS. This explains why some information never arrives at the PS. If the PS had direct contact with domestic suppliers and the regional port (i.e. the transit base, or "base de transit" of the regional unit) the information channels would not be so overloaded. What this means is that the merchandise is introduced into stock but the normally accompanying information is, sometimes, not available. Selling SMPs to customers without having the manufacturer's specifications at hand causes problems to those operating the depots.

Also, the flow of SMPs into the depots of the PSs is usually irregular. It would be great help to those handling the stock if they are informed by the arrival of SMPs in advance. Knowledge of the arrival times of SMPs in advance and availability of information regarding their specification is necessary for smooth functioning of the operations of stock handling and selling.

Another major constraint imposed on the horizontal flow of variety (on the Operations <---> Management loop) of fig.13.16 is that the points of sale are not allowed to interact freely.

Apart from inherited managerial practice, there is no practical reason why they should not do so. In fact, in keeping with the new spirit of decentralisation of decision making (metasystemic ethos of the government level), it is necessary that interactions among the PSs take place. If this cybernetic necessity were catered for, we expect that time delays experienced at present, in the flow of information on the command channel, would be considerably alleviated. For example, inter-PS sale transfers of SMPs need not be the concern of the regional unit.

It seems that this loop does not suffer so much from the variety imbalance which is manifest in the previous loop (Environment <---> Operations). However, it is appropriate to emphasise that the operations of selling and stock handling would improve if the information concerning the specification of SMPs accompany the merchandise rather come through the channels of R1 and R2. We also recommend that the arrival times of deliveries of SMPs be forwarded to those operating the depots of the PSs before actual delivery. This would certainly improve the efficiency of those in charge at the depots. The amplification of variety concerning the arrival times is added to the amplifier C on the regulatory centre ---> Operations channel (which does not appear on fig.13.16).

As a summary (i.e. for both loops), fig.13.16 above is redrawn to appear as fig.13.17 below. For the sake of clarity it was thought best to assemble the amplifiers and filters on each loop. These include theexisting and the recommended amplifiers and filters; they are as follows:

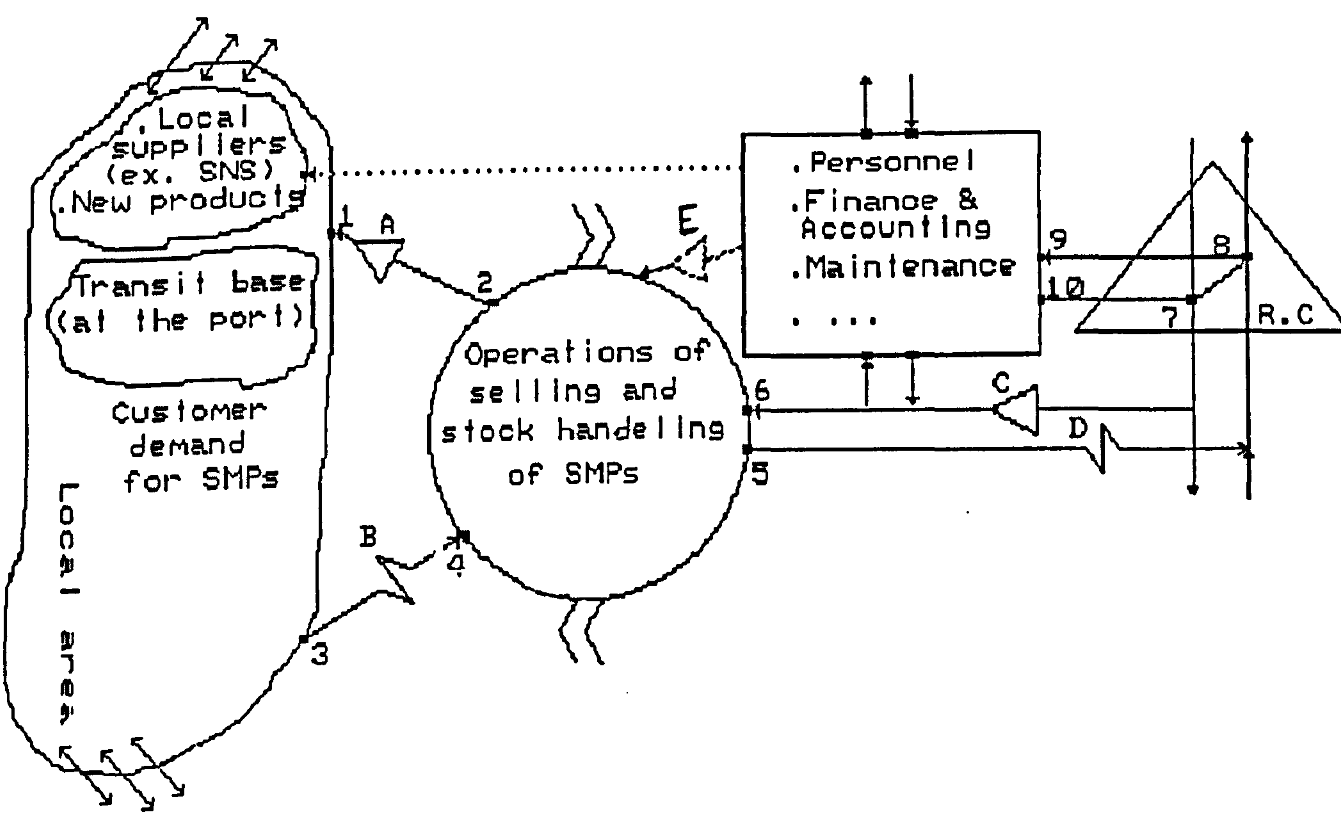


Fig.13.17. Reshaping the overall variety engineering of a PS

.Amplifiers A:

.Delivery facilities.

.Discounts and credit facilities.

.Publicity campaign through local dealers and road posters.

.The products catalogue.

.Filters B:

.The distribution limits.

.Payment conditions.

.Demand forecasts.

.Amplifiers C:

.The Prices Scale (Bareme des prix).

.Inventory programme (Programme d'inventaire).

.Arrival times of the deliveries (imports and domestically supplied SMPs).

.Filters D:

.Weighing day in (Journee de bascule entree, JBE).

.Weighing day out (Journee de bascule sortie, JBS).

.Statement of bills and credit (Releve de factures et avoirs, RFA).

.Amplifier E:

.Instructions regarding degrading or withdrawing of SMPs from depots.

On this diagram we also indicate the squiggly lines above and below the circle (operations) to stress the necessity of interactions among the PSs of the same region. The same goes for the arrows emanating from and converging on the regulatory centre, i.e. there should be a flow of information among the regulatory centres of the PSs of the same RU. The same can be said about the management boxes, regarding the interactions between the adjacent environments. The dotted line indicates that the management of the PS needs to have direct access to its local environment.

Proper design of amplifiers and filters cannot in itself guarantee homeostatic equilibrium at the point of sale. A comprehensive variety engineering of the PS has to include a check on channel capacity, on transduction capacity, and a check that continuous flow of variety is maintained in all the loops all the time. To avoid repetition, we use the same figure (fig.13.17) to illustrate these points below.

II.3.2 CHANNEL CAPACITY

Here we try to adopt the same approach as in the previous section, i.e. to shed some light on the existing problems, then proceed to put forward some recommendations for the channel capacity of each set of amplifiers and attenuators. This we will do with reference to fig.13.17, without necessarily separating the two loops as was the case in the previous section.

We begin with the amplifiers A. It is plausible that the benefits of the credit and the delivery facilities are not reaching all the customers in an area. Owing to the limited resources (financial and transport fleet) at the disposal of the PS, it is more likely that the customers who are nearer and better known to the PS will benefit most from the services offered. This to say that, for those who live far from the PSs, the channel capacity of these amplifiers is virtually zero.

As to the product catalogue, to some extent it is sufficiently organised. It carries the necessary information to satisfy the customers who regularly deal with the existing stock of SMPs. However, for new customers, it may inially prove too technical. As we mentioned earlier, it is designed to be used as a common tool for internal use by the services of GCL as well as a guide for customers. This idea of the double function of the product catalogue can work to the detriment of its primary function, which is as a means or channel to carry information to customers about GCL's marketed products.

Next, is the set of filters B. One of these filters is to do with the payment conditions of customers regarding their transactions with GCL. However, if we take the frequency of unsettled payments (impayes) as an indication, we could say that the payment conditions are misunderstood or not taken seriously by customers. In other words, the payment conditions are not attenuating the undesired states (non-payment) GCL wants to avoid.

As to the distribution limits, only regular clients are aware of their existence and this only as regards the sample products with which they themselves deal. The ordinary customer does not know their applicability to the various samples.

Consider now the set of amplifiers C. In general, these amplifiers operate satisfactorily. However, to allow the option of a discount price for certain samples of products, the Price Scale manual should be accompanied or enhanced by some flexible guidelines which give scope for the PS to offer discount prices, should the need arise. It is also important to notice that the inventory programme operates reasonably in normal conditions. It is established in advance to fit a typical period. In certain circumstances, however, it does not answer the requirements of the stock-handling operations when supply of certain classes of product samples increases, for example sudden arrival of delayed orders. In these cases, it might prove difficult for the operators to complete the inventory programme in time. However, this appears to be a difficulty from which the PSs cannot escape.

The last is the set of the filters D. Normally, there is no problem with these filters at present.

II.3.3 THE CAPACITY OF THE TRANSDUCERS

Again, we follow in this sub-section the same line of reasoning as adopted in discussing the channel capacity, i.e. we briefly expose the problems, then give recommendations.

Refer once again to 13.17. On the environmental side of the loop Environment <---> Operations (node "1" and node "3") we find that the PSs pay little attention to the question of transduction. For example, the language of the sample products catalogue is not well understood by most potential customers. The organisation of the catalogue into samples of products is motivated by the internal needs of GCL, rather than the desire to acquaint the customer with the SMPs available. To alleviate the difficulties customers find in understanding the language of the catalogue, we could envisage a situation where the catalogue is designed in such a way as to take into consideration the needs of the customers rather than emphasise the internal needs of GCL.

We turn now to the loop joining the operations with the management box. The Price Scale (Bareme des Prix) manual needs rearranging. Not all the samples for which prices are quoted in the manual exist on the stock list of a PS at all times.

Thus it is sometimes confusing to operators at a depot (particularly in PSs poorly replenished in remote areas) to use a thick manual out of which they need only a small list of product prices. Also, at node "6", the inventory programme undergoes transduction. Weeks are converted into exact dates, and the schedules are prepared for the different parts or locations of every depot. Apparently no major difficulties are encountered here.

At node "5" the summarised information regarding the weighing day (in and out), and the statement of bills and credit, are prepared on special documents provided for the purpose by the metasystem (R1) and sent to the regulatory centre. Arriving at node "8" the information is again transduced and filtered. The transduction at node "9" consists of replacing the technicalities as much as possible before passing the information over to the manager. Node "7" can be seen as the opposite of node "8", transducing the instructions of management, and those emanating from the RU through node "10", to more detailed programming (for example inventory programmes) amenable to the language of the foreman at the depots.

It seems that on the Operations <---> Management loop the transducers in place operate reasonably satisfactorily, except, to some extent, the Price Scale manual at node "6".

We must add to the discussion, above, of the adequate design of amplifiers and attenuators (to meet the requirements of the law of requisite variety), of the provision of channel capacity, and of proper transduction mention of the fact that information flows in the PS of fig.13.17 are not continuous. This should come as no surprise, knowing that time lags are characteristic of GCL's information system. Cybernetically, however, this should not be the case. We expect the information flows on the channels of a PS to be always continuous (the fourth principle of organisation [Beer, 1979]).

Before we end discussion of variety engineering at R3, let us recapitulate. We began by tackling the horizontal flow across a PS as an OE. This we did by separating the two loops: Environment <---> Operations and Operations <---> Management. Having identified the appropriate variety amplifiers and attenuators on the two loops, we moved on to discuss whether the variety flow conforms to the law of requisite variety, whether adequate channel capacity is provided, and whether proper transduction takes place. For each of these points we enumerated the problems, then we put forward recommendations where it was possible.

This exposition of the activities of a PS and the flow of information in its channels provides us with necessary insight into the flow of information from the operational level of the RU (i.e. the totality of its PSs). This corresponds, as we know, to the horizontal flow. With this in mind, we go back now to our chosen regional unit, namely the RUC (the regional unit of the centre). Thus we return to recursion level two (R2).

III. VARIETY ENGINEERING AT R2: THE REGIONAL LEVEL

In this section we deal with variety flow on the vertical plane. We begin by describing environmental interactions and operational interactions, then put forward appropriate recommendations which we consider as relevant in improving the situation. After that, we tackle variety flow in the managerial domain in the same manner, i.e. describe the existing system, then diagnose its ills, if any. We end the discussion of this section by dealing with the question of resource allocation to the regional units. Again we follow the same approach, i.e. describe the present practice, then propose a cybernetic remedy if the need arises.

Refer to the diagram of fig.13.18 below. It represents RUC with its (seven) points of sale. Between them they exhaust the operations of S1 (i.e. of RUC). The organisational task of any PS is the same. The only noticeable difference between any two PSs is that the level of activity of those in densely populated areas is appreciably higher than those in remote areas. Generally speaking, however, the difference in the level of activity is more significant between PSs of different regions than between PSs of the same region. As far as the information loops are concerned, the only difference to expect is in the number of OEs (i.e. the PSs) of S1 of the RU in the case of R2, or in the number of depots of a PS in the case of R3. S1 of fig.13.18 is a reproduction of fig.13.17 above seven times (one for each PS). We have dealt extensively with the horizontal variety engineering, i.e. for a PS, within the limits of keeping the latter a black box. Being at the next level of recursion up (i.e. R2), the variety engineering we are now considering is vertical, since the RU stands vertical or orthogonal [Beer, 1979] to its PSs (S1).

The VSM of fig.13.18 below gives a full diagrammatic account of RUC. However, our intention here is not to make it transparent (since it is not the system in focus) but to show the existing information loops at work. This knowledge is necessary and will become useful when we come to consider systems two and three of GCL in the next chapter.

III.1 ENVIRONMENT, OPERATIONAL INTERACTIONS

Consider the environmental interactions of fig.13.18. Although there is a geographical demarcation, as already mentioned, between the PSs, in reality there exists an overlap among the local environments. In addition, there is an aspect of the general environment (i.e. at the level of R2) which is shared among all the PSs. This explains why the local environments of the PSs are shown to be floating inside the shared enveloping environment. This is mainly to do with the supplies of SMPs, whether nationally produced or imported from abroad. The latter case is represented (for this level of recursion R2) by the transit base (Base de transit) in the port of the region. For the case of RUC, there are two transit bases: one in the port of Algiers and another in the port of Delys, some hundred miles from Algiers. Consulting the organisation chart of an RU (see Appendix B) will show only the hierarchical relationship between the transit base and the management of the RU. This gives no indication of how the PS is supplied with SMPs from the port. The hierarchical relationship referred to here is totally inadequate for presenting the environmental relationships between the RU and its PSs.

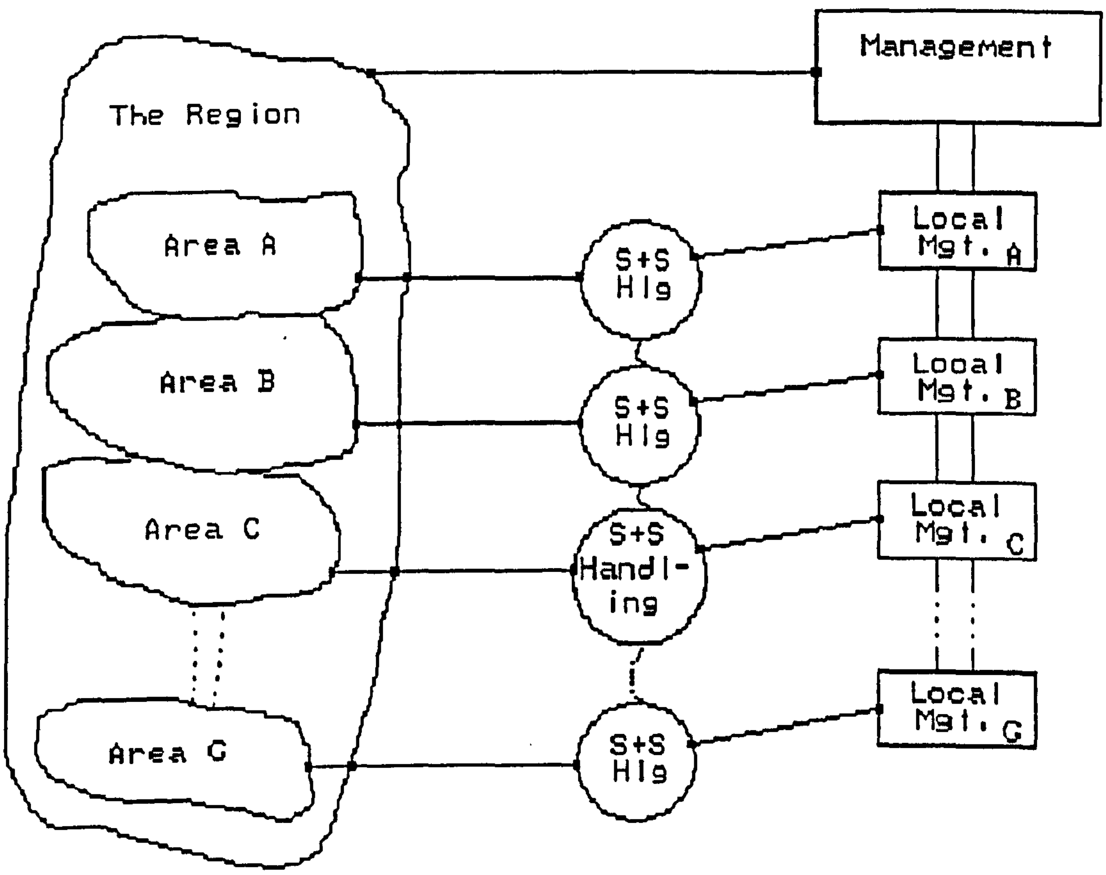


Fig.13.18. The VSM of RUC.

Fig.13.18 also indicates that there is a portion of the environment which exclusively belongs to the metasystem of the RU. The specificity of this environment resides in the fact that the level of economic activity, and the scale of the urbanisation drive in the central region of the country, and the consequent heavy demand for SMPs used in the construction industry, make demand for SMPs significantly different from that in other regions, both quantitatively and qualitatively.

We mentioned in chapter 11 that part of GCL's mission is to promote nationally produced SMPs. One role of the metasystem of RUC and that of every region could involve implementing this task (a position which unfortunately does not exist at present). If it carried out proper analysis of the economic activity and monitoring of the customer demand for SMPs in the region, the metasystem of RUC could influence supply by advising the local producers to orient their production towards certain types of SMPs. In other words, the metasystem of an RU could play a double role, on the one hand informing its "clientele" of the existing SMPs and on the other hand, passing over the requirements of customers to the manufacturers.

The next step in this vertical engineering of variety is to look at the interactions between the circles (the operations) of fig.13.18 above. The present practice does not allow free flow of variety between the operations. The variety concerning links between the operations is exclusively supplied by the metasystem. The consequences for the operational interactions are the constant delays in getting the SMPs transferred from one PS to another. The thin squiggly lines appearing between the circles of fig.13.18 reflect the fact that the only existing interaction between the operations is the actual flow of SMPs. The corresponding flow of information regarding the transfer of the products comes through the managerial channels.

As we saw in the previous section the bulk of the information flowing from the PSs is of a routine character. This implies that the channels of the regulatory centre should be used extensively, contrary to the present practice where the organisational structure requires that information should go through the command channel. Knowing that the organisational structure of GCL is built following the classical theory of organisation, it is not surprising that GCL experiences problems of information overload (refer to the classical model of the organisation, chapter 3). As fig.13.18 indicates all the information generated at the operational level (the PSs) is passed over to the RU's management (no filters on the way). This reflects the hierarchical (in the classical sense) character of GCL, where it is expected that superiors invigilate all actions of their subordinates. This explains the continuous overload in the information channels and the chronic time lags with which GCL is infested throughout its structure.

From the cybernetic standpoint this is to be expected; the system (i.e. GCL) is in a pathological state. By contrasting fig.13.18 above and fig.13.19 below we soon discover the reason why. The first diagnosis to come from studying fig.13.18 is that there are numerous information loops which are initiated at the operations level (PS), and which should be closed at the same level if S1 is to have real autonomy and discretion in managing its operations. There is no need to transmit the detail of all the transactions with customers to the regional level (eventually to central level).

The second point which is diagnostically important concerns the channels of the regulatory centre. As stated above most of the information is of a routine character. This means that, in terms of the VSM, this routine information should be switched from the command channel to those of the regulatory centre. Fig.13.19 makes explicit this diagnosis. Allowing for autonomy to the PSs, as advocated cybernetically, the management at the regional level (metasystem R2) accepts the fact that it should manage at a distance. Environmental overlap is bound to happen at the local level; for example the impact of free transport for certain products offered to customers by one PS must have reverberations on customers in the neighbouring areas. This, and the free interactions between the operations (the squiggly lines) regarding the transfer of SMPs, alleviate much of the vertical variety hitherto flowing on the managerial command channel. In addition to the routine information, the regulatory centre handles the variety that could be generated from potential oscillatory behaviour, resulting from the PSs behaving autonomously.

Another important addition to fig.13.19 above, as compared to fig.13.18, is the monitoring channel on the left of the diagram. This channel is of utmost importance to S3 of the regional management, within the evolving framework of the VSM. Owing to the present structural arrangement which results, as we have seen, in a constant overload of the existing channels (fig.13.18 above), the management at the regional level cannot find time to study the reports prepared by the technical

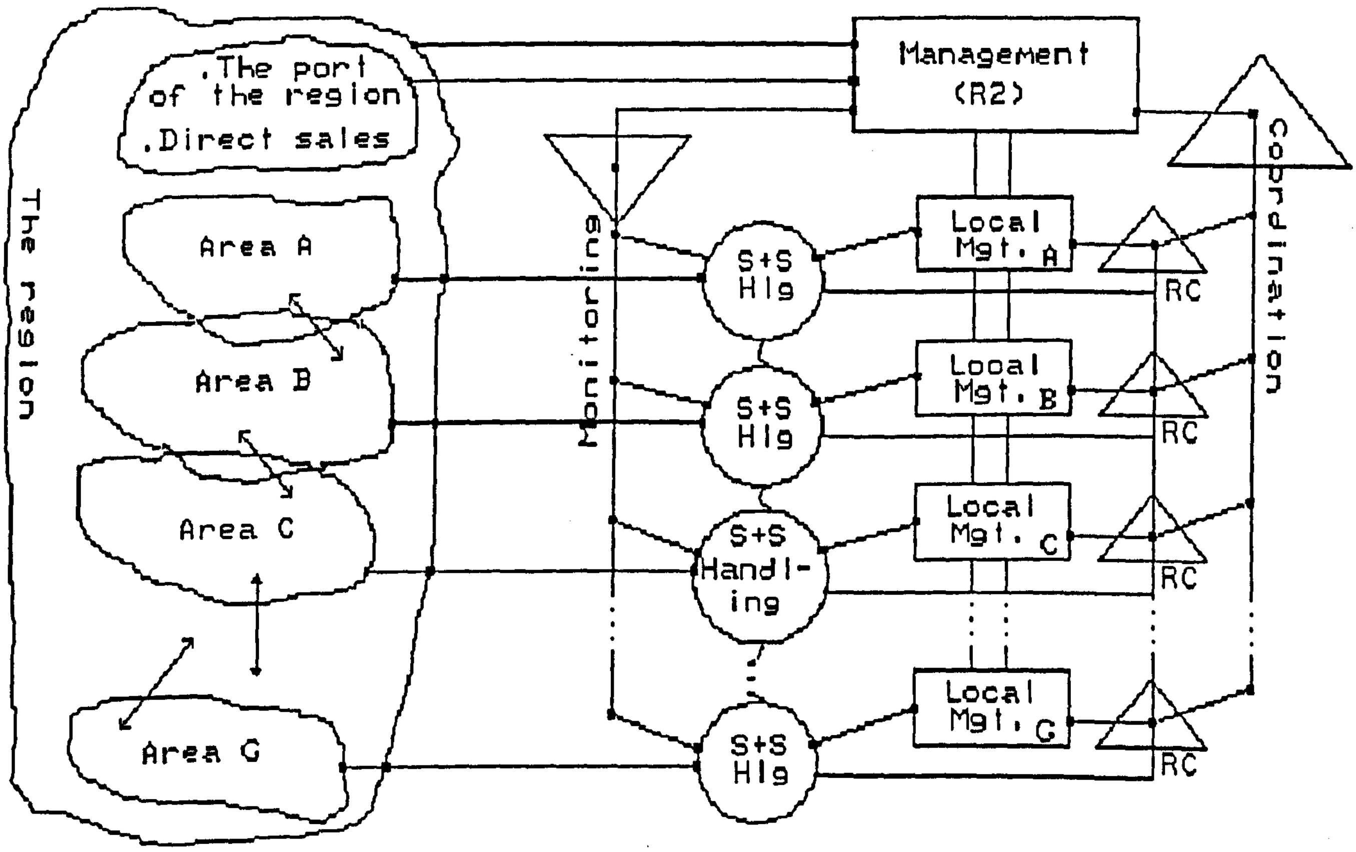


Fig.13.19. The improved VSM of RUC.

division and finance and accounting division. These concern the state of the machinery and the accounting practices of the PSs, which must abide by the National Accounting System (Plan Comptable National, PCN) for which the metasystem is legally responsible. This lack of requisite variety of the RUs management, vis-a-vis the operations of the PSs, can only be offset by installing the monitoring channels of fig.13.19 above. Since the RU is not our system in focus we will not dwell further on these channels here. Instead we turn to the question of reassessing managerial vertical variety engineering.

III.2 MANAGERIAL VERTICAL VARIETY REASSESSED

In this chapter about S1 of GCL, we have focused discussion so far on variety engineering on the operational side. To understand the information flows and owing to the characteristics of the structure of GCL, it was necessary to drop one level of recursion and look into the horizontal variety engineering of the OEs (the PSs) of recursion 2 (R2) without, however, going into details in this modelling. It would not be possible to get to grips with the information flows through the channels of R2 and R1 without an initial understanding of the nature of the commercial activity, which is basically performed or implemented at the PS level, albeit with excessive interference. In this section an attempt is made to reassess the information flows on the command channel, which cybernetically must be minimal and limited to resource allocation and accountability for resources [Beer, 1979, 1985].

In chapter 11 we distinguished between two types of information system used by GCL: specific and general systems (remember a system here refers to a software package). Systems of the specific type are of an operational character. In that sense they are the domain of system two (S2) or the regulatory centre. As to the general systems, there are: the integrated accounting, budgeting and fiscal system (systemes comptables, budgetaires et fiscaux, SCBF), personnel management system (systeme de gestion de personnel), the file of GCL's business partners (fichier tiers) and the file of the main products (fichier des produits principaux). The information generated by these systems is expected to flow, at present, on the central command channel. Apart from some aspects of SCBF, to which we will give extra attention shortly due to the importance of this in supplying management with control information, it is argued that the other general systems should be added to the regulatory battery of S2.

Consider fig.13.20 below. We are now at recursion level one (R1). In terms of the VSM we expect the command channel linking S1 of GCL to its metasystem to be reserved for variety flow concerned with resource allocation and the accountability of the RUs for their resources [ibid]. However, for GCL the situation is manifestly different. We mentioned in chapter 11, that the present management information system (including SCBF) dates back to the days of the old SNS. The latter was restructured (refer again to ch.11) with a view to making GCL more autonomous and extending that autonomy to the RUs (S1) of GCL. However, much of the decentralisation of decision making, supposed to accompany the restructuring drive of the government, remains of no managerial consequence. GCL (and the rest of ENS of which GCL is part) is trapped by the existing

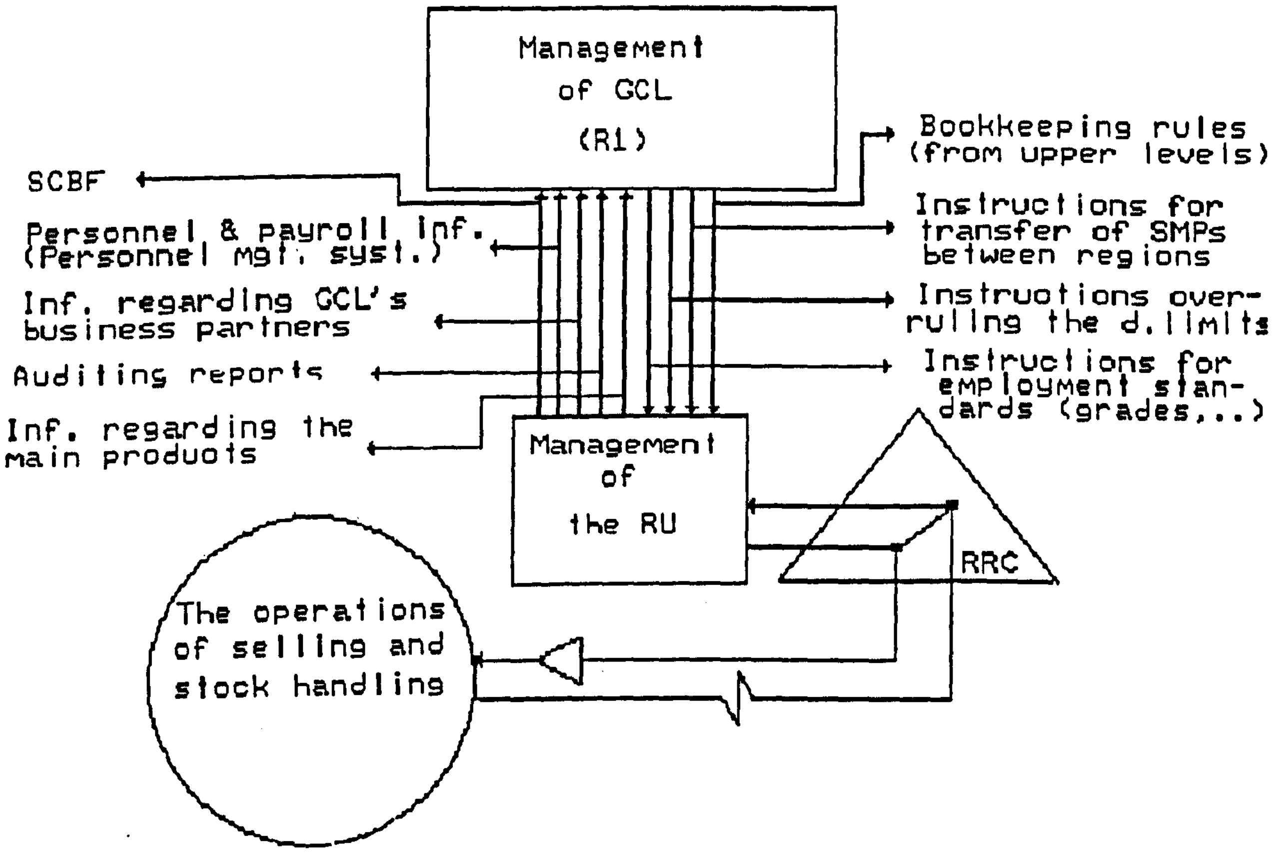


Fig.13.20. The present state of the GCL information system.

management information system, the legacy of SNS, particularly in terms of the information flowing upwards from the RUs. The management of an RU is expected to act autonomously within the agreed plan and budget, in accordance with the spirit of the restructuring process of the economy, but the management information system (essentially SCBF) linking it to the metasystem ensures that all is reported upwards, albeit with a time lag. The information loops thus generated have to be closed by the metasystem, again after a time lag (refer to fig.13.20). The result is that the system is infested with time lags and the command channel is overloaded with information that should be flowing elsewhere.

The existing software mentioned above (SCBF and the others) although poorly adapted to the new reality of GCL after the restructuring of SNS, constitutes an expensive investment which GCL cannot scrap. Nevertheless, some change to improve vertical variety engineering can be made.

Refer to fig.13.21 below. As this figure indicates, the bulk of the routine information could be transferred to the S2 channels (refer to S2 next chapter). Also, the information generated by the auditing activity of the metasystem, whether it concerns accounting practices or inspection of the state of stock handling or equipment maintenance at the PSs, might be diverted from the command channel to the monitoring channel. For the command channel, we are left with that minimal information regarding budget proposals, and the corresponding resource allocation to carry them out. Added to this information might be instructions relating to exceptional cases, where certain customers, usually from the public sector, are allowed to exceed the distribution limits (refer to section

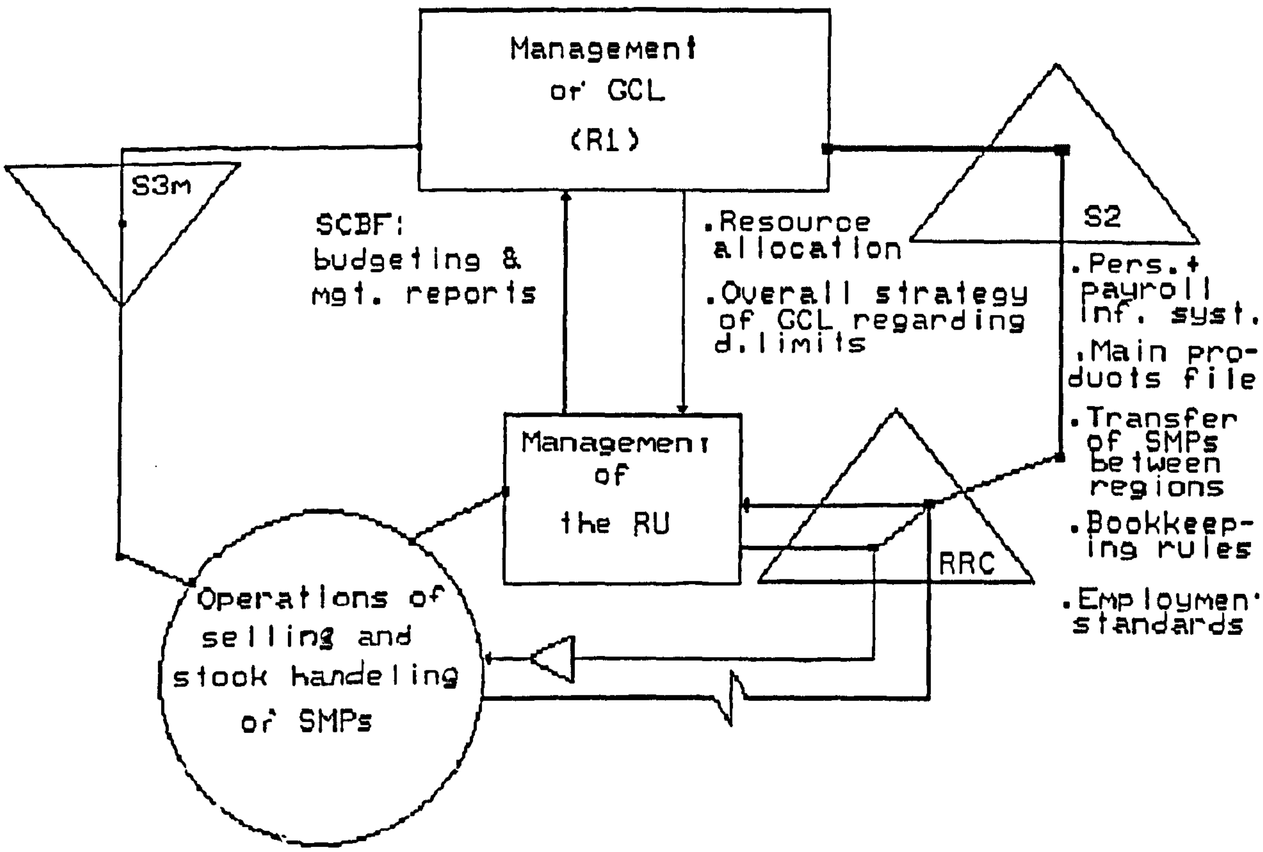


Fig.13.21. The information system of GCL redeployed.

I above). In fig.13.21 the S1 (i.e. the RUs) side of this information loop is represented by the integrated accounting, budgeting and fiscal system (SCBF).

SCBF as a management information system was conceived and built around the structure of the old SNS (see ch.11). At present it operates for ENS (the parent of GCL or R0, see ch.12) in the same fashion as it used to for SNS. In other words, the structure of ENS was put in place so as to be compatible with the inherited management information system, which explains by and large why the organisation chart of ENS is an exact replica of that of SNS (see Appendix A). This amounts to saying that the destination of the information supplied by SCBF from the lower recursion level (the RUs) goes beyond recursion one (the system in focus) to R0 (ENS). Owing to its importance in the information network of GCL, it is appropriate to discuss, briefly, organisation of SCBF as it operates at present.

SCBF is organised so as to provide information for control purposes at different levels of aggregation which correspond to the levels of recursion: R2 (the RU), R1 (GCL) and R0 (ENS). It is also flexible in its levels of aggregation to allow each operational element of ENS, in addition to GCL, to structure its budgeting process. SCBF recognises the following levels of aggregation or budget structures (structures budgetaires) [ENS/DF, 1985(c)]:

.The basic operational centre (centre operational de base or COB). This is the first i.e. the lowest structural level accepted by SCBF. For our modelling purposes COB corresponds to an RU (R2). It is at this level that all the budgeting objectives are determined: "C'est au niveau COB que sont fixes tous les objectifs budgetaires" [ENS/DF, 1985(d)].

.The management entity (l'entity de gestion or EDG). This lies at the intermediate level between the COB and the total unit (GCL) around which the budget is articulated. For GCL, the management entity (EDG) corresponds to the intermediate structure (functional) between the RU and the senior management of GCL. The criterion by which to distinguish an EDG as a structure to be incorporated in SCBF is that it should permit the setting up of clear and separate objectives from other EDGs of the same unit, the integration of which make up the ensemble of the objectives of the unit [ENS/DF, 1985(c)]. Like the basic operational centre (COB), an EDG can cover an operational entity as well as a functional one; for example the functional subdirectorates S/D MI and S/D TRC (see fig.13.1 of section I above and section III.1.2 ch.11) are considered as EDGs by SCBF.

.The possibility of another structural level between EDG and the total unit. This level is referred to as the patrimony and management entity (l'entite de gestion et de patrimoine or EDGP). This possibility is an option in SCBF relevant to other operational elements of ENS (remember that SCBF is ENS's not GCL's).

In addition to this structural arrangement, SCBF also requires the SMPs commercialised by GCL, and those produced by the factories of ENS for export, to be grouped in particular units [ibid], these are: Lines of production and consumption (Lignes de production et de consommation or LPC). An LPC is made up of an integer number of samples of products; also the group of product samples making up an LPC must be homogenous in terms of the measuring unit and tax rate. This is the limit of detail accepted by SCBF in order to supply information regarding the physical flow of products. To answer to the needs of management for synthesis, LPCs are grouped in what are known as "lines of consolidation" (Lignes de consolidation or LC) which in turn are grouped in a "family of lines of consolidation" (Famille de lignes de consolidation or FLC).

Having dealt with its organisation, we try now to describe the way SCBF is used by the management of GCL as an information reporting system.

III.2.1 SCBF: THE MANAGEMENT REPORTING SYSTEM

In this sub-section, we try to give an insight into the way SCBF is used to provide management with information. It is hoped that this exposition will give an indication of how easy it is for management to be overloaded with information in the present system.

The role of SCBF as a reporting system for management control purposes is so important that we need to elaborate on its place in the vertical managerial variety engineering of GCL. It is built with the aim of providing the managements GCL and ENS with the following [ENS/DF, 1985(d)]:

.Processed data regarding actual achievement (sales, credit status, etc.). This data is extracted and fed into the system from the accounts at the various structural levels (COB, EDG, etc.), aggregated as they are passed up through the management structure until they reach senior management of GCL (eventually R0).

.Budgeting or forecasting data concerning future achievement (traitements des previsions). The forecasting horizon extends over two years. For a current year (t) the system aims to establish the objectives of the following year (t+1), at the same time as updating the objectives of the year (t) which were made the previous year. The forecasting horizon is apportioned as follows:

year (t+1) divided into three quarters

year (t) divided into two semesters.

The forecasts are then translated into a budget. This is prepared in the following stages:

.The physical budget (budget physique)

.The pre-budget (pre-budget).

.The management budget (budget de gestion).

III.2.1.1 THE PHYSICAL BUDGET

The physical budget in SCBF consists of processing the data from programmed physical flows of products [ENS/DF, 1985(c,d)]. It starts at the level of COB. At this level the data is made available on a special document (bordereau) required by SCBF to allow computerised processing. The data is then aggregated (consolidees) at the next structural level EDG (made up of more than one COB). This, in turn, is again aggregated to formulate the budget of GCL. This aggregation, or consolidation process of structural levels, is depicted graphically in fig.13.22 below.

For the sake of completion, and for reasons which will help explain the chronic delays with which the system is infested, it is appropriate to explain the process of feeding SCBF with raw data (saisie) [ibid]. The special document or format (the bordereau referred to above) appears in fig.13.23.

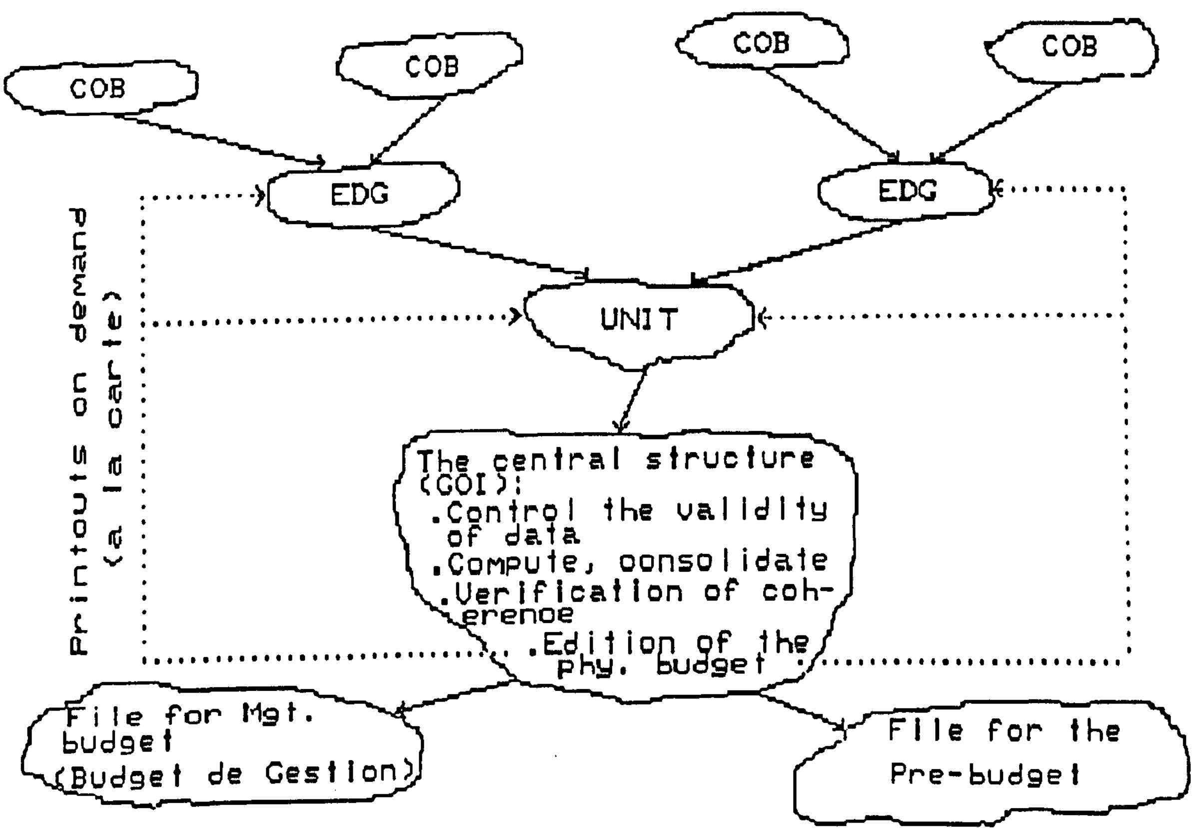


Fig.13.22. The aggregation of the physical budget.

Ds

PHYSICAL-BUDGET

Unit: |______________|

Data |_|_| |_|_| |_|_| Page |_| |_|

COS: |______________|

Inst: |______________|

Area for Entering Data			
Card	Unit	COS	Inst
|P|H|Y|	|____|	|____|	|____|
1 3	4 7	8 10	12

1. LPC 2. Information 3. Criterion	Unit for Measure	Area for Entering Data				Values					
		Up Date	Code LPC	Code Information	Code Criterion	Year |___|		Year |___|			
						Semestre 1	Semestre 2	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec
1. |____| 2. |____| 3. |____|	|__|	13	14 18	19 26	27 31	32 39	40 47	48 55	56 63	64 71	72 79
1. |____| 2. |____| 3. |____|	|__|	13	14 18	19 26	27 31	32 39	40 47	48 55	56 63	64 71	72 79
1. |____| 2. |____| 3. |____|	|__|	13	14 18	19 26	27 31	32 39	40 47	48 55	56 63	64 71	72 79
1. |____| 2. |____| 3. |____|	|__|	13	14 18	19 26	27 31	32 39	40 47	48 55	56 63	64 71	72 79
1. |____| 2. |____| 3. |____|	|__|	13	14 18	19 26	27 31	32 39	40 47	48 55	56 63	64 71	72 79

Fig.13.23. Format for entering data of the physical budget.

Boxes 1 -- 31 inclusive are reserved for the identification of the data to be fed into the system.

Boxes 1 -- 3 are always kept for the printed characters PHY (physique).

Boxes 4 -- 7 contain the code of EDG (or EDGP) or the unit concerned.

Boxes 8 -- 10 contain the code of the COB concerned.

Boxes 11 -- 12 concern the other (production) units (COBs) of ENS (i.e. irrelevant to GCL).

Box 13: MAJ (mis - a - jour), is employed for updating purposes. In it is inscribed any of the following codes:

C: Creation; when data is fed for the first time into the system or has been fed but rejected by the system.

M: Modification; to modify one or more of the values in the six columns (boxes 32 --- 79).

R: Replacement (remplacement); to replace all the values in the columns (boxes 32 --- 79) which already exist on file.

A: Annulation (annulement); used to erase the values of the six columns which already exist on file. When this code is used the columns should appear blank.

Boxes 14 -- 18 contain the code of the LPC in question. This code is extracted from a file in SCBF itself. For example, for the LPC "sulphide of zinc" (which would be inscribed in the space marked 1 at the left of the document) the code is A0108.

Boxes 19 - 26 contain the code for information regarding the LPC. For example for the information "initial stock", the code is CK02I, (the information itself is inscribed in the space marked 2 on the left of the document).

Boxes 27 -- 31 contain the criterion code.

Boxes 32 -- 79 are reserved for the data.

III.2.1.2 THE PRE-BUDGET

This constitutes the second stage in the preparation of the total budget. Preparation of the pre-budget comes after approval of the physical budget. In the pre-budget process, the system translates the physical programmes into forecasts of the accounting results (les comptes de resultats previsionels). So this pre-budget stage includes [ENS/DF, 1985(e)]:

.Valorization of the physical budget (translation of the physical quantities into monetary values). This implies introducing into the system (SCBF) the purchase and sale prices. These are detailed into those of the home market, some of those of the world market and inter-enterprise prices (in fact the inter-enterprise prices are irrelevant to GCL as they are destined for other elements of ENS).

.Forecasting of expenses. In addition to the valorization of the physical budget, the pre-budget must include forecasts of expenses. These, however, are prepared in global or aggregate terms at the unit level (i.e. beyond COB and EDG). As in the physical budget, feeding the data for the pre-budget into SCBF is performed on a special document (bordereau), shown here in fig.13.24. The encoding (saisie) of the data on the document follows the same procedure as in the the physical budget above.

EMS

PRE-BUDGET

Unit: |_____________|

Data |_|_| |_|_| |_|_| Page |_| |_|

1. Information 2. Criterion	Area for Entering Data			Values						
	Code Information	criteria of decision	Code up date	Year |___|		Year |____|			
				Semestre 1	Semestre 2	Jan-Mar	Apr-Jun	Jul-Sep	Oct-Dec
1. |________| 2. |_______|	8 15	16 22	23	24 31	32 39	40 47	48 55	56 63	64 71
1. |________| 2. |_______|	8 15	16 22	23	24 31	32 39	40 47	48 55	56 63	64 71
1. |________| 2. |_______|	8 15	16 22	23	24 31	32 39	40 47	48 55	56 63	64 71
1. |________| 2. |_______|	8 15	16 22	23	24 31	32 39	40 47	48 55	56 63	64 71
1. |________| 2. |_______|	8 15	16 22	23	24 31	32 39	40 47	48 55	56 63	64 71

Fig.13.24. Format for entering data for the pre-budget.

III.2.1.3 THE MANAGEMENT BUDGET

The budgeting process does not end with the preparation of the pre-budget. The end of the process for the manager, at whatever structural level (COB, EDG, or GCL as a whole), is to receive what is referred to in SCBF jargon as the "Budget de gestion" [ENS/DF, 1985(g)], which could be translated as the budget for management.

The stage of "Budget de gestion" takes place in October / November. This budget differs from the physical budget and the pre-budget in one important respect: the forecasts it provides are made according to the choices or requirements of the addressee (the decision maker). The purpose of having this extra budget is to provide management with information of the kind which is not available in the ordinary general accounting system (comptabilite generale). In other words, SCBF provides the manager (through the "Budget de gestion") at the three structural levels (COB, EDG, GCL) with the information that he/ she needs or wants. It is up to him to specify the decision criteria (les criteres de ventilation) which are relevant to him/ her [ENS/DF, 1985(c)]. For an RU (i.e. COB), for example, a manager could ask SCBF to supply him/ her with a report regarding his/ her region in terms of products stocked, sold, expected stock run-outs, the clients' credit situation in terms of delays overdues, etc. At the EDG level the manager could specify the same information, and for every COB under his responsibility. However, the choice or freedom to specify the criteria by which the information is presented to the manager is only possible within the catalogue of decision criteria (criteres de ventilation) contained within SCBF.

Fig.13.25 Gives a schematic presentation of the budgeting process as implemented by SCBF [ENS/DF, 1985(d)]. In this figure appear the decision criteria (criteres de ventilation) and management indicators (indicateurs de gestion). They help guide the manager in the choice of his/ her decision criteria. These are catalogued in SCBF.

This brief exposition provides us with insight into the organisation of SCBF and the manner by which it provides management with information. We turn now to the diagnosis of the system and consider the possibility of introducing some improvements into the system, and to have another look at the whole arrangement of SCBF, in terms of the principles of organisation.

As we have seen, then, SCBF is a centralised management information system. Its design fits R0, i.e. ENS (see chapters 11 and 12). Its structural arrangement (COB --> EDG --> GCL --> ENS) is a mirror image of the organisation structure of ENS (consequently that of GCL). Refer to section I and fig.13.1 above. In the actual organisation chart of GCL; S/D TRC, S/D MI and S/D GP are considered as operational structures (structures operationnelles); they correspond to the level of EDG in SCBF. Their dependent structures (for example, two divisions of S/D TRC and seven RUs of S/D MI, see the organisation chart of GCL) correspond to the COB in SCBF. As it stands, SCBF is a system designed for an organisational structure, that of the old SNS, which manifests a pathological state (remember that SNS is already extinct). We reached the conclusion (section I above) that only the regional units (RUs) can be considered as operational elements (OEs) of GCL.

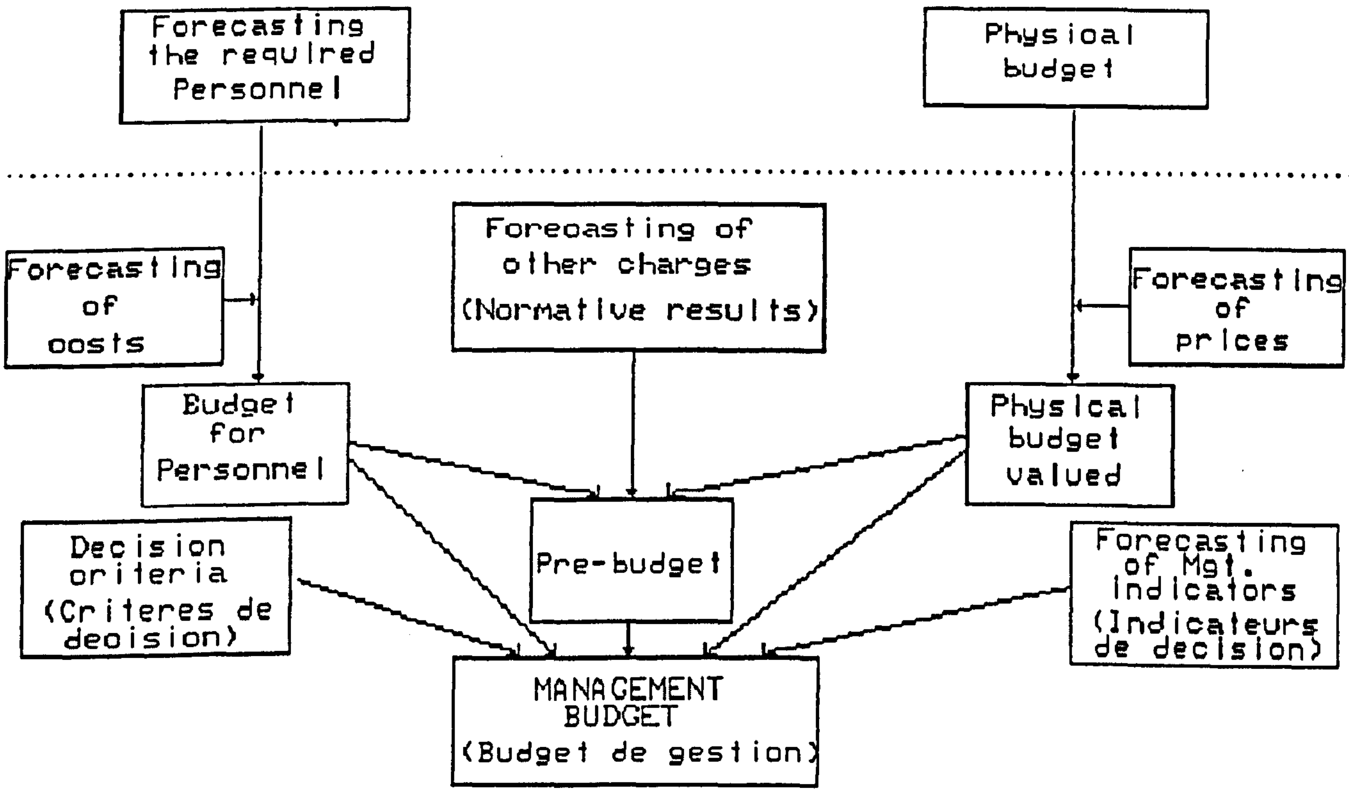


Fig.13.25. The budgeting process of GCL.

Therefore, a COB in SCBF should correspond to the RU as an OE and we can do without the second structural level (EDG), since as far as the system in focus (GCL) is concerned the OEs should be considered as black boxes.

Any adjustment to SCBF based on this diagnosis would necessarily encounter implementation difficulties within the existing status-quo. As we have seen, SCBF is a management information system of GCL as a unit of ENS. This means that we cannot review the structural arrangements of SCBF without including the next level of recursion up (i.e. ENS). however, SCBF accepts the possibility of having the COBs and the unit (i.e. GCL) without EDGs. In other words it considers EDGs as fictitious: "Lorsque l'activite d'une unite ne justifie pas l'existense d'un niveau structurel entre le COB et l'unite, celle-ci admet d'une maniere fictive une seule EDG" [ENS/DF, 1985(c): p. 01.10]. That is to say the data collection, processing and transmission processes presented by fig.13.22 above, would look, instead, like fig.13.26 below. The question must remain as to whether this rearrangement would meet with the approval of the senior management of ENS (R0).

We consider now the role of SCBF in the variety equation metasystem <---> S1 and the question whether it answers the requirements of the principles of organisation. As it stands, SCBF as an information system is a variety amplifier, whereas we expect, in terms of the VSM, that the variety flow from S1 (the collection of the RUs) on the command axis should be kept to that minimum related to accountibility for resources allocated by the metasystem.

We see that SCBF is designed to supply the metasystem of GCL with all the details of the operations of its S1. However, this does not mean that it provides the metasystem with requisite variety. The total variety generated by the operations of S1 is by definition far higher than that with which the metasystem can live [Beer, 1979]. For requisite variety to be restored, filters (attenuators) are required on the channels linking S1 with the metasystem to meet the requirements of the first principle of organisation (needing the law of requisite variety).

The second principle of organisation is also violated (refer to part II). The direct command channel is constantly overloaded with detailed operational data irrelevant to the task of controlling operations. As a result, many of the information loops generated at the operational level (RUs) remain without closure; and the organisational task, the sales activity, remains unattended to, particularly when the information needed is of a coordination or monitoring type (refer to the next chapter). For example, requests by an RU for transfer of SMPs from another RU always encounter delay. The same is true of requests for spare parts for equipment at the depots of the PSs, even when the maintenance reports are duly presented to the metasystem.

Regarding the third principle of organisation (refer again to part II): as we have seen in section II above, operational variety is expressed in terms of samples of products, i.e. the stock control system at the PS level employs the variety of samples for the classification of its products; whereas the requirements of SCBF are that the SMPs are expressed in terms of a different metric, namely Lines of Production and Consumption, i.e. LPCs (owing to the existence of manufacturing elements in ENS besides GCL). This state of

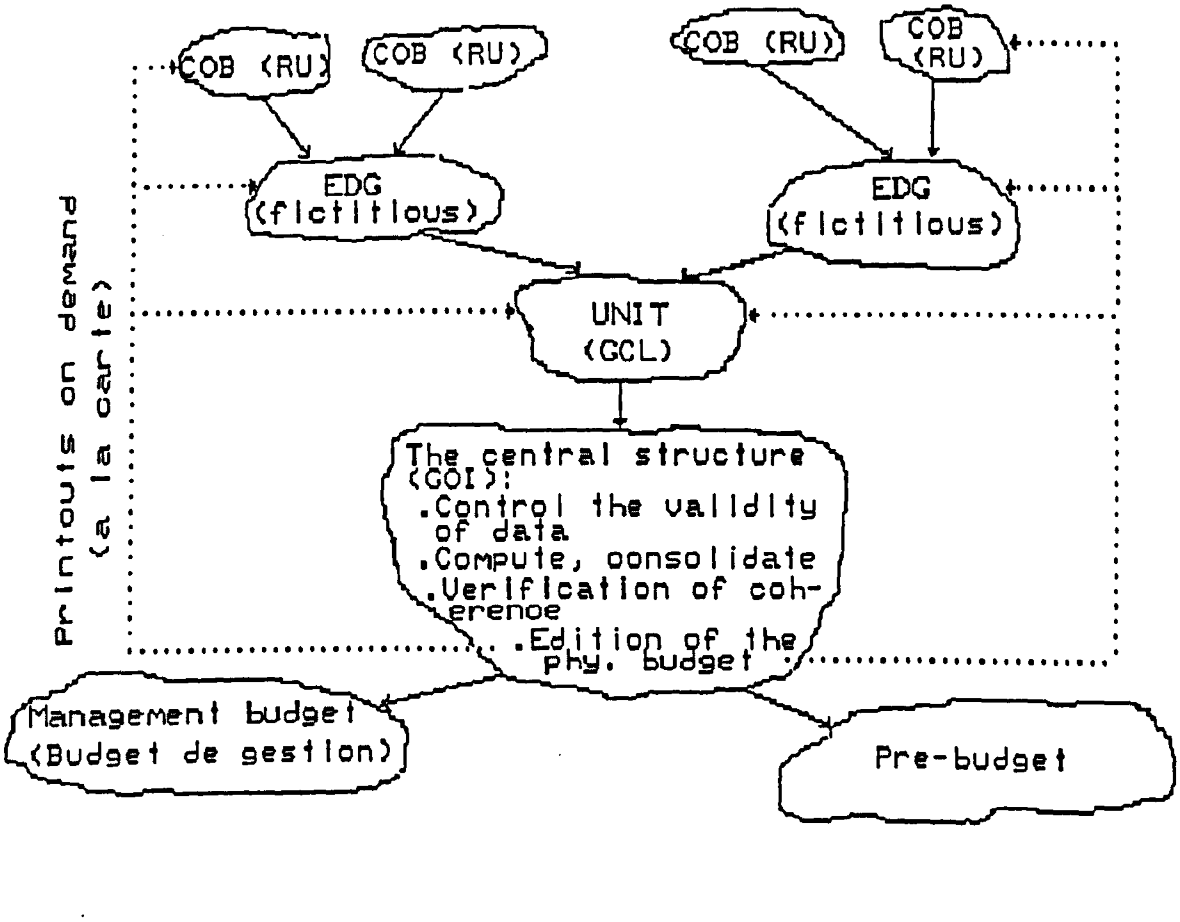


Fig.13.26. Rearrangement of the budgeting process.

affairs creates problems of transduction at the operational level, since the data is fed into SCBF at that level (see fig.13.23), i.e. at the COB level, which corresponds to the RU, as we have seen. A transduction problem at the metasystem level (the computer centre) is manifested when the data on the special documents (bordereaux of fig.13.23 and fig.13.24 above) is put on punched cards and/ or magnetic tapes and compiled to be read by the system. More often than not, errors occur during the process of transducing the documents into instructions readable by SCBF.

As to the fourth principle of organisation, regarding the continuous flow of information, it can be seen that SCBF is less than adequate. The problems enumerated above, in addition to technical problems associated with the maintenance and breakdowns at the computer centre, make it difficult for SCBF to live up to expectations in this regard.

III.3 ALLOCATION OF RESOURCES TO THE RUs

It would be appropriate to end this chapter by discussing, briefly, the question of resource allocation to the RUs. We begin the section by describing the status-quo, then consider the possibility of improving the situation. So far we have not touched upon the investment side of the system. This is partly due to the fact that the investment budget, so to speak, is not included in SCBF [ENS/DF, 1985(d)]. It is also important to mention that investment proposals and the allocation of resources to carry them out are not a straightforward bargaining exercise between the RUs and the senior management of GCL. Investment decisions are taken at levels beyond that of recursion one (R1). The official practice up to 1987 was that the investment projects of any RU should form part of the overall investment plan of ENS (R0), which has to be approved by the Ministry of Heavy Industry and the Ministry of Planning. However, at the end of 1987, a very important political step was taken at the highest level, apparently with a view to bringing decentralisation of decision making nearer to reality. This was the decision to abolish the Ministry of Planning.

As from 1987 it became unnecessary for the economic agents to acquire the approval of a central planner for their projects. Also, the intervention of the Ministry of Heavy Industry is to be limited (it is claimed) to ensuring that the investment plans of the companies under its tutelage, including ENS, are in accordance with the strategy of the overall industrial sector. Investment plans of GCL (officially within ENS) still require Ministerial approval, but if the political declarations at the government level (which can be equated with a S5 metasystemic ethos at the highest level of recursion in the economy) are to be taken seriously, we can assume that the amount of detail in the plans required prior to 1987, is no longer needed by the Ministry. Following these metasystemic developments at the highest levels, we can reasonably expect that future investment decisions regarding the operational side of GCL will be taken at the level of R1, though requiring the approval of the upper level of recursion, i.e. R0.

In the event of that happening (which we assume to be the case) a cybernetic redesign of the variety flow between the management of an RU and the metasystem might look like fig.13.27 below.

By comparing this figure with fig.13.21, we see that SCBF no longer appears on the command channel, except for management reports. These reports are the expression of the accountability of S1 for the resources allocated to it by the metasystem. SCBF has joined the rest of the software systems and will be operated by S2. Its proper place in the overall information network of GCL will be fully appreciated when we come to the elaboration of S2 and S3 in the next chapter. The proposed arrangement of fig.13.27 is in accordance with the limited capacity of the command channel. The only variety flow normally allowed on this channel is that related to investment [Beer, 1985].

On the S1 side of the loop of fig.13.27 we have the investment proposals. The variety of the latter is shown to be attenuated. This is so since we cannot expect that the management of GCL will grasp every technical detail of an investment proposal, be it the construction of a depot for stocking SMPs or buying a new crane or a weighing machine (refer to section I above) for its PSs.

On the returning side of the loop we have the instructions of the metasystem concerning the conditions attached to an accepted proposal. A condition which is always present in acquisitions of material (machinery) or construction of depots or buildings for administrative use, is that the supplier of the machinery or the contractor for the construction should be from the domestic market. Only when this is not possible can a contract be made with the world market. However, close inspection of these conditions will show that they are applicable not only to GCL; they are guidelines of the Ministry of Finance aimed at rationalising the use of foreign currency on the one hand, and encouraging local products on the other.

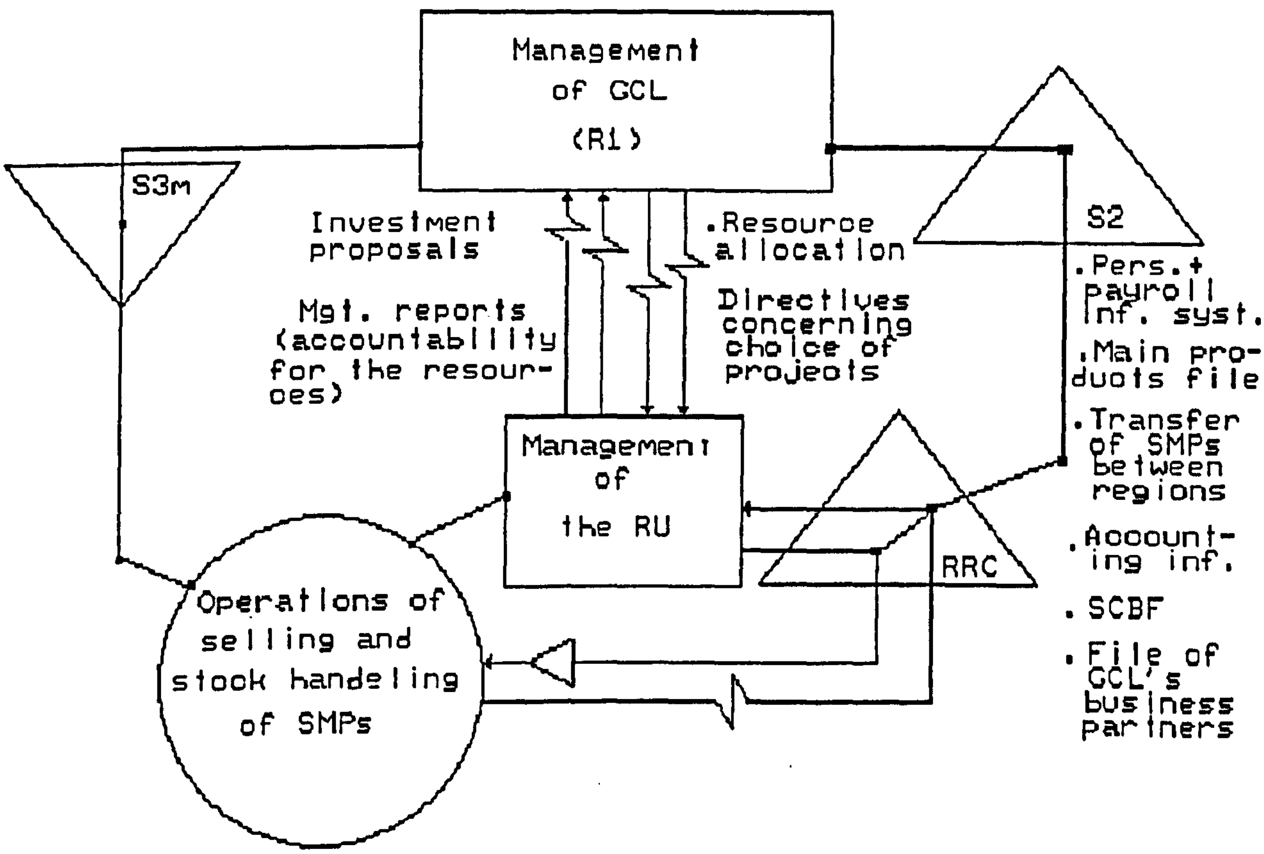


Fig.13.27. Variety flow Management (R2) ----> Management (R1).

These rules and guidelines are applicable to all sectors of the economy. In this sense the conditions attached to investment proposals can be considered as a metasystemic ethos from the highest level (the government) rather than conditions imposed by recursion one (GCL).

Also on the metasystem side of the loop we have the statement for allocating resources to an RU. At present the process of resource allocation to S1 (the RUs) is not the result of a negotiated deal, as advocated cybernetically [ibid]. The deployment of a new PS is greatly influenced by political factors, which means that the decision to initiate a construction project of a PS is taken beyond R1 and R0. The task of S/D GP (refer to section I above) is mostly the supervision of the execution of the project. For all practical purposes, the RUs (S1) are not concerned with the project's progress until it becomes ready for operation, i.e. it is literally handed over to S1. In terms of the VSM, however, given the assumed autonomy of S1 vis-a-vis the metasystem, the construction of depots should be the prerogative of a regional unit. The attenuator on the loop metasystem ---> S1 of fig.13.27 above, indicates that the decision statement regarding the resources to be allocated is of low variety. That is to say, for example in the case of the installation of a new depot, we would not expect senior management to specify in detail how the depot is to be constructed. To close the loop, the RU in question must be accountable for the allocated resources. The relevant variety in the management report (of the RU) is, again attenuated. It is not necessary for the management of the RU to give a progress report for every stage of (for example) the construction of a depot. However, it is expected that the management of the RU will announce to the metasystem the start of work on the construction project and also communicate the date of its completion.

The monitoring and the coordination channels on fig.13.27 show the redeployment of the information systems hitherto operating on the command channel. The detailed analysis of how they fit in S2 and the monitoring channel S3m is the subject of the next chapter.

Before we move on to the next chapter we summarise the discussion of this chapter. We began the chapter with the identification of the OEs of GCL; these were the RUs, the collection of which makes up S1 of GCL. Having made such as identification, the next step was to understand the variety engineering at the horizontal level of S1. For this purpose we chose one of the RUs, namely the regional unit of the centre (RUC). However, the task of understanding the operational side of an RU required a drop of one level of recursion, i.e. to the level of a PS or R3. This was the subject of section II.

At R3 we took the PS as an OE and proceeded to the analysis of variety engineering by taking the two loops (environment <---> operations and operations <---> management) of the PS separately. On each of the loops we identified the appropriate amplifiers and attenuators. The next step was to check whether requisite variety, channel capacity and transduction capacity are adequate on the channels joining the components of the PS. The approach adopted was to expose the problems then put forward appropriate recommendations.

Understanding variety flows at the PS level made it possible subsequently to tackle vertical flows at the RU (R2) level i.e.: environmental interactions, operational interactions and managerial interactions. This was done in section III. Owing to its importance in the present system, we devoted most space to managerial variety engineering. We discussed the organisation of SCBF (the management reporting system) and the way it is used by the management of GCL. As with the previous section (variety engineering at R3), it was considered important to check that the cybernetic principles of organisation are adhered to. We ended this last section of the chapter by addressing the question of resource allocation to the RUs.

To consolidate this summary, we present the S1 diagram of fig.13.28 below. It is, to some extent a reproduction of fig.13.2 above (section I). However, in fig.13.28, the place of a PS in the overall structure of GCL is made explicit. To remain consistent with our step by step approach to the development of the VSM of GCL, it is thought preferable to leave the metasystem as a black box, except for S2 and the monitoring channel (of S3) S3m, which are necessary to show the different channels by which S1 links to the metasystem.

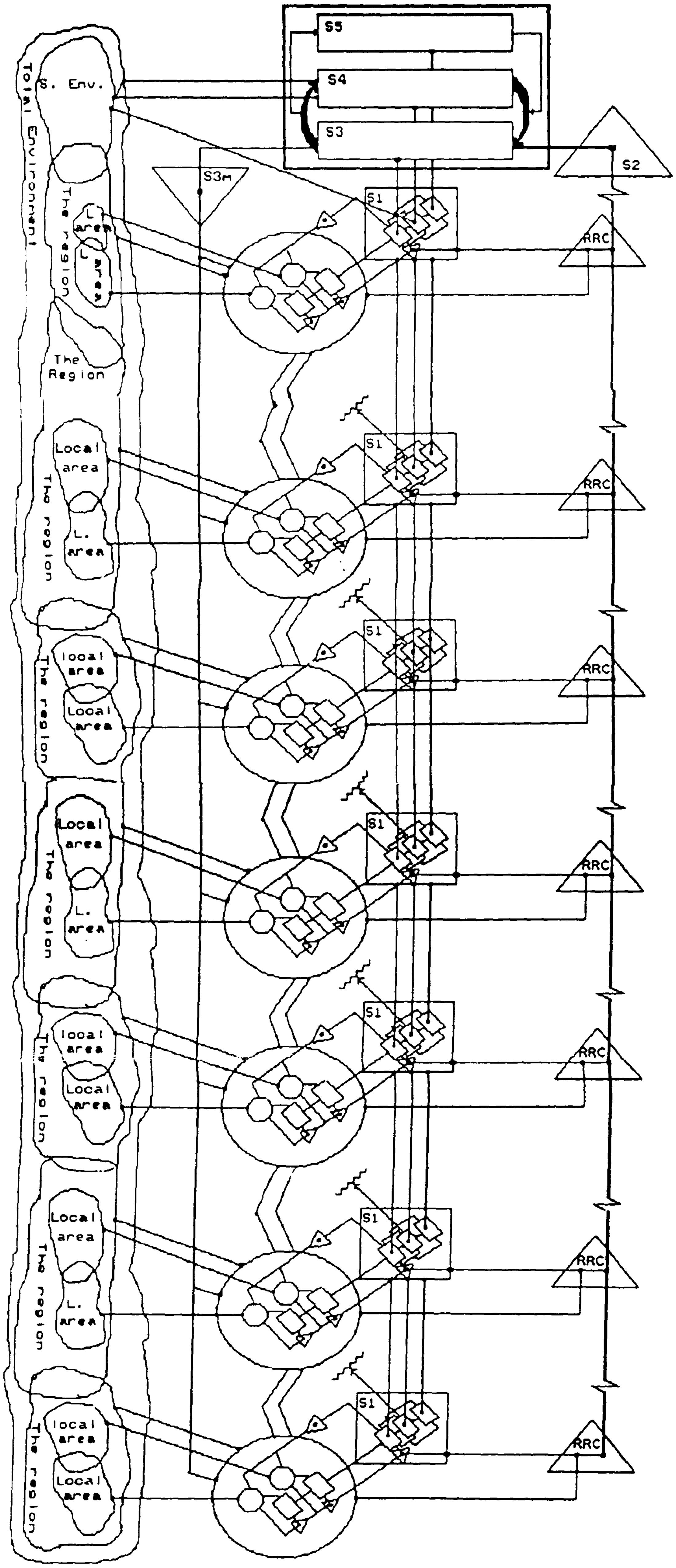


Fig.13.28. System One of GCL.

Chapter 14

THE INTERNAL REGULATION OF GCL

In this chapter we deal with the necessary subsystems through which GCL strives to maintain its internal control. As will become clear by the end of the next chapter, the bulk of the information circulating in GCL, in fact, deals with the internal functioning of the system. Apart from the suppliers' file (fichier fournisseurs) the whole battery of specific systems of GCL (refer to ch.11) deal with its internal regulation.

The major part in the process of internal regulation is played by S2. Because of its importance, and in line with the approach adopted in chapter 8, we begin our analysis with this coordination function (i.e. S2). Again, owing to its prominent place in the internal network, and the relatively massive quantities of information carried through its channels, it is thought appropriate, for the sake of clarity, to subdivide the coordination function into its major constituents, in order to achieve a better understanding of the way this function could be carried out. The same approach is also adopted for the monitoring and control functions.

I. THE COORDINATION FUNCTION: S2*

The "raison d'etre" of S2, as we came to understand it in chapter 8, is to damp oscillation arising in S1. This implies that, when we consider S2 of GCL, we need to avoid the idea of merely accommodating S2 within the framework of the present organisational structure. What we need to do, instead, is to understand the functions carried out by the RUs while implementing their task of selling SMPs (refer to the last chapter). From this initial understanding, one will be in a position to design an S2 which will facilitate the routine operations of the RUs and eliminate those aspects of the operations which may lead to oscillation and instability of the system (GCL) as a whole. The question whether the present structures, for example (refer to chapter 11) the central service of commercial coordination (SCCC), the central service of stock control (SCGS) and the central service of client credit management (SCR), fit the new design, is another matter. What is important is to have the proper information channels in place with such transmission and transduction capacities as are necessary for coordinating the activities of the RUs.

The battery of computerised information systems (refer to section VI. ch.11) dedicated to the operation of the RUs is impressive. However, it would not be wise to try and fit the design of S2 into the present management information

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* Unless otherwise indicated, S2 in this chapter refers to system two of the system in focus (R1).

system, since the latter is not sufficiently adapted to the evolving needs of GCL.

As we have seen in chapter 11 and chapter 13, the existing management information system is excessively slow and is designed to serve the higher echelons of management, namely that at recursion 1 (R1) and recursion 0 (R0). The main purpose of S2, as we know, is to service S1 (the RUs), while at the same time amplifying the control variety of S3 [Beer, 1979]. On the other hand, we should be aware of the practical constraint imposed by the already operational (and costly) systems.

Our approach to the design of S2 of GCL is to conceive of it as a collection of S2s. Each will cover an aspect of the function of S2 corresponding to potential sources of oscillation from the operations of the RUs. These are:

1.Stock control.

2.Direct sales.

3.Client credit management.

4.Personnel management.

5.Accounting and budgeting.

We proceed in this chapter by explaining the existing system, how each of these S2s operate, and then put forward a diagnosis of existing ills.

I.1 S2: STOCK CONTROL

Stock control is probably the most important and the most complicated part of the coordination function of GCL. To guide the reader through this section we give the following brief outline of how to deal with S2 for stock control. We begin by positioning S2 for stock control organisationally; after that we describe the forecasting model of GCL. The next step is to discuss the variety flow on the loop regional regulatory centre (RRC) <---> S2; we do this by taking each side of the loop separately. Having dealt with the variety flow we proceed to verify the questions of requisite variety, channel and tranduction capacity on the loop. At the end of the section we tackle the possibility of putting forward some recommendations.

The activity of stock control is fundamental to the success of the RUs in carrying out the task of selling SMPs in the country. This particular S2 (i.e. for stock control) is not difficult to position organisationally. Within the present framework, the function of stock control is carried out by the central service of commercial coordination (Service Central de Coordination Commerciale, SCCC). It belongs to the department of commercial management of S/D MI (refer to ch.11 and the organisation chart of GCL in Appendix C) while at the regional level, we have the regional service of stock control (Service Regional de Gestion de Stock, SRGS) [GCL (S/DMI), 1985] which is the organisational equivalent of this S2 at the regional level.

Demand forecasting, analysis and the computation of the economic order quantities (EOQ), and the determination of delays of the arrival of SMPs, are all carried out at the regional level, according to the model of regional replenishment (model de reapprovisionnement regional) contained in an elaborate manual [GCL, 1976]. This manual is the first amplifier on the S2 --> regulatory centre channel of the RU. Given the nature of the commercial activity of the RUs, the operation of stock handling is fundamental to that activity. This implies that it is essential to understand the forecasting model as elaborated in the manual. In what follows an attempt is made to explain this model as it is employed by the regional unit. We begin with demand estimation and demand forecasting followed by delay analysis. We then come to the question of calculating the replenishment order quantity.

I.1.1 DEMAND ESTIMATION AND DEMAND FORECASTING

The method employed in this forecasting model is referred to as the backlog method. The process is carried out in the following stages:

.Demand estimation.

.Demand forecasting.

.Delay analysis.

I.1.1.1 DEMAND ESTIMATION

Information on the demand for SMPs is updated every month on the basis of the most recent information. The total sales for the month are designated as actual sales (ventes realisees). If the stock is sufficient, all customer demand is satisfied, which means that the actual sales reflect the demand during the month. However, more often than not, the stock is not sufficient to satisfy customer demand. The general case, then, is that demand is estimated in the light of the stock-outs. The ordinary procedure is, for a given sample, to evaluate the stock-out, then estimate demand. The customer demand for the month, not met during the stock-out is known as deferred sales (ventes differrees). When the stock-outs become frequent the method used is that of cumulated deferred sales (cumul des ventes differees).

The level below which the stock is considered as stock-out (le seuil de rupture) varies from one sample to another. It is either zero or a specified percentage of the predicted demand. The present practice is that this level is decided at S2 of R1 [ibid]. The stock-out is evaluated as a percentage of the number of days sale of the month. At the end of the month we know the number of days sale and the number of days during which there was stock out, i.e. :

Stock-out = (no. of days of stock-out) / (no. days sale) =

($\mathcal{R}a$ stands for rupture actuelle or stock-out).

Translated into quantities, the deferred sales for this month are calculated as follows:

$$Sd = \mathcal{R}a * \beta * X$$,where:

Sd stands for deferred sales.

$\mathcal{R}a$ stands for "rupture actuelle" ,i.e. stock-out.

β is the coefficient of depreciation of the deferred sales (le coeffient de depreciation des ventes differees), the value of which is set by S2.

X the forecasted demand (as opposed to estimated demand, see below).

The estimated demand (De) for the next month is evaluated as the net sales for this month (Sn) plus the sales deferred from this month to the next month, i.e. :

$$De = Sn + Sd$$

Net sales are differentiated from actual sales in the sense that sales are considered net if they satisfy at least part of the last deferred sales. Fig.14.1 below gives a graphic summary of the steps for estimating demand.

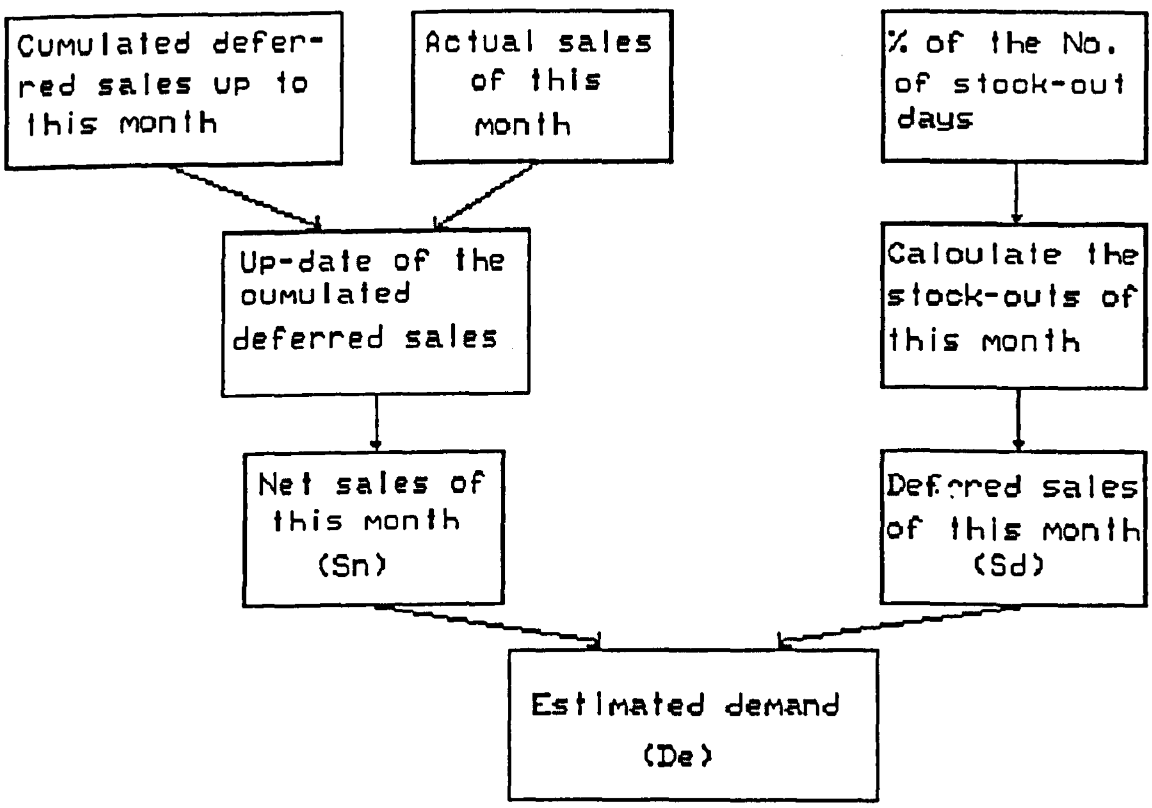

Fig.14.1. Steps for demand estimation.

I.1.1.2 DEMAND FORECASTING

Having acquired this information, i.e. estimated demand (De), in addition to last month's forecast for this month, the regulatory centre (RRC) of the RU is in a position to forecast the future demand on which to base the quantities to be ordered for each sample in the stock. The forecast is made at the end of every month, following the method of exponentially weighted average, and it is performed in the following manner [ibid]:

Consider Xi as the demand forecast for next month, then,

Xi-1 is the last month's forecast for this month

α the coefficient of exponential smoothing, is a parameter determined at S2, $(0 \leqslant \alpha \leqslant 1)$.

The forecast is then calculated as follows:

$$Xi = \alpha\, De + (1-\alpha)\, Xi\text{-}1$$

where the standard deviation of the demand X is σ_d

Extra information or requirements are needed to check on the reliability of the forecast:

.The standard deviation σ_d is redefined as:

σ_d = 1.25 MAD, where:

MAD is the mean absolute deviation of errors (i.e. forecasting errors)

$MADt = \alpha\, |e_t| + (1-\alpha)\, MADt\text{-}1$, where:

t stands for the current month,

t-1 stands for the last month,

e_t (the forecasting error) = the difference between actual sales and the forecast.

.The Tracking signal (Ts) is defined as:

$Ts = \bar{e}_t$ / MADt; (0 < Ts <1), where:

$\bar{e}_t$ is the exponentially weighted average of forcasting errors at time t, and is defined as:

$$\bar{e}_t = \alpha e_t + (1-\alpha)\, e_{t-1}$$

When the value of Ts is negative ===> the forecast > demand.
When the value of Ts is positive ===> the forecast < demand.

.The cumulative sum of forecasting errors is defined as:

$$\text{CUSUM} = \sum_i ei$$

a forecast being considered as good if its CUSUM fluctuates around zero.

.The variability (V) of demand is defined as the ratio between the standard deviation σd to the mean value of demand (X), i.e. $V = \sigma d / X$

For the forecasting model operated by GCL the values of (V) vary as follows [ibid]:

$V < 0.40$	demand is stable.
$0.40 < V < 0.80$	demand is fairly stable.
$0.80 < V$	demand is unstable.

I.1.1.3 DELAY ANALYSIS

The delay in the replenishment of SMPs to the the PSs is composed of:

.Supplier delay (delai fournisseur, F). This is the time interval between the placing of the order and its reception.

.Replenishment period (delai reapprovisionnement, P). This is the lead time between the arrival of the present order and the next. Generally this period is taken as one month (P=1), but for certain samples it is three months (P=3).

The total delay (supplier delay + replenishment period) is:

$$L = F + P$$

Since the RUs have no access to the market conditions in the general environment the analysis of the delay is carried out by the regulatory centre of an RU on the basis of the information received from S4, i.e. S/D TRC and S/D EPO (see ch.15 below). Having acquired the information concerning the estimated demand (De) from which we can make the forecast for the future (i.e. Xi), and having determined the total delay, we are now in a position to determine the replenishment order quantity.

I.1.2 CALCULATION OF REPLENISHMENT ORDERS

This calculation is performed every month on the basis of the most recent analysis of the delays F and P above. The aim of the calculation of the replenishment orders is to determine the quantity of stock necessary to satisfy customer demand, while waiting for the orders to arrive. This quantity of stock is known as the required quantity (couverture requise, Qr). It is composed of:

.The probable demand during the delay (couverture en delai) which is referred to as the delay quantity (Ql), defined as the forecasted demand during an average delay, i.e.:

$$Ql = X * L$$

.The security stock (stock de securite, Qs); included in the calculation so as to take into account the randomness in the delay for replenishment and the randomness in customer demand, i.e.:

$$Qs = \gamma * \sigma_d * \sqrt{L} + \delta * X * \sigma_L$$

The required quantity is, then defined as:

$$Qr = Ql + Qs$$

$$= X * L + \gamma * \sigma_d * \sqrt{L} + \delta * X * \sigma_L$$, where:

X is the forecasted demand,

L is the delay (average),

γ is a multiplier fixing the number of deviations in demand, a parameter determined by S2.

σ_d is the standard deviation of customer demand,

σ_L is the standard deviation of the delay,

δ is a multiplier fixing the number of deviations in delay, a parameter also determined by S2.

In addition to the required quantity (Qr), there is a need to know the actual quantity of stock (couverture actuelle). The actual quantity (Qa) for the month is made up of the available stock (stock disponible, Sa) plus the quantities of stock on order but not yet arrived (les attendus, A) minus the cumulated deferred sales (Sd). In other words:

$$Qa = Sa + A - Sd,$$ where:

Qa is the actual quantity,

Sa is the available stock,

A is the stock on order,

Sd is the deferred sales.

The order quantity is calculated as the difference between the required quantity and the actual quantity:

$$OQ = Qr - Qa$$

$$= [X * (L+\delta\sigma_L) + \gamma * \sigma_d * \sqrt{L} - (Sa+ A - Sd)]$$

The steps for the determination of the Order Quantity, OQ, are summarised in fig.14.2 below. With this knowledge of the forecasting model, let us now look into the variety flow between S2 and RRCs.

I.1.3 THE INFORMATION LOOP RRC <---> S2

We attempt here to describe the variety flow between the RRC and S2 by taking one side of the loop at a time. After that we check whether requisite variety holds between the two sides of the loop. Also we consider whether the arrangement of the above loop (fig.14.3 below) has channel capacity and transduction capacity. We begin by the S2 ---> RRC side of the loop.

I.1.3.1 VARIETY FLOW S2 ---> RRC

The implementation of the forecasting model, as we have already mentioned, is the task of the regulatory centres of the RUs. The role of S2 as an oscillation damper is clearly apparent in the way the model is amplified to the regional regulatory centres. The calculation procedure is made to comply to a special format, to which all the RUs must adhere. This is operated on two special documents in accordance with the steps (above) of the application of the model:

1. A sheet for the calculation of the estimated demand and the cumulated deferred sales (feuille de calcul de la demande estimee et du cumul des ventes differees).
2. The second sheet is for the calculation of the quantities to be ordered (feuille de calcul de la commande).

These two sheets appear in Appendices D and E. They are self explanatory and we do not need to go into the details of writing data on them. For any one RU, this data is prepared from the reports emanating from the PSs in the region. At the head of the sheet (left) appear the parameters for which the value is fixed by S2. The values of these parameters are

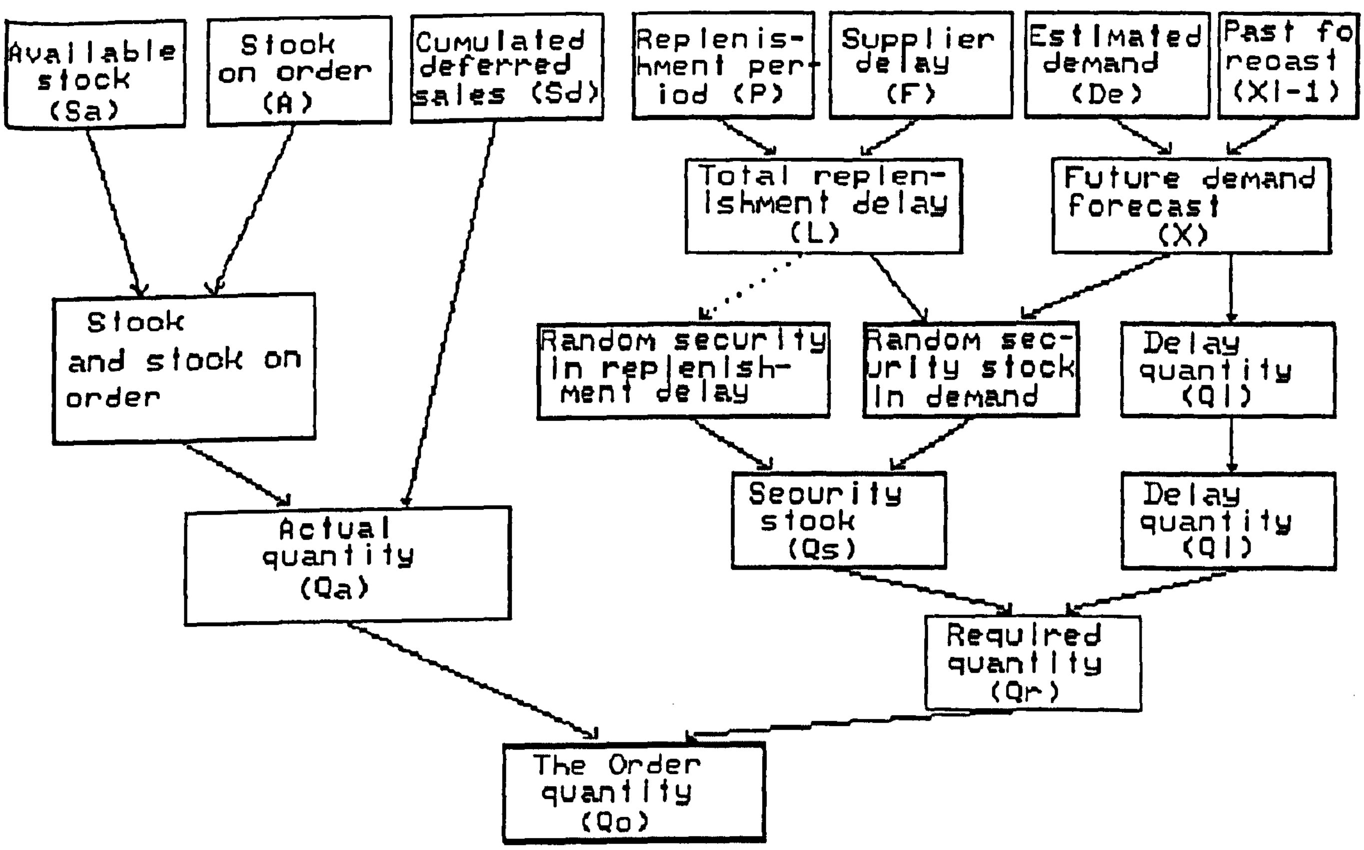

Fig.14.2. Steps for the determination of the order quantity.

updated after every new appraisal of the stock situation [ibid]. In addition to these periodic communications to the RUs, S2 intervenes on an exceptional basis, for example in the case of introducing new product samples into the stock of the regions (i.e. the depots of their PSs), or the case where the stock situation of certain product samples has so deteriorated that it merits a new remedy, like a change in the value of the parameters above.

The standardisation of the format (the two sheets above) on which to feed data into the system is dictated by the protocol of the computerised stock control system (refer to ch.11) which is operated centrally at the computer centre in GOI (Groupe Organisation et Informatique). Given the lack of computing facilities, the RUs cannot afford but to have data processed at GOI. Nonconformity by the RUs to the same parameters and the level of security stock arrived at by applying the steps of the forecasting model above, may cause stock levels for the different samples to vary between the regions. This will make it harder for S2 to keep pace in transmitting its knowledge about the external conditions of supply and demand (provided by S4, i.e. S/D TRC and S/D EPO) to the regional regulatory centres in time for them to adapt to the changes. Imagine the difficulties of S2 when each of the latter uses a different forecasting model, or modifies at will the level of security stock and the values of the parameters involved in the forecasting process. This fact is particularly relevant when we remember that the RUs have no access to the supply side of the environment.

This argument is valid only in the context of current practice, which is not compatible with the requirements of autonomy for the RUs, in which the channels with the suppliers are not open. Again, as we argued in the last chapter, GCL is trapped by its information system. Even if the RUs are totally autonomous, they could not each afford to have a computerised information system. To carry on using the facilities of the computerised stock control system, a matter in which there is hardly a choice, they have to comply with its requirements. To elucidate the latter point, take for example the independent enterprises newly created from the restructuring of the old SNS (refer to ch.11). Owing to the lack of resources, these enterprises cannot install their own computer systems; they find themselves obliged to mortgage their independence and carry on with the inherited information system from SNS, particularly the general systems. We come now to the return side of the loop, namely regional regulatory centre (RRC) ---> S2.

I.1.3.2 VARIETY FLOW RRC --->S2

If the system is left to operate automatically, the variety it will generate will be overwhelming. In other words, if all the RRCs were to carry out a systematic calculation of the demand estimates and forecasts for every product sample, and pass everything to S2, the situation would become chaotic. To avoid this kind of a situation, the variety flowing in the direction of S2 has to be filtered. At present this variety is attenuated in the following manner: the two special documents (Appendices D and E) referred to above are prepared only for the product samples for which there is a stock-out: "le gestionnaire selectionne les echantillons pour lesquels il se confirme une situation de rupture" [ibid: p.47].

The information regarding the stock-out comes to the RRC from the PSs in the relevant region. Every PS has to submit to the RRC of its region a monthly statement, compiled from its own file of stock, of its stock-outs (releve monsuel des ruptures) accompanying the monthly report of the movement of the products in and out [GCL/VEI (F19), 1974]. However, on recept of these statements the RRC does not automatically proceed to place the replenishment order. It first verifies the state of the orders in waiting for the region (les attendus de la region) at the port, or about to be shipped from factories, in the of locally produced SMPs. The information concerning the orders-in-waiting is kept on special stock control documents at the RRC (i.e. SRGS) [GCL/VEI (E22), 1974]. This information loop RRC <---> S2 is presented graphically in fig.14.3 below.

On the face of it the variety flow on the return side of the loop (i.e. RRC ---> S2) is effectively attenuated. However, the logic in the design of this filter is faulty for two obvious reasons:

.Since it allows through only information about those product samples in a state of stock-out, it automatically filters out those samples for which the stock-out is about to happen. In other words, there is nothing to stop the stock control system from operating in a perpetual state of stock-out. It cannot be otherwise, as is evidenced by the long waiting lists on customer orders, particularly for the products needed in the construction industry. The only customers who can escape this situation are the direct order customers who are not replenished from stock (these have waiting problems of a different sort, as we shall see in the next section).

.The raison d'etre of the forecasting model is to predict future demand. However, the way the returning side of the loop (of fig.14.3) operates renders the model historical. All it does is manage the backlog of sales.

The argument advanced by management in defence of the resulting long waiting lists is that these are due to government curbs on imports and lack of foreign currency with which to buy from the world market. This argument is valid to some extent. However, even if there were no curbs on imports and foreign currency were available, the situation could not improve under the present stock control arrangement.

After this discussion of the two sides of the loop RRC <---> S2, we now try to examine the balance of variety between S2 and RRC. The time it takes to make a replenishment order is much longer than is envisaged by the system. In the meantime other orders are flowing from the RRCs and the deferred sales accumulate over time. The accumulation sometimes becomes so important, for certain samples of SMPs, that the sales of the current month (at the PSs) do not even cover the deferred sales.

To restore overall requisite variety, S2 intervenes by amplifying its own variety towards the RRCs. This takes the form of increasing the value of the parameter β in the calculation of the deferred sales:

$$Sd = \beta * \mathcal{R}e * X, \quad \text{where:}$$

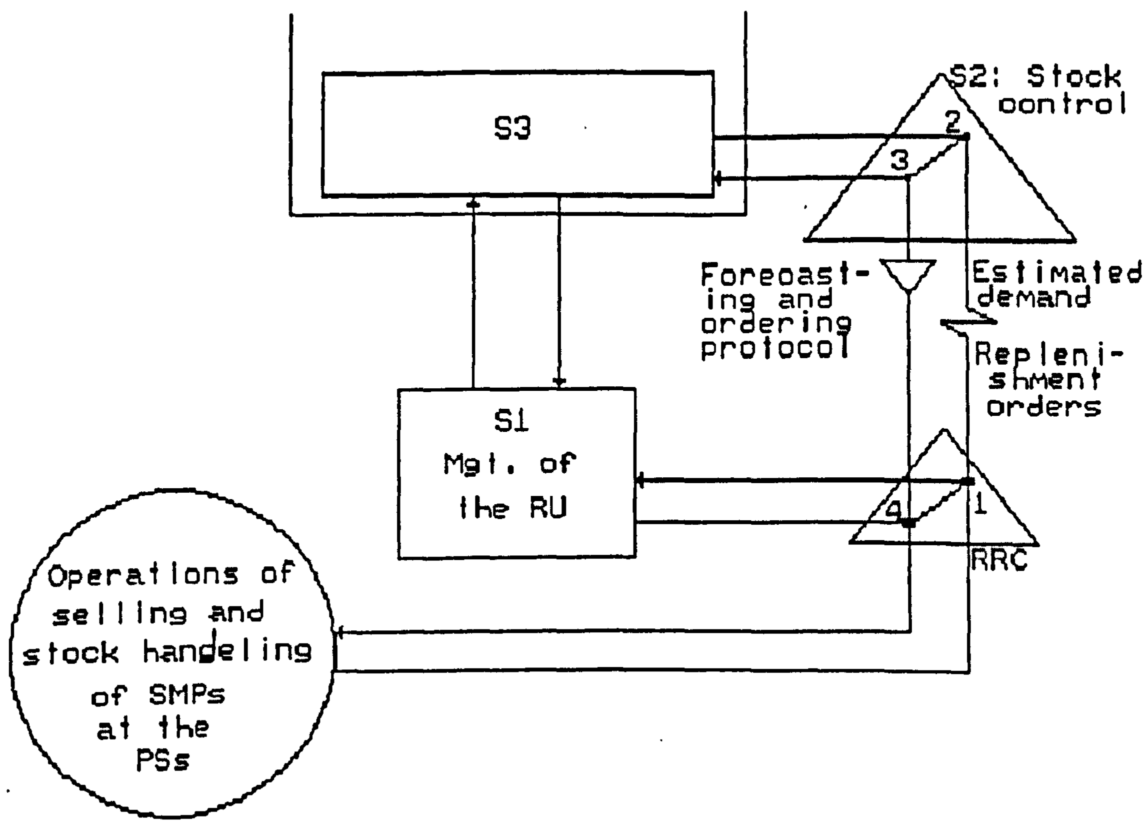

Fig.14.3. The information loop S2 (stock control) <---> RRC.

β is the coefficient of depreciation of the deferred sales $(0 \leqslant \beta \leqslant 1)$.

Re (reestimation of stock-outs) is substituted for Ra.

The short term effect of the change will be detected on the returning filter RRC ---> S2 (fig.14.3). The nearer is the coefficient of depreciation of the deferred sales β to zero, the smaller will be the deferred sales Sd, i.e. the greater is the amount of variety attenuated on the return loop RRC ---> S2.

In terms of the variety balance, further attenuation is introduced in the returning loop above. This attenuation takes the form of cancelling those sales which are deferred for a long period, and taking some samples out of the list of imported products altogether. This, however, involves S3 as well as S5. S5 involvement is particularly relevant, since there is a noticeable shift from the GCL objective of satisfying customer demand to that of managing the queues or the waiting list of that same customer demand. This is particularly apparent with regard to the SMPs used in the construction industry, where demand largely outweighs the actual supply capacity of GCL.

We come now to the channel capacity and transduction capacity of the channels on the loop of fig.14.3 above. The two computer systems (packages) relevant to S2 for stock control, out of the existing battery of available systems, are the system for physical flows (systeme des flux physiques), and the stock control system (systeme de gestion de stock). Like the rest of the systems, they are designed to process data and generate information rather than filter it.

The variety flow RRC ---> S2 is not limited to the variety carried by the special documents (of Appendices D and E). In addition, the metasystem (through its S2) requires from the RRCs extra information provided on two more special documents referred to as "tableaux de bord" (see Appendices F and G). The purpose of S2 in having this extra information is to allow a close watch to be kept on the information carried by the two previous documents or sheets. [GCL, 1976]. The variety generated by the two computer systems above is more than the channels of fig.14.3 can carry.

In addition to this lack of channel capacity, there is also a transduction problem. As was mentioned above errors often occur at node "1", where the operational data is put on the special documents (format) required by the computer system. The errors are discovered at node "2", they are sent back through nodes "3" and node "4" for correction and back again from node "1" to node "2". This back and forth correction is explained by the fact that the language of the required format is that of S2 and not of the RRC. The format of the documents (above), on which data is entered, dates back to the early seventies when SNS was in existence. The lack of transduction capacity at node "1" reflects another characteristic of the stock control and physical flow systems, that is, like the rest of the specific systems, they are concerned and designed to serve the metasystem rather than S1 (i.e. the RUs). Yet as we know, the whole raison d'etre of S2 should be to serve S1 [Beer, 1979]. The mistakes at node "1" are a consequence of the not always understood language of the forecasting model as it is elaborated at node "3".

The centralising character of the data processing system makes it necessary that the transduction process (encoding the data from the two sheets above onto punched cards and/ or magnetic tapes) instead of taking place at node "1" is performed at node "2" of fig.14.3. Given the great quantities of data involved, the transduction operation rarely takes place without errors being made. Only format errors are corrected at S2. Other errors (missing, writing, etc.) need be corrected at the RRC.

Before we end this section of S2 for stock control, let us consider the possibility of putting forward some recommendations for improvement. If we are to adhere to the principles of organisation [ibid] and at the same time operate within the constraints of the available computer resources (both hardware and software), the first step is to evaluate the variety equation RRC <---> S2. At present too much operational data is flowing to S2, even when replenishment order quantities are made only for the samples with deferred sales. For example, the variety carried by the two documents "tableaux de bord" (of Appendices F and G) should not be generated at the RRCs, since the variety they carry is generated out of the demand estimation and demand forecasting documents already transmitted to S2 on the other two documents (Appendices D and E).

The overflow due to the re-circulation of variety (error correction in the documents) can also be reduced. The conversion of data from the documents above (la saisie de donnees), onto punched cards and/ or magnetic tapes, is carried out at the computer centre. This operation could be performed at RRC which might then forward the encoded data to S2. Doing so would not only enable the restoration of requisite variety between the two sides of fig.14.3 above, it would also alleviate the difficulties of transduction which exist at present, which stem from encoding data (saisie des donnees) from the special documents to the punched cards and/or magnetic tapes.

I.2 S2: DIRECT SALES

We are now considering the second element of S2, i.e. S2 for direct sales. As with the previous section, we begin by positioning this S2 organisationally, then we consider the information loop RRC <---> S2. However, the nature of the variety flow of this particular S2 makes it necessary for us to emphasise the flow RRC ---> S2. Having done so, we deal with variety balance, channel capacity and transduction capacity. Management of the direct sales (ventes directes) at the regional level is distinct from management of the sales from stock. Direct sales are not subject to the stock control system exposed above. The information loop is shorter than that concerning sales from stock of the PSs. This loop is initiated at the RRC, as opposed to that of sales from stock which is the domain of the point of sale (PS). Since the information circuit is different, it is appropriate to have a separate S2 (from S2 of stock control above) to regulate the transactions concerning the direct sales.

The coordination function for direct sales at the present time is performed by the same organisational structure housing S2 for stock control, namely SCCC. As was stated in chapter 11, the organisational task of SCCC is to centralise all the information flows about the movements of SMPs in and out of the RUs. However, the task of S2 here is seen as that of coordinating the actions of the RUs relevant to the direct sales. It does not need saying that we should not be alarmed if the evolving VSM of GCL cannot isomorphically be mapped onto the existing organisation chart.

At the regional level (R2), however, we find that there is recognition of a separate structure to deal with the direct sales, namely the regional service of internal sales (service regional des ventes interieures, SRVI) parallel to the regional service of stock control (SRGS) above. The S2 of direct sales is shown graphically in fig.14.4 below.

I.2.1 THE INFORMATION LOOP RRC <---> S2

Customer orders considered as direct sales (Commandes Directes) are distinguished from the ordinary sales operations (i.e. sales from stock) in that they are ordered by the services of GCL on the account of customers or clients. They are not part of the stock, they are delivered directly to the customer. These direct sales are usually orders for product samples not in the stock of GCL, or orders which are sufficiently big to merit special treatment and a short-circuiting of the lengthy procedures of the stock control system, for example orders for raw materials by the enterprises created from the restructured SNS.

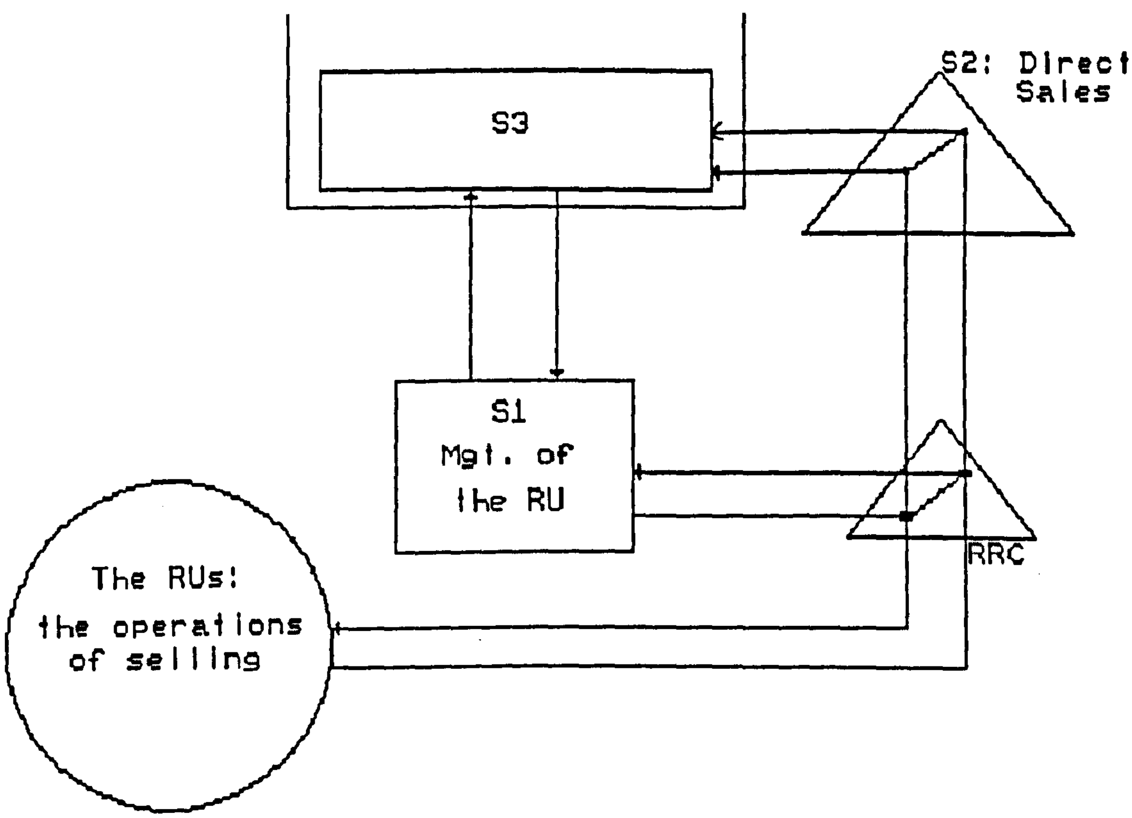

Fig.14.4. S2 for direct sales.

The information loop starts with the customer or client expressing his order to the RRC of the relevant RU, then it proceeds as follows [GCL/VEI (R12), 1974]:

1.This customer order is transduced into an internal document referred to as a "commande ventes interieures" at the RRC, then passed (through S2) to S/D EPO (in S4) for placement with the local (national) supplier or to S/D TRC (also in S4, refer to the next chapter) to be placed with a foreign supplier. This stage is known as the confirmation stage of the order (en attente de confirmation).

2.When the order is confirmed by the supplier, the information comes back to the RRC through the same route. However, a copy of the document (confirmation) is sent to the customer and another to the transit base at the port (part of S4 of the RU) in the case of imports. The order is now at the stage of waiting for delivery (commandes en cours).

3.The orders, upon reaching the second stage, are individualised and organised in the RRC file according to the source of supply, i.e. local and foreign suppliers. They are organised in this way in order to facilitate any subsequent correspondance with the suppliers, and to record or register the successive states of each order until it is finally delivered.

4.This is the stage of delivering the merchandise to the customer. It is marked by the issuing or establishment of the bill of delivery (Bon de sortie - facture pour les ventes directes, BSD) [GCL/VEI (E33), 1974]. With the establishment of this document, BSD, the file regarding that particular order is closed.

Between the date of the placement of the order by the customer and the date of its delivery, there are a host of informational transactions between the RRC and S2.

I.2.2 VARIETY FLOW RRC ---> S2

The flow of variety in the direction of S2 can be described as follows:

1.The order for direct sales is sent (commande ventes directes, CVD) to S2 with the relevant information regarding the customer, and a description of the product samples in question.

2.The order having being placed at a supplier, confirmation does not always follow immediately. In that regard, the RRC sends a monthly report to S2 about orders not yet confirmed. The information contained in the report is [GCL/VEI (R12), 1974]:

a.The order number, date of the placement and date of required delivery.

b.The client's name.

c.The product sample specification.

d.The ordered quantities.

In this report no distinction is made between local and foreign suppliers.

3.For orders already confirmed, there is usually a delay in the delivery. In the same way (like 2 above), the RRC sends a monthly request report to S2 in order to accelerate the delivery of the merchandise. However, in this case a distinction is made between imports and the locally produced SMPs. The information contained in the report concerning imports is [ibid]:

a.Import number, supplier name, date of placement of the order, date of the confirmed delivery.

b.The customer's name.

c.The product sample specification.

d.The ordered quantities.

e.Number of months of the delay to date.

For the locally supplied SMPs, a request report is established for every individual supplier. It contains the same information as the report concerning imports except that it does not include the supplier's name.

4.Delivery of the merchandise to the customer. This is the final stage in the whole cycle of data processing regarding an order; "le BSD (above) est la conclusion d'une serie d'operations initiees... par le SRVI a partir de la prise de commande" [GCL/VEI (E33), 1974: p.3]. The delivery document contains the following information:

a.The code and number of the document (for computer use).

b.Supply origin (foreign or local).

c.The number of the order and reference.

d.The customer's specification: code, name, address, number of his trade register (registre de commerce).

e.Date of issue of the document.

f.The mode of payment.

g.Sample's description: dimension, measurement unit, etc.

h.The unit price.

i.Tax: rate, amount deducted, etc.

k. The amount to be paid.

The delivery document having being completed, a copy is sent to the customer or client, a second to S2 for direct sales, a third to the service in charge of client credit management (recouvrement) in the RU and a fourth copy is transmitted to

S2 for accounting (see below), while a fifth copy remains at the issuing RRC for archive purposes.

In addition, at the end of every month, the RRC produces a summary report of all the transactions of the month, i.e. for every source of supply. One report is completed for each of the local suppliers [GCL/VEI (E14), 1974]. Also, a separate report is made out for deliveries through the port of the region concerned, which is a recapitulation of the documents (CD PORT) provided by the transit base [GCL/VEI, 1974].

The variety flow from the RRC to S2 (direct sales) is shown graphically in fig.14.5 below.

Variety attenuation in this figure is essentially determined by the amplifiers on the S2 ---> RRC side of the loop. It is S2 which decides on the protocol of operation of the reporting process above, i.e. the periodicity of the enquiries (relances) from the RRCs, and the format of the documents (i.e. the BSDs and the monthly reports) which are standard for every RRC of the RUs.

The information regarding confirmation and delivery of orders emanating from S2 in the direction of the RRCs is not as regular as the enquiries from the latter. S2 receives the information from S4, via S3 (refer to the next chapter), and organises it according to the specific enquiries of the individual RRCs. The variety flow from S2 and its amplifiers is presented graphically in fig.14.6 below.

Although the variety imbalance is not as acute as it is in the case of the S2 for stock control (section I.1 above), we can still detect unnecessry flow on the RRC ---> S2 side of the loop. Consider the enquiry protocol regarding the

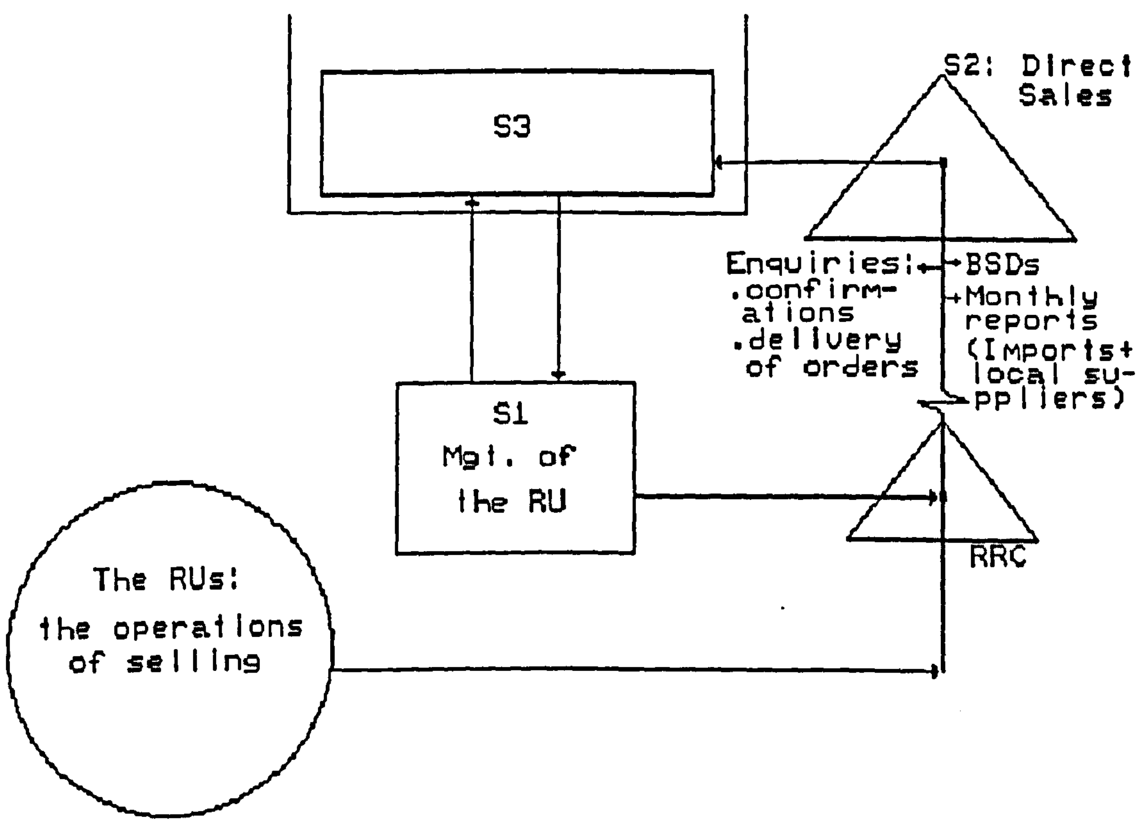

Fig.14.5. Variety flow RRC ----> S2 (direct sales).

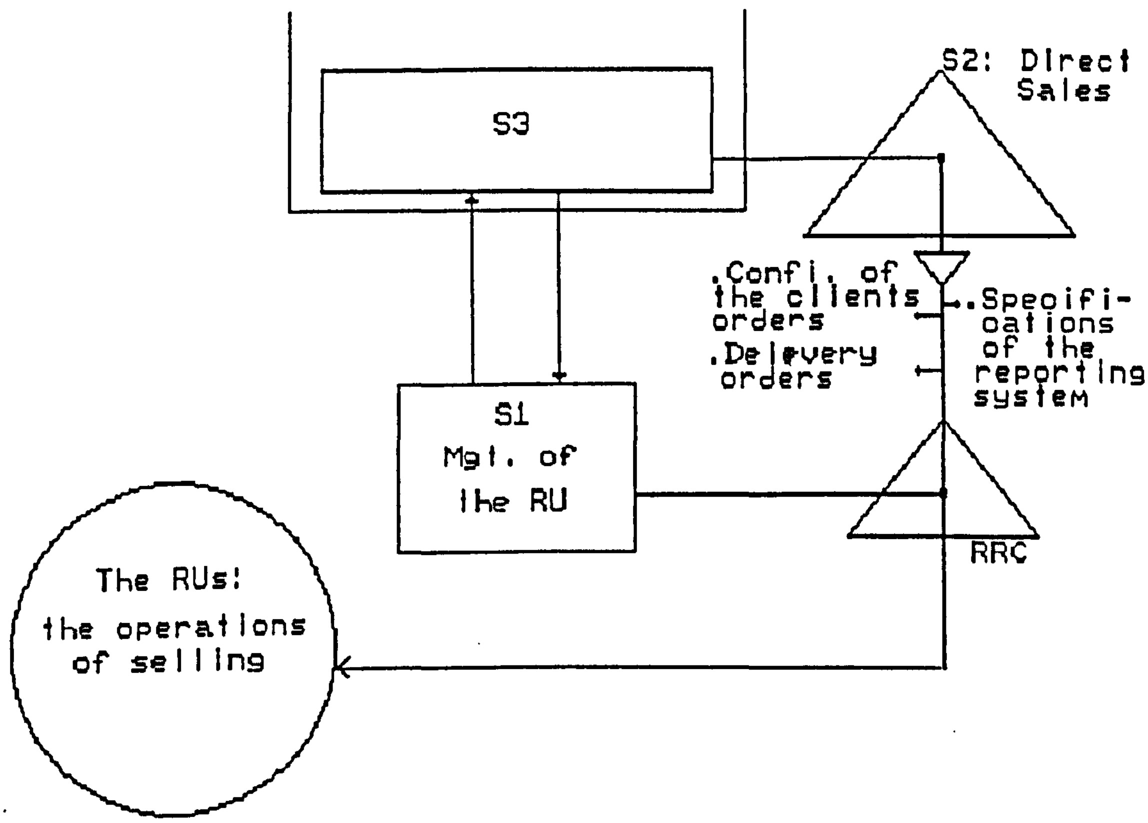

Fig.14.6. Variety flow S2 (direct sales) ---> RRC.

confirmation and delivery of customer orders from suppliers. Requisite variety of S2 vis-a-vis the RRCs would be enhanced considerably if the RRCs were left to deal directly, with the local suppliers at least.

The channel capacity is a considerable problem for the S2. However, the transduction problems are more or less the same as in the case of S2 for stock control above. They are encountered whenever data is encoded from the manually prepared documents (CVD, BSD) at the RRCs into the system at the computer centre. As was recommended for S2 for stock control above, the first step towards tackling the problem of transduction would be for encoding (saisie) of data to be carried out at the RRCs.

Fig.14.7 below gives an overall picture of the variety exchange between the S2 for direct sales and the RRCs.

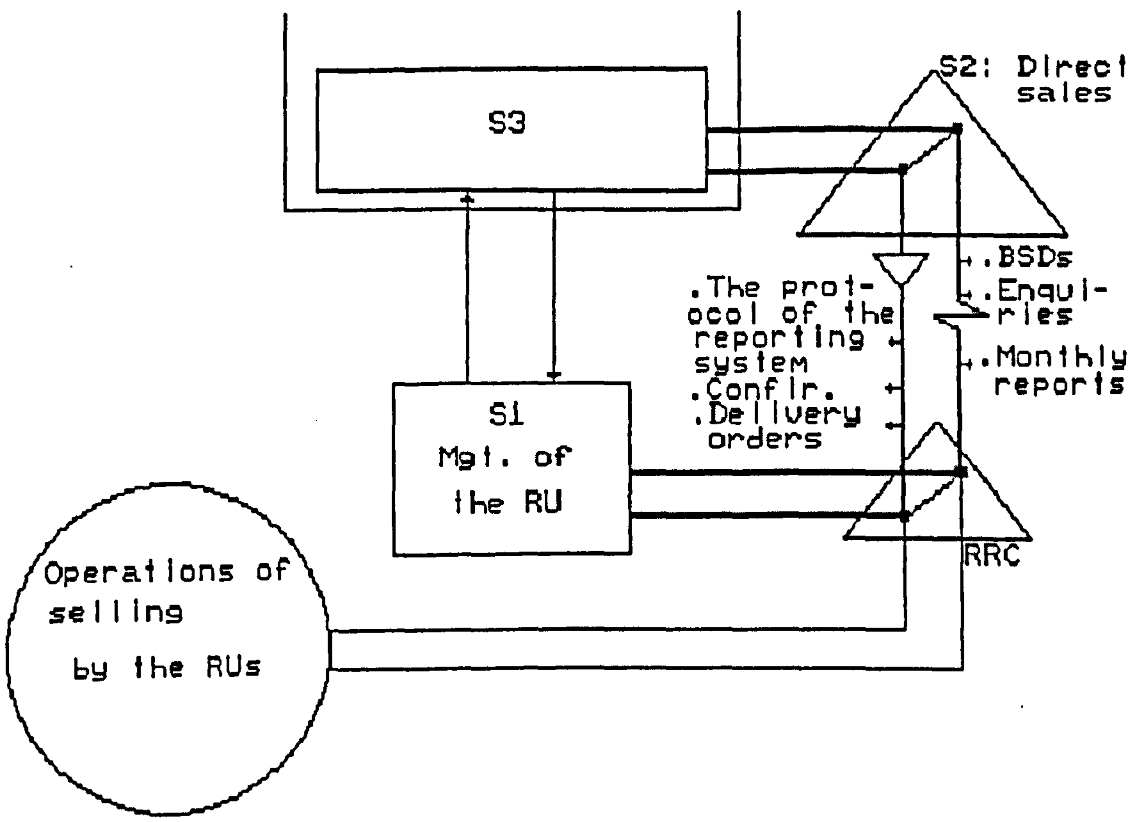

Fig.14.7. Variety engineering S2 (direct sales) <---> RRC.

I.3 S2: CLIENT CREDIT MANAGEMENT

We proceed with this S2 for client credit management in the same fashion as we did with the previous S2s. After explaining the necessity for having this S2 we proceed to consider variety manipulation at R2. Next we discuss the loop RRC <---> S2 and end the section by a discussion of requisite variety, channel capacity, transduction capacity, before puting forward some recommendations.

Client credit management or credit recovery (recouvrement) is normally a supporting activity to sales. Over the years, and with the growing clientele of GCL, this activity has acquired sufficient complexity to occupy an important place in the organisational structure of GCL, at the central as well as at the regional level (we saw in ch.10 that it has its own computerised file). However, this is not our justification for treating it separately from other activities, for example, stock control and direct sales above. The choice of an S2 for the client credit management activity is supported by the fact that it is a potential source of oscillation at the regional level.

At the RUs level this activity is performed by the regional service of client credit management (service Regional de Recouvrement, SRR). Structurally it belongs to the regional commercial division, i.e. the same structural level as SRGS and SRVI. It is convenient, therefore, to identify the regional service of client credit management (SRR) as the relevant regional regulatory centre (RRC). It manages all the credit matters of the customers, i.e. those of the sales from stock and those resulting from direct sales.

I.3.1 VARIETY MANIPULATION AT THE RRC

The "raison d'etre" of the client credit management system is to provide, at any time, a summary of the credit position of the clients and customers vis-a-vis GCL. To facilitate this task, a situation file is introduced at the RRC, referred to as "fiche de position" [GCL/VEI (H10), 1974]. This file contains information about all the customers in the region, sorted into one or more of the following categories:

.Client in Credit (a terme) position.

.Client paid an advanced instalment on an order.

.Client having an unsettled account.

Each client or customer has a separate record on the file. In addition to the above, there are also two more categories added to the file:

.Credit or debit resulting from rectifying a bill (issue error, returned goods, etc.).

.An advance paid on order from stock.

However, the information about these two latter types of clients is kept on the file of the (relevant) PS.

I.3.1.1 THE INPUTS TO THE SITUATION FILE

Every client record contains the following information:

.The client's code.

.Record number.

.Date and nature of the transaction.

.Input document (see below).

.Maturity of the bill (date of payment).

.Delay in payment (number of days).

.Balance (debit or credit).

The documents used for input to the situation file are:

a.Bill of sale for credit (bon de sortie a terme, BST).

b.Bill of sale cash (bon de sortie au comptant, BSC).

c.Statement of deferred settlements (bordereau d'enregistrement des reglements differres, BRD).

d.Statement of unpaid debts (bordereau d'enregistrement des impayes, BEI).

e.Statement of the regularisation of accounts (bordereau de regularisation d'ecritures, BRE).

Apart from BRD which is a document relating to direct sales, all input documents above emanate from the PSs of the relevant region.

The situation file is updated every month. Therefore, it is possible, in theory, to know the credit situation of any client at any time. Because it is so elaborate, it plays a pivotal role in the RRC and it is accessed by services other than the service of client credit management. For example it is consulted by S2 for direct sales, to find out whether to allow or process orders of customers who are in an irregular credit situation vis-a-vis GCL.

I.3.1.2 THE OUTPUTS FROM THE SITUATION FILE.

The situation file is also used to generate reports for control purposes for S3 of the relevant RU and the metasystem (R1). The output documents from the situation file can be summarised as follows:

a.Credit statement situation of the RU (tableau de bord regional, TBR: etat de la creance) [GCL/VEI (H90), 1976(a)].

This report is established monthly and is the most important document emanating from RRC intended for use by S2 [ibid]. It is a synthesis of the state of the credit situation for the RU concerned. It allows an analysis of the evolution of the credit situation from one month to another. The collection of the seven statements (seven RUs) provides S2 with an overall picture of the credit situation of GCL.

The format of TBR is decided by the metasystem (i.e. S2) and is organised so as to contain, for any one RU, the following information:

.State of the credit situation:

  .direct sales,

  .sales from stock.

.Balance:

  .initial (last month's final balance),

  .total debts of the month,

  .total credits of the month.

.Advance payments on direct orders (sales).

.Unpaid due payments.

.Ratio. It gives the value of the credit as a proportion of turnover, i.e.:

$$\text{Ratio (R)} = \frac{\text{(amount of credit during the month)} * 6}{\text{accumulated turnover of the last six months}}$$

b.Statement of the situation of unpaid due payments (tableau de bord de situation des impayes, TBI) [GCL/VEI (H90), 1976(b)]. Like the previous statement TBR, this is established monthly. TBI is a listing of unpaid due payments for the month. For every item (unpaid payment) it provides the following:

.Motive for nonpayment.

.Action taken. For example transfer to disputed claims service [ibid].

.Observation. For example promise by the client of payment by a certain date.

This document (TBI) allows a close and systematic surveillance of the unpaid due payments in the region, and permits the necessary action to avoid their stagnation or their proliferation.

c.The register of unpaid due payments (bordereau d'enregistrement des impayes, BEI) [GCL/VEI (H90), 1976(c)]. This is a register of bank statements and CCP (Compte Courant a la Poste) statements (the equivalent of the Giro Bank). It provides the following information:

.Number of the transaction document (BSC, BST, BSD, BRC, BRD).

.Name of the bank or the agency of the post office (case of CCP).

.Cheque number.

.The amount unpaid plus the bank expenses.

.Reason for nonpayment, for example, insufficient cover.

These documents (in a, b, and c) do not exhaust the documentation making up the paperwork of the RRC, but they are the most essential in the variety flow between it and S2.

I.3.2 THE RRC <---> S2 LOOP

Having had an insight into the variety manipulation at an RRC, we are now in a position to appreciate the flow of variety between the RRC and S2. In the present organisation structure, the documents emanating from RRC reach two destinations, namely the central service (in the metasystem) of client credit management (service central de recouvrement, CCR) and the accounting department in the S/D MI. However, since the terms of reference of our exposition are no longer the organisation chart of GCL, we consider that this destination is S2 (whatever structural form it may take at present), and that S2 coordinates all the operations relating to the activity of client credit management of the RUs.

Consider figure 14.8 below. The channels carrying variety in the direction of S2 do not show any attenuation. This reflects the fact that all the variety generated by the RRCs of the RUs is pumped in the direction of S2. That is to say that the operating protocol at present makes it necessary to report everything to the metasystem. For example the accounting services require that even the individual bills (BSC, BST, etc.) issued by the PSs, and the bank statements from RRCs, be forwarded to the metasystem. This is an indication of how paramount is financial control in the organisation, and of the obsession of the financial services with minor details. The consequence is an information overload at S2 in which requisite variety is lost. This loss is manifested in various ways. An outsanding example is the chronic delay in settling irregular situations. A trivial case, like nonconformity of signature on a cheque, may turn out to be costly, in terms of delay for the client and GCL.

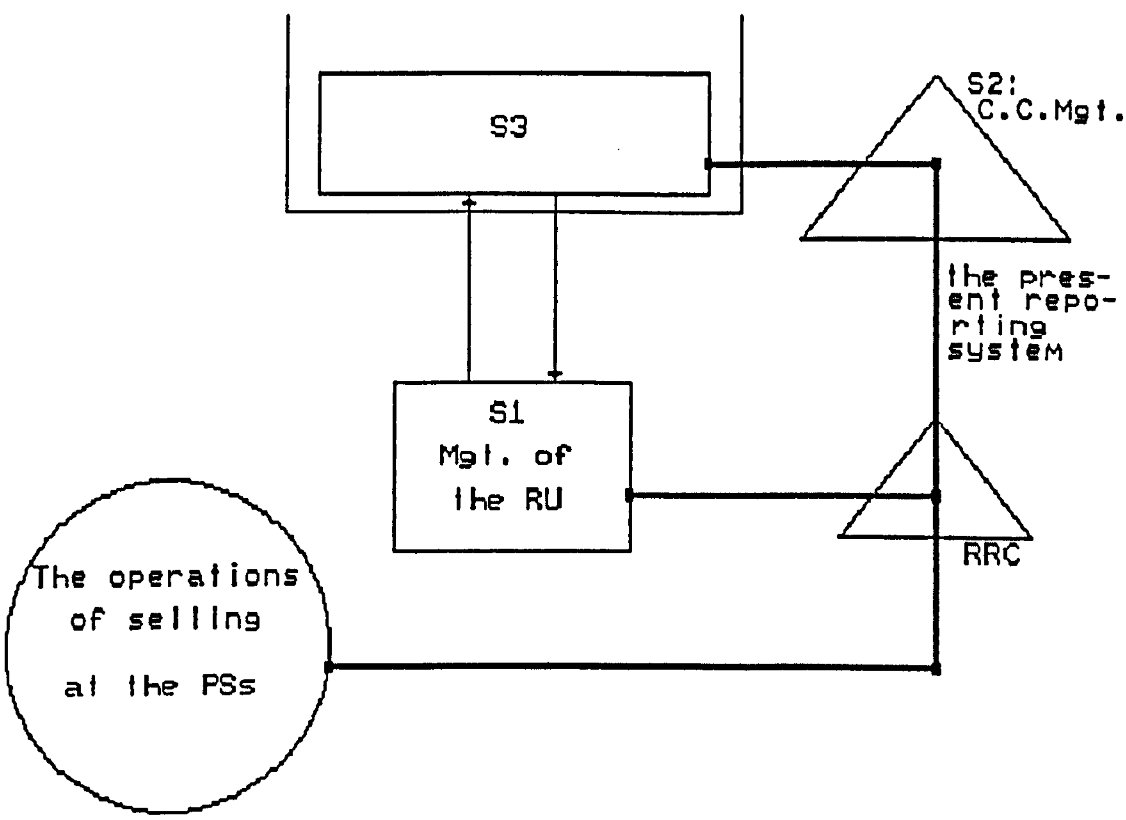

Fig.14.8. Variety flow of the present system.

Cases like this should be settled at the PS, without even going as far as the regional level, let alone the metasystem.

The computerised client credit management system operating at present is supposed to handle all aspects of the activity, with checks on every single document, with the purpose of enhancing financial control of the metasystem. Like the rest of the specific information systems of GCL (refer to ch. 11), the client credit management system requires transmission of masses of data from RRC to S2. This data has to be transferred from the special documents (bordereaux de saisie), prepared by the RRCs, into punched cards and/ or magnetic tapes (refer to sections I.1 and I.2 above). This operation causes considerable delay, which reduces the reporting system to an historical record of events. If we had variety filtration at the operational level, many of the unsettled due payments would be resolved at the lower level of recursion. and quite a number of them would not arise at all.

Proper engineering of variety between the RRCs and S2 of fig.14.8, requires the design of attenuators to filter the massive variety flowing to S2, as well as amplifying the variety of the latter towards the RRCs. Some of the variety amplification is already implicit in the detailed specification of the format for the documents carrying variety to S2. The detailed rules and procedures laid down by the metasystem for the RRCs to follow in their dealings with clients and customers, regarding the activity of credit management, is also seen as an amplifier of S2 variety on the S2 ---> RRCs side of the loop. Refer to figure 14.9 below.

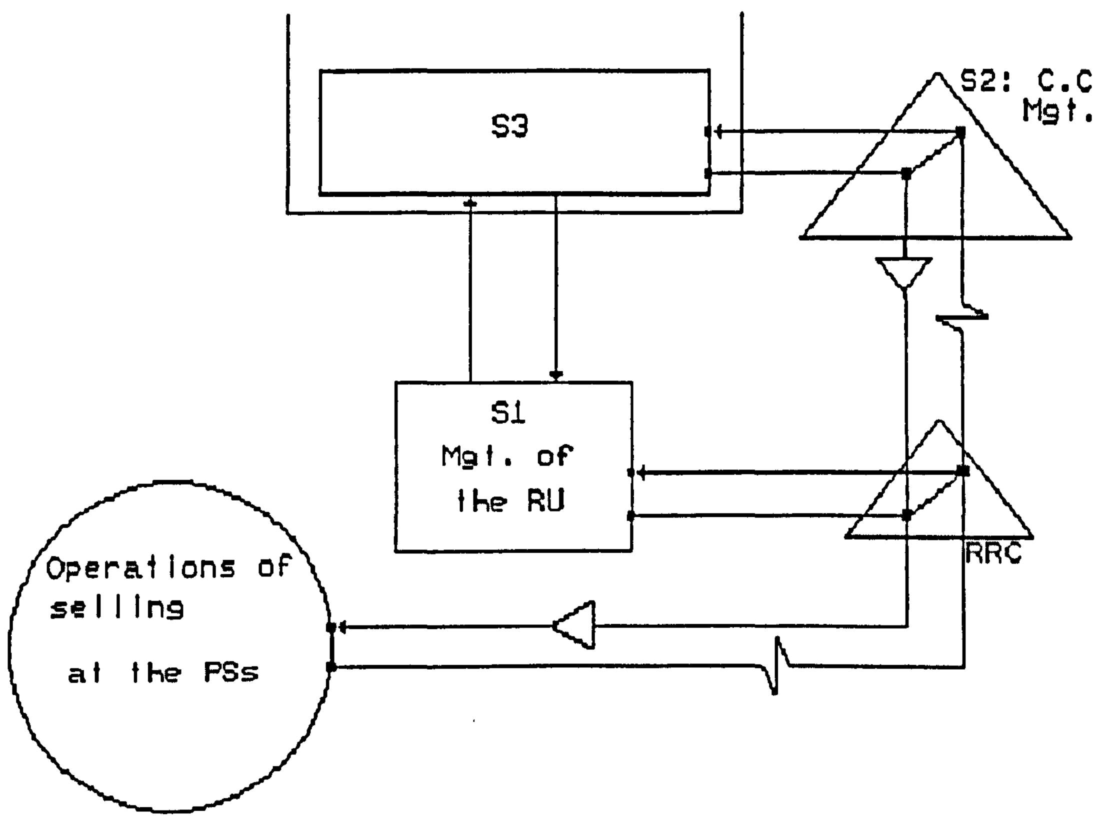

Fig.14.9. Variety engineering S2 (C.C.Management)
<---> RRC.

The loop in this figure represents the variety exchange between S2 and the RRCs. An example of the variety amplification by S2 is the instruction to the RRCs as to what preliminary (albeit limited) action to take in the case of unpaid due payment, for example allowing a certain period of time for the customer to settle his account before it is reported to the metasystem.

On the RRC ---> S2 side of the loop, the specification of the format of the documents carrying variety to S2 will automatically ensure filtration. However, there is a need to go beyond the present level of filtration. For example we have a duplication of variety between the statement of unpaid due payments and the register of unpaid due payments (above) to mention only these two documents.

As to the transduction capacity at the cross-over points between the RRCs and S2, the same pathological symptoms detected in stock control and direct sales (section I.1 and section I.2 above) are present with this client credit management system. The same diagnosis made then is equally valid for the arrangement of fig.14.9. This implies that S2 should take into consideration the language prevalent at the RRCs. However, so long as the transduction process remains as it is at present, errors will continue to proliferate.

I.4 S2: PERSONNEL MANAGEMENT

Again we proceed in the same manner as with the previous elements of S2. We describe S2 for personnel management, then consider the loop RRC <---> S. Once we understand the variety transactions on the loop, we can then assess the loop in terms of requisite variety, channel capacity and transduction capacity.

The motivation for having an S2 for managing the affairs of personnel does not stem just from the fact that GCL owns a computerised personnel management system. The amount of information circulating in GCL regarding personnel affairs is just as important as the other S2s discussed previously. From an information processing point of view, treatment of the affairs of GCL personnel is diffused across more than one service and department. There is the personnel and pay file, which is a data processing system for the accounting services, and the personnel management system which is exclusively operated to prepare the personnel budget [ENS/DF, 1985(f)]. The domain or scope of the activities of this S2 (personnel management) includes the following categories [ibid]:

a. Personnel training, in the country and abroad.

b. Salaries.

c. Bonuses, indemnities, and allowances.

d. Leave and holidays.

e. Social security contributions.

f. Overtime working.

As part of the overall management information system, the personnel management system operates in the same fashion as that of SCBF (refer to section III, ch.13). When data is fed into the system, it is grouped into "families of professional categories" (familles de categories professionelles) [ibid] for every COB, then consolidated to form EDG, then aggregated to make up the unit (i.e. GCL). Data is prepared on special documents (bordereau de saisie) for this purpose, where a code is attached for every category. Like SCBF, this system provides a report (printout) for all the relevant structural levels. This report contains the following elements [ibid]:

a.A list of the input elements from which the report is prepared (les elements de saisie).

b.A printout of physical objectives (etat des objectifs physiques) for every relevant structure (COB, etc.), i.e.:

.available manpower,

.personnel on training leave,

.number of overtime working hours.

c.Monetary valuation of overtime work.

d.Evaluation of personnel related expenses.

e.Rate of personnel turnover.

f.Rate of absenteeism. For a given period this rate is:

$$R.\ Abs. = \frac{\text{no. of working days lost}}{\text{no. of working days} * \text{no. of employees}}$$

The way the system is operated at present makes it open to oscillation. When this occurs, it is dealt with through the command channel. Since this channel is constantly overloaded (in any case it shows an inherent lack of channel capacity) the oscillatory behaviour, stemming from personnel management across the regional units, is never completely damped. An outstanding example of this oscillatory behaviour is in the area of personnel training. The overwhelming majority of those who receive this are among those staff and personnel who are already relatively well qualified. We find this type of personnel or "categorie professionnelle" in the well established PSs and urban areas. One effect of this oscillation is the high rate of personnel turnover and absenteeism in the less priviledged.

Another equally important source of oscillation concerns allowances and benefits, particularly housing benefits. The dilemma of the RUs, which to some extent pervades all these oscillations, is that they have no budgets to allow them to tackle the problem, i.e. compensate, by transport allowances for example, those living far from their place of work.

The computerised personnel management system operating at present does provide some useful information for management, for example the rate of personnel turnover and the rate of absenteeism. Nevertheless, it is centred on accounting aspects. It operates more as a support for the accounting function rather than as a system for coordination of the personnel policies of GCL. Much of the information supplied by this system is in fact duplicated by SCBF.

For the personnel management system to have any credibility as an S2, it has to go beyond the supporting role of a database to the finance and accounting services (of S/D FCO). Its role must be to damp oscillation and stop it from proliferating at the regional level. It can only do that if the data it receives from the regulatory centres (RRCs) of the RUs has relevance to the areas of potential oscillation.

It must not just settle for information of a financial character.

I.4.1 THE RRC <---> S2 LOOP

It is not feasible at this stage to give an exhaustive list of the problems (sources of potential oscillation) which merit attention, but we can mention a few examples. In addition to personnel training and housing referred to above, we might cite medical care as another problematic area requiring close attention. GCL personnel do not get the same quality of medical care in all the RUs. The medical centres belonging to GCL exist only in the major cities. Theoretically every employee is entitled to the same medical service but, for all practical purposes, only employees living in those major cities have access to the services of the medical centres of GCL. The rest rely on private care and the national health service, which is poor outside the major urban areas. The problem, however, is that all the personnel pay the same monthly amount (cotisation) which is supposed to cover those services.

Clearly there is a need to address this question of imbalance of opportunity. Although it is not possible for GCL to provide medical facilities for every point of sale, nevertheless it can tackle the problem of imbalance. For example, it is open to S2 to modify the social security contribution so as to make it compatible with the availability of the medical services in the area of residence of an employee. In other words, it could reduce the contribution of those who live far from the urban centres and perhaps, at the same time, introduce a medical care allowance.

Another amplifier necessary on the same loop is to do with guidelines regarding the safety of the personnel handling the SMPs at the depots of the PSs in the regions. S2 is required to inform the RUs about the dangers of handling steel and metallurgical products (SMPs) and provide guidelines of how to give emergency treatment in case of an accident. Manual workers operating the depots at the PSs are particularly susceptible to accidents. The present personnel management system does not deal with this type of information. It is simply a forgotten issue.

Figure 14.10 below depicts this amplifier in addition to the requirements of data collection.

On the RRC ---> S2 side of the loop we can say that there is hardly any filtration of variety. Thus, the first step in improvement might be to introduce filters on this side of the loop. Having a centralised computer system in place, it falls upon S2 to design the required filters. There is no need to allow through data of a financial character. This type of data should go through the channel of S2 provided for accounting and budgeting (see section I.5 below).

Attenuation of variety on the RRC ---> S2 channel should not mean that only what S2 wants to know is allowed to go through. There is a need for redundant channel capacity to handle that extra variety the RUs regard as important to pass over to the metasystem; for example claims concerning insufficient medical care in the remote parts of the regional units. This point is particularly relevant, knowing that the RUs do not yet exercise their full autonomy.

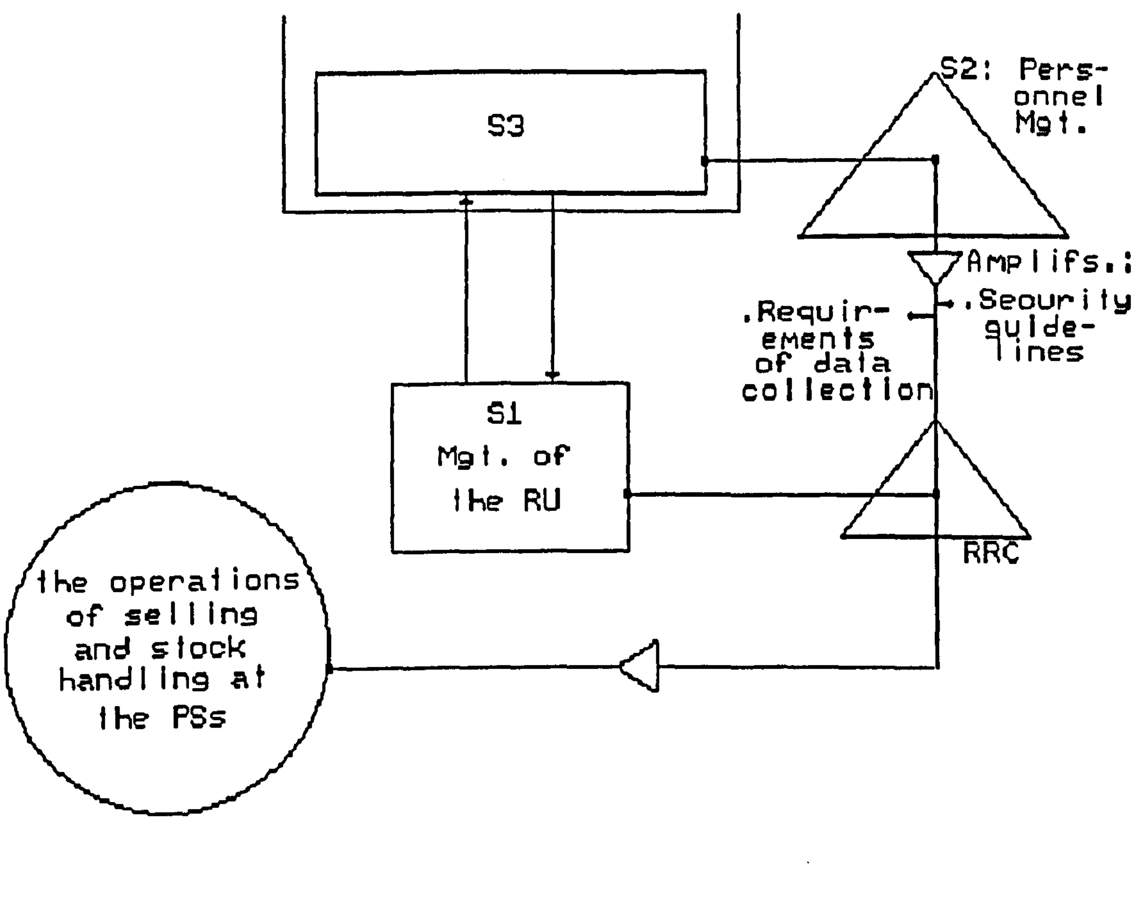

Fig.14.10. Variety amplification S2 (Personnel management) ----> RRC.

In figure 14.11, below, the positions of amplifiers and filters on the loop RRC <---> S2 and the variety expected to flow on this channel are depicted. This figure represents a diagnosis rather than an account of present practice. The system in place, as we have often indicated, has more of a reporting character, serving the metasystem rather than being a service to the RUs, which is what we should expect it to be. The absence of filtration on the channel RRC ---> S2, which is the case at present, is a recipe for variety imbalance. The lack of requisite variety of S2 vis-a-vis the RUs is manifest in the lack of coordination of personnel policies at the operational level. Employees of the PSs outside the urban centres lack many of the facilities that their more fortunate colleagues in the big cities receive, for example, transport for personnel, summer camping for children, etc. The variety filtration suggested in fig.14.11, is workable provided that the autonomy of decision of the RUs is supported by the necessary resources rather than remaining just a political slogan.

An important point needs emphasising at this stage. This concerns the channel capacity and transduction capacity of the amplifier (safety guidelines) of fig.14.11. Although the law lays down safety regulations concerning the manual workers at the depots, these regulations are rendered almost meaningless, because the transduction capacity vis-a-vis those concerned (the workers) is zero. Illiteracy among the workforce, particularly those outside the urban centres, is very high. If the guidelines are not transduced into posters with appropriate signs, and supported by explanatory campaigns by the management, the variety amplification is

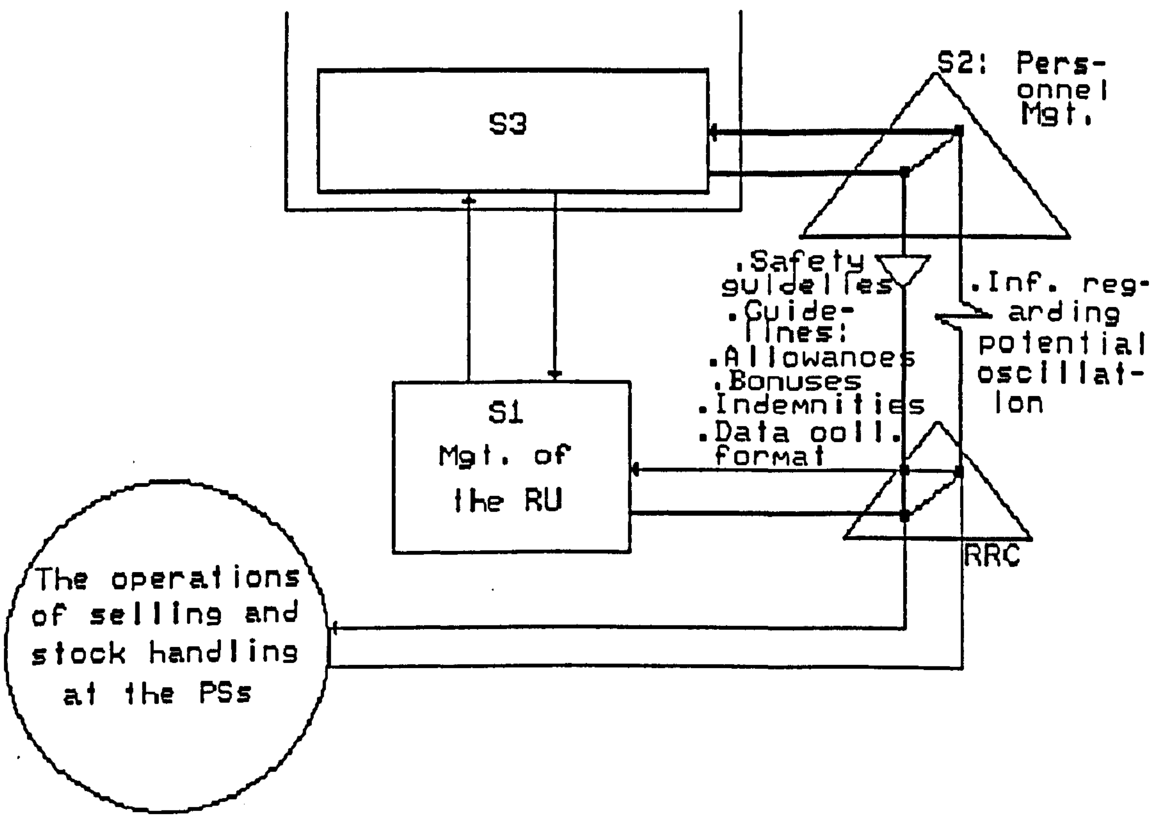

Fig.14.11. Variety engineering on the S2 (Personnel management) <---> RRC loop

necessarily lost.

As to data collection, the ills of the personnel management system are the same as those of the systems dealt with in the previous sections. Treating these ills implies reduction of transduction errors, by attention to the task of decoding of data from the manually prepared documents (bordereaux de saisie) into punched cards and/ or magnetic tapes from S2 to the RRCs of the RUs.

The first step here might be to redesign the "bordereaux de saisie" (i.e. the special documents from which data is encoded into the system). Since these documents are particular to the personnel management system, their modification would not create a major problem at the computer centre. We could begin by removing all duplication of data, or data already provided by SCBF, and replacing it with data of direct relevance to the activity of personnel management.

Ideally, and as a final point, we should expect the variety flow around the loop of fig.14.11 above to be continuous, not periodic. However, if we exclude the alternative of a complete overhaul of the present management information system, the possibility of attaining the objective of getting real time information is a long way ahead. It is characteristic of the present system to be periodic (which is true of all the elements of S2). That is to say that the fourth principle of organisation [Beer, 1979] can only be partially satisfied. Nevertheless, with amplifiers and filters properly put in place, and the transduction problems out of the way, improvements which are quite feasible, it is possible to redesign the processing cycle of the loop in fig.14.11 above, as a first step towards achieving a real time information system.

I.5 S2: ACCOUNTING AND BUDGETING

In the context of the status-quo and in terms of the volume of processed data, the accounting and budgeting activity is the most important of those dealt with so far. On the organisation chart of GCL (refer to Appendix C) we find an entire sub-directorate (S/D FCO) dedicated to the financial and accounting operations, in addition to one department in S/D MI, and a department and a service in S/D GP. The same importance is also given to this activity at the regional level, where a full division is in charge of the financial and accounting matters of the RU [GCL (S/D MI), 1983]. The important position of the financial and accounting activity in GCL is mirrored by its management information system, particularly SCBF.

In the context of the VSM, however, the S2 for accounting and budgeting is no more senior than any of the S2s looked at in the preceding sections. At the regional level, the regulatory centre for this activity can be mapped onto the existing regional division of finance and systems (division regionale des systemes et finances) [ibid]. Howevr, as we have indicated, this activity at the metasystem level is fragmented. The solution would be to combine these dispersed structures into one S2 for accounting and budgeting.

Our approach to the design of the information loop linking this S2 and the corresponding regulatory centres (RRCs) will follow the same route as with the previous S2s.

In trying to put this S2 in place, our efforts will centre around the issue of setting the accounting and budgeting standards for the RUs to prevent any oscillatiry behaviour, rather than finding ways to damp such oscillation after it happens.

I.5.1 THE REDEPLOYMENT OF SCBF

In the context of our evolving model there is a need to re-identify the scope of the accounting, the budgeting and the fiscal function of GCL. At present the bulk of the data transmission and processing for this function is carried out by SCBF. A description of the specification and data format requirements was presented in section III.1, chapter 13. The conclusion arrived at was that SCBF should be redeployed from the command channel to the channels of S2; except for the part dealing with management reports (les rapports de gestion) for accountability purposes. In what follows we attempt to present the architecture of SCBF in a way complementary to what has been already said in chapter 13.

As an integrated system, SCBF is made up of the following modules [ENS/DF, 1985(c)]:

1. A subsystem for the processing of actual data (systeme des realisations). This is the real accounting system of GCL. It deals only with actual data, registering all that has taken place. This system is organised into the following sub-parts:

a. The module for direct imputation (module d'imputation directe). It is through this module that actual data is transduced from the manual documents of the bookkeeping system (comptabilite generale) and the management accounting system into the medium of the computer. This module also generates detailed accounting entries (ecritures comptables) and specific printouts (bordereaux specifiques) for every accounting event concerned.

b.The common module (module commun). This module generates recapitulatory entries (ecritures recapitulatives) from the detailed entries provided by the direct imputation module above. At the same time it controls these detailed entries. It also can provide individual managers, at their request, with printouts regarding certain accounting events.

c.The bookkeeping module (la comptabilite generale). This provides the printouts required by the national accounting system (Plan comptable national, PCN) for fiscal purposes. These reports are prepared on a monthly and an annual basis.

2.The budgeting system (systeme des previsions). This part of SCBF has been treated extensively in section III, chapter 13. To recapitulate, it is made up of the following [ENS/DF, 1985(d)]:

a.The physical budget. In it are elaborated the physical flows of the SMPs of GCL as well as the physical flows of the other operational units of ENS (i.e. the next level of recursion up).

b.The pre-budget. As we have seen in chapter 13, during the pre-budget stage the programmes determined by the physical budget are translated into monetary values. To do so, the pre-budget has to calculate the purchase and sale prices.

c.The management budget (budget de gestion). This differs from the other two budgets in that the elements encluded in this budget are at the discretion of the manager, within the list of decision criteria of SCBF. It is prepared in December at the COB level, whilst the physical and the pre-budget are prepared during April/ May.

3.A management accounting system (comptabilite de gestion) [ENS/DF, 1985(g)]. The objective of this system is to provide management with monthly reports comparing actual achievement with the budget. As indicated earlier, accounting is the means by which the management of GCL exercises control over the RUs. It is in this sense that management accounting finds its usefulness as a control tool for management.

I.5.2 THE RRC <---> S2 LOOP

With the knowledge we now have of the architecture of SCBF and the insights already gained (from ch.13, section III) about its structural requirements, we are in a position to place SCBF in the overall information network of the coordination function of GCL. Before we begin this task we have to emphasise, again, that the issue here is to adapt SCBF to the requirements of the coordination function, S2, not the other way round.

As was shown during our reassessment of vertical managerial variety engineering (ch.13, section III) the place of SCBF is on the S2 channels. We begin with the S2 ---> RRC half of the loop. At present, the RUs have no say in the manner in which they run their financial and accounting operations. Even if they do have full autonomy, there will be a number of operational constraints which impose adherence to certain rules. Some of these constraints are associated with the need to use the facilities of the computerised information system. In this respect GCL has reached a point of no return. Other constraints are simply those relating to the national accounting system (Plan Comptable National, PCN). This means that we need to design amplifiers on this loop to spell out the rules and the format in which data is to be encoded into the system.

In this respect we distinguish two types of amplifiers: those which are specific to the internal system of accounting and budgeting, and those which are applicable to the accounting profession in the country (i.e. PCN). Regarding the first type, we can also distinguish between amplifiers dealing with actual data and those concerning budgeting.

1. The first amplifier is for rules and format specification regarding the actual data (les realisations). This is already in place but with excessive amplification since it requires the RRCs to generate more data than is actually necessary, for example, the requirement to make extra copies of the same transaction for the purposes of the metasystem.

2. The second amplifier is related to the format specification for data for budgeting. For a detailed description of the documents for entering data, refer to ch.13, section III. These two types of amplifiers have been in existence since the seventies (refer to ch.11) when the computerised information system was relatively simple and limited to payroll management. There have been a few modifications which were necessary to accommodate the arrival of the new systems, particularly SCBF; but the underlying

philosophy of their design remains the same, the emphasis being on detailed reporting.

3.The third type of amplifier is that dealing with the legal and fiscal aspects of accounting. This stands in a metasystemic position vis-à-vis GCL, which implies that S2 has limited scope for manoeuvre regarding its design. It is embodied in the manual of the National Accounting System (Plan comptable national, PCN). Nevertheless, the rules of the PCN are sufficiently general to leave some scope for manoevre to individual enterprises and businesses like GCL. In this context S/D FCO (i.e. part of our S2) has elaborated procedures specific to GCL, while at the same time remaining within the framework of the PCN.

In fig.14.12 below are shown the positions of these amplifiers on the loop.

On the other half of the loop, i.e. RRC ---> S2, the logic applied in relation to earlier S2s (stock control, direct sales, etc.) is equally valid with this S2. The variety amplifiers of fig.14.12, as well as setting the rules of conduct for the accountants at the RRCs, also determine, to a large extent, the variety flow in the direction of S2. By analogy we may distinguish between three types of filters or attenuators of variety:

1.A filter of the variety generated by the modules for processing actual data as above (the direct imputation module, the common module and bookkeeping). The variety generated by these modules is colossal. As indicated above, in addition to the detailed data, they also provide recapitulatory data. We can play on the latter to design

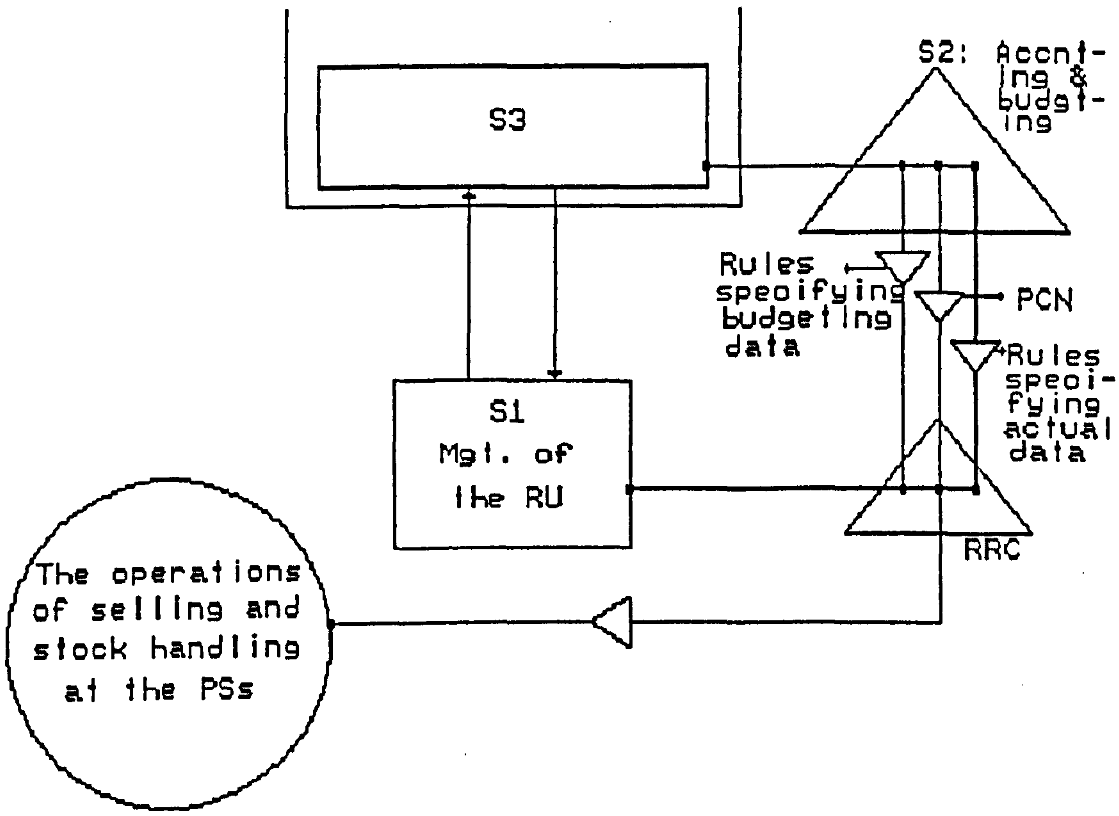

Fig.14.12. The different amplifiers on the S2 (Accounting & budgeting) ---> RRC loop

this filter. This design should take into consideration the overall network of filters of the coordination function, not just of this particular S2. For example, suppose that the volume of direct sales has increased during the last three months. The client credit management records also show a correlated increase in unpaid debts. The filters of the accounting subsystem of the total S2 should be designed to reflect a picture of the situation without necessarily going through the individual items of the transactions of the last three months.

2.A filter of the variety related to the budgeting process. This was fully discussed in chapter 13 (section III). We may add, however, that this design can be taken as adequate in so far as the autonomy of the RUs remains of limited consequence. However, if the metasystemic claims (at government level) are any indication, the position of the RUs' managements is going to change. Therefore, the level of detail of the budget proposals, as distinguished from investment proposals, is bound to change. In other words, if the autonomy of the RUs is enhanced, variety attenuation is expected to go even further, at which point, each RRC would concentrate its efforts on providing information to its corresponding systems three (R2), instead of spending time in collecting and transmitting data to S2.

3.A third filter is needed on the loop to ensure that certain data or information needed by the taxman is not filtered out. This could happen if the only filters available were those of actual data as in 1. above.

These three filters are shown graphically in fig.14.13. To reflect the dynamic character of the loop we join the two

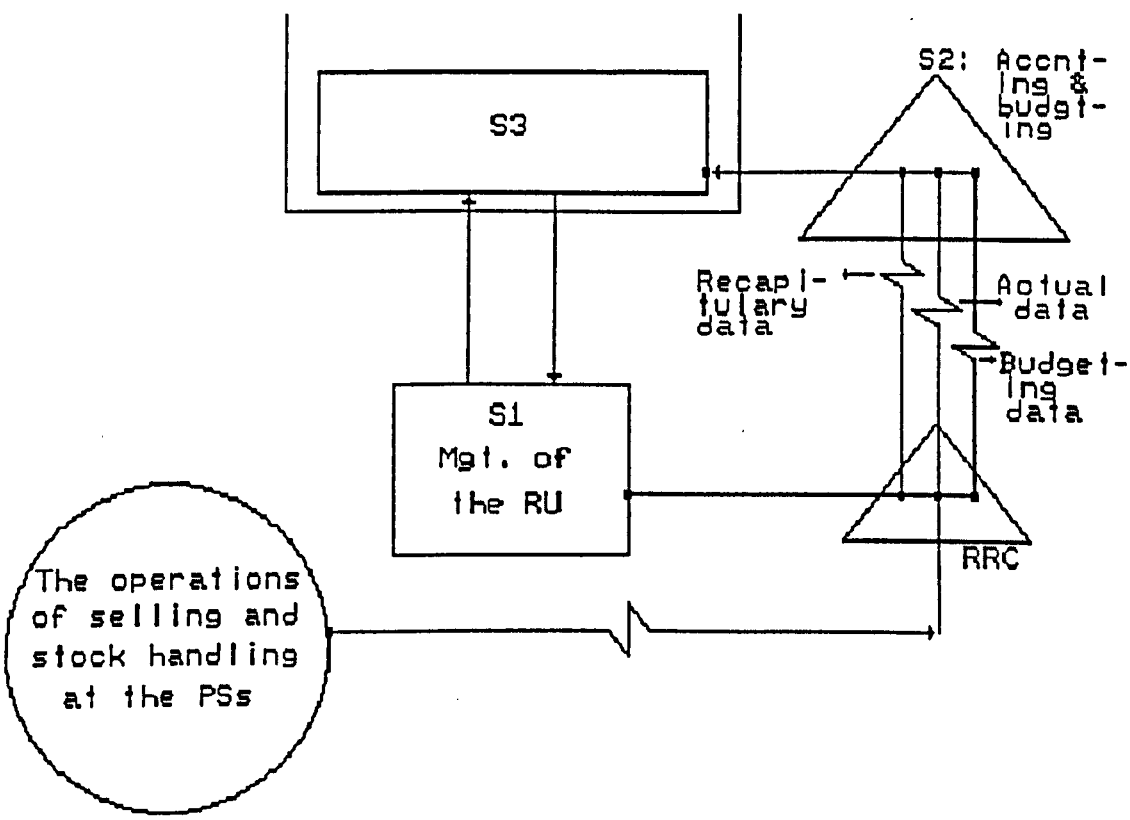

Fig.14.13. Variety filters on the RRC ---> S2 (Accounting & budgeting) loop.

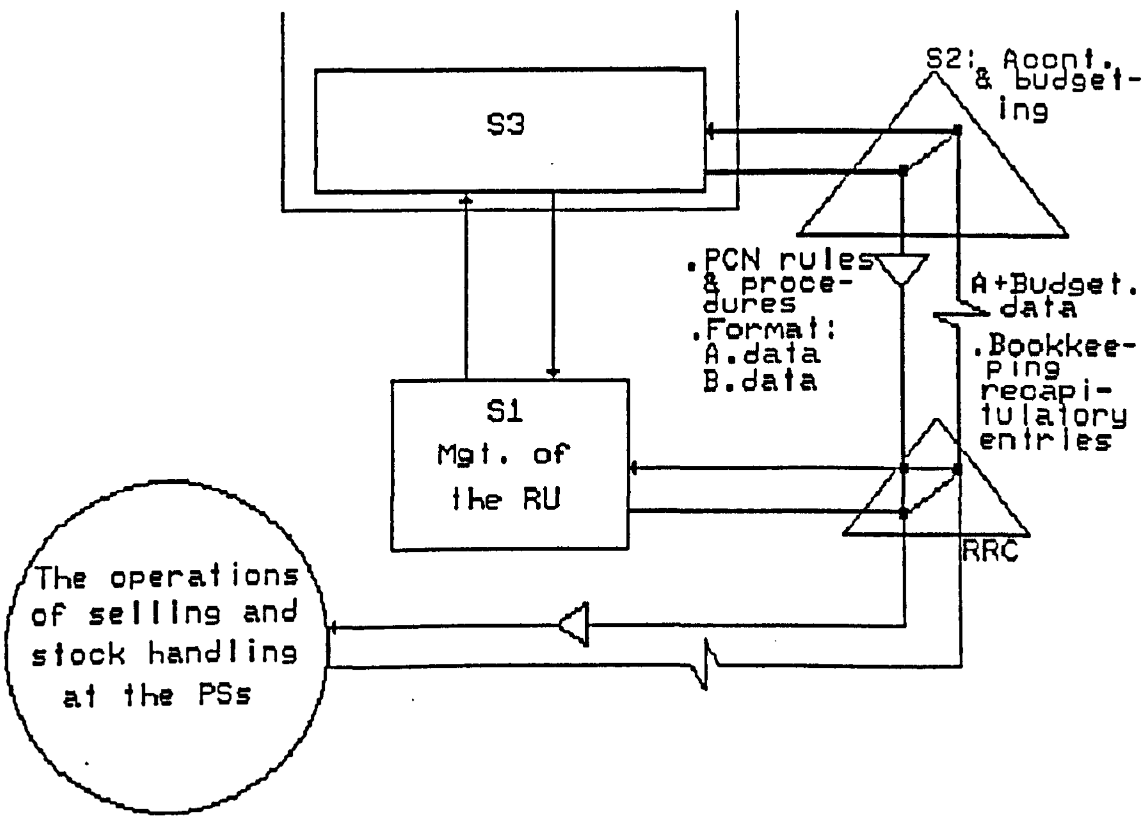

Fig.14.14. Variety engineering on the S2 (Accting & budgting) <---> RRC loop.

halves, to come up with the diagram of fig.14.14. Owing to the lack of space, the set of amplifiers of fig.14.12 and the set of filters of fig.14.13 are represented by one symbol for amplification and another for filtration.

The redeployment of SCBF from the command channel to those of S2 would undoubtedly take much of the information overload from the former. However, what of the variety equation on the S2 channels as a result of this redeployment? The answer is that the redeployment would improve the situation but with some reservations. Requisite variety of S2 vis-a-vis the RRCs could be enhanced even more if filtration went another step further. However, this can be accomplished only if decentralisation is translated into the financial autonomy of the RUs, to allow the reduction of much of the detailed reporting required of them at present.

At the end of this exposition of the coordination subfunctions, we need to remember that the above S2s eventually form one integrated total S2. Fig.14.15 below is an attempt to summarise the above discussion and depict the totality of S2. Note that the diagnostic recommendations stemming from the requirements of the law of requisite variety and the principles of organisation for S2 of accounting and budgeting are contained in the discussion of SCBF in chapter 13.

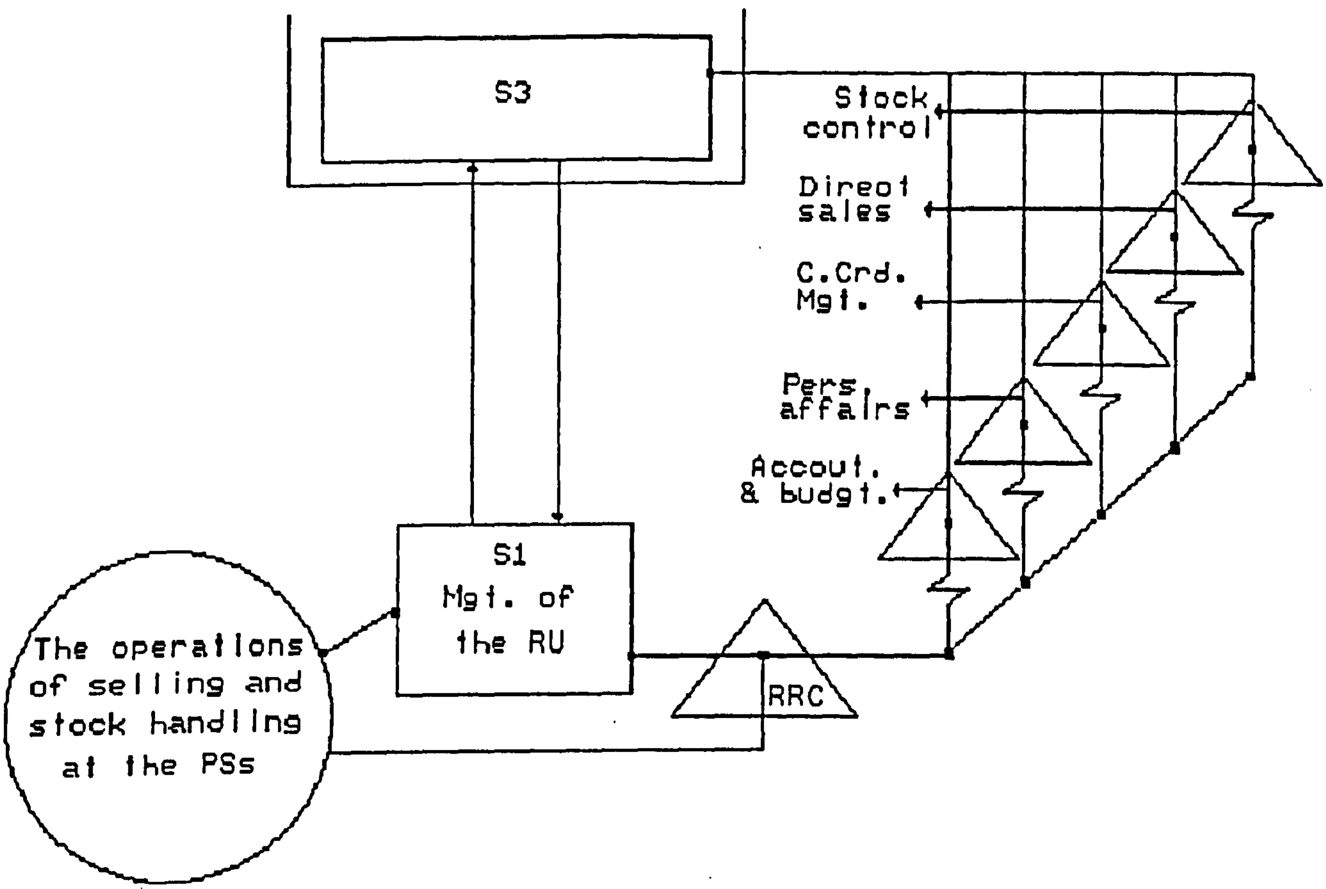

Fig.14.15. The total S2 of GCL.

II. THE MONITORING CHANNEL: S3m

Our discussion above about the vertical flow of variety between S1 (the RUs) and the metasystem (senior management of GCL), i.e. the coordination channel of S2 (with its multiple facets), and the previous discussion about metasystem intervention (command) channel, appear to have covered all aspects of the management information system of GCL. Indeed it has, in so far as the present system is concerned. However, given what we have said so far, can it be claimed that senior management is adequately informed by its information system of the operational reality of the RUs? If we adopt the logic of the status-quo, it can be argued that the information is there, and it is up to the management to exploit it. However, in terms of the VSM, this argument cannot be accepted so lightly. It is true that all the events taking place at the operational level are reported by the information system. The question is, does the management have the capacity to process all that is reported? The answer to this question is certainly in the negative, and we will shortly discover why. The problem for management is not to get more printout information; on the contrary, it has more than it can digest. What senior management of GCL really lacks is requisite variety.

Refer to chapter 8 (section II). There it was indicated that according to the first axiom of management [Beer, 1979], the senior management of an organisation like GCL cannot possibly have requisite variety vis-a-vis the operational elements with just the coordination channel (S2) and the metasystemic intervention channel. In order to restore the homeostatic balance between the senior management and the RUs we need, therefore, to design a monitoring channel (S3m) on the vertical plane joining the control function (S3) of senior management and the operations of the RUs, namely the PSs. The lack of requisite variety of senior management of GCL, due to the absence of the monitoring function, is manifest at the operational level. An outstanding example is related to the very nature of the operations of selling and stock handling of the PSs. This is related to the frequency with which samples of SMPs are degraded or declared obsolete (declasse) because of rust or damage [GCL/VEI (E24), 1974]. The cause of this is lack of monitoring of the operations at the PS level by the control function (S3). Another example is the chronic shortage of spare parts for the various machines (cranes, transport vehicles, etc.). It is difficult to get hold of statistics for the number of breakdowns, but it is exceptionally high. One of the causes is the lack of proper maintenance. The design and implementation of proper S3m is therefore urgent.

II.1 THE PLACE OF S3m IN THE INFORMATION NETWORK

There exists at present some form of monitoring activity of the operations of the PSs by the metasystem. However, this monitoring activity is seen as such only for checking inventory of stock in the depots of the PSs [GCL/VEI (E30), 1974]. As we mentioned in chapter 13, the inventory of stock is carried out on a regular basis, according to a pre-established programme and following predetermined guidelines. Stock inventory is monitored by the metasystem through an agent referred to as the procedures and stock controller, or inspector, (le controleur des stock et des procedures). He/ she is expected to go round the PSs of all the RUs every two months. On arrival at a PS, the inspector establishes the inventory programme with the manager of the PS: "En general le controleur des stocks et des procedures effectue une visite chaque mois ou deux mois a chaque point de ventes. A cette occasion il etablit le programme des inventaires a effectuer avec le chef du point de ventes" [ibid: p.11]. After the visit he/ she produces a report called an inventory results statement (l'Etat resultat inventaire, ERI).

The ERI contains the following information for every sample of stock concerned [ibid]:

.A listing of the inventories carried out since the last programme (visit); this listing is taken from the chronological file (referred to as "chrono") of the inventories of the PS.

.Sample code.

.Description of the sample.

.Date of the inventory.

.Stock level before inventory (to be compared eventually with the central file).

.The inspector's observations regarding the outcome of the inventory operation, i.e. the difference between the inventory and the quantities as registered on the stock file.

All this information is taken from the records of the stock file of the PS.

The report, ERI, is made in four copies [ibid]. The inspector keeps one for his/ her own purposes, the other three are sent to:

.The S/D MI, for use in case of an eventual investigation.

.The management of the RU concerned.

.The manager of the PS in question.

There are various drawbacks associated with this kind of monitoring. The first is that it uses a totally inappropriate channel for the transmission of its findings, namely the ERI is transmitted along the command channel. Owing to the information overload experienced by senior management, even significant findings of the controller or inspector, such as the need for a thorough investigation of an unsatisfactory inventory situation, are not always followed up by action from the management. This is not because of lack of information; the information is there, but it cannot be found, or if found, is still waiting for consideration.

The second drawback is related to the manner in which the inspection is carried out. In addition, if the intention is to check on the security stock, for example, it is necessary to carry out a random physical check (i.e. counting) of various samples, and not just to reproduce the inventory results from the file of the PS. Otherwise there is no point for inspection.

The only other monitoring function at present is the auditing of accounts. This auditing is not carried out systematically or often enough. This might be expected from an organisation like GCL. The lack of enthusiasm on the part of the metasystem for auditing is explained by the fact that, on the one hand, qualified auditors are not readily available; on the other hand, the metasystem is already continuously overloaded with information. It follows as well, of course, that the audit reports that are provided do not receive the necessary attention or the follow up they deserve. The few times when an audit is initiated arise when GCL is penalised by the taxation offficials because of anomalies in the bookkeeping practice of its RUs. Again, the findings of the auditors follow exactly the same route as the reports of inventory inspections above. The only difference is that auditing reports land in S/D FCO instead of S/D MI (both of these sub-directorates form part of S3 as we shall see later).

Fig.14.16 below is a graphical summary of the status-quo regarding the monitoring activity.

With reference to the discussion of chapter 8 (section II), it is obvious that the system as depicted by this figure is in a pathological state. The variety generated by the monitoring activity should not be transmitted through the metasystemic intervention channel. This normally lacks the capacity to carry such variety. To remedy this situation we need to redeploy the variety of the monitoring function from the intervention channel and put it in its proper place. Refer to fig.14.17 below. In this figure the first thing to note is that the monitoring channel has no direct link with the management of the RUs. Once monitoring becomes standard pactice there is no reason for the management of an RU to be informed in advance of the exact date of the visits made by S3m. The feedback from the findings of the auditors and/ or the inventory contoller, such as for example correction of the anomalies found in the bookkeeping practice of certain

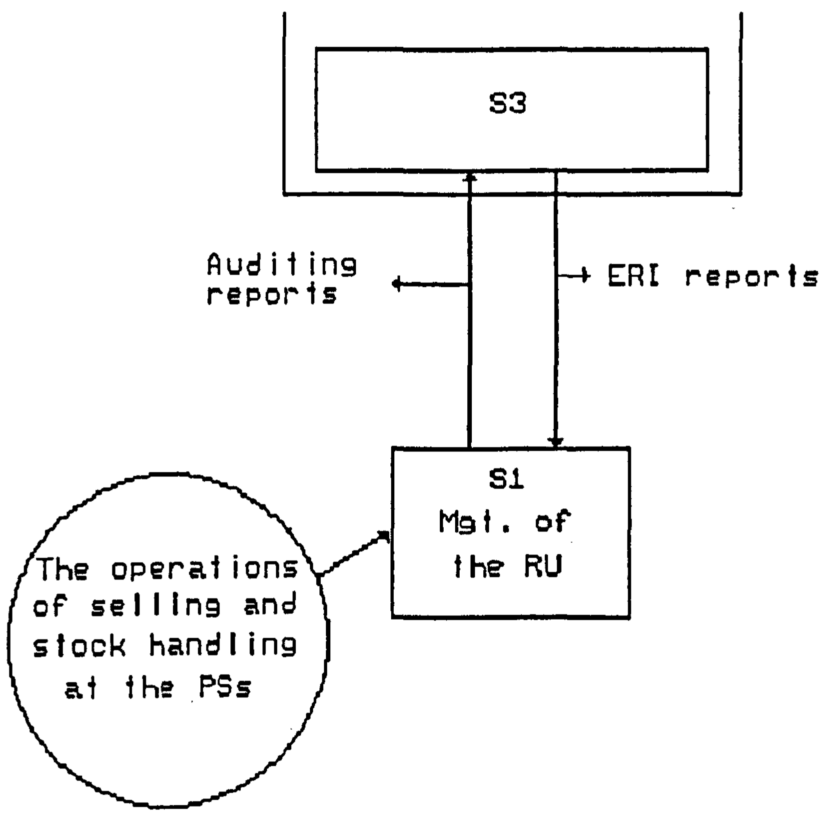

Fig.14.16. The flow of the monitoring information of the present system.

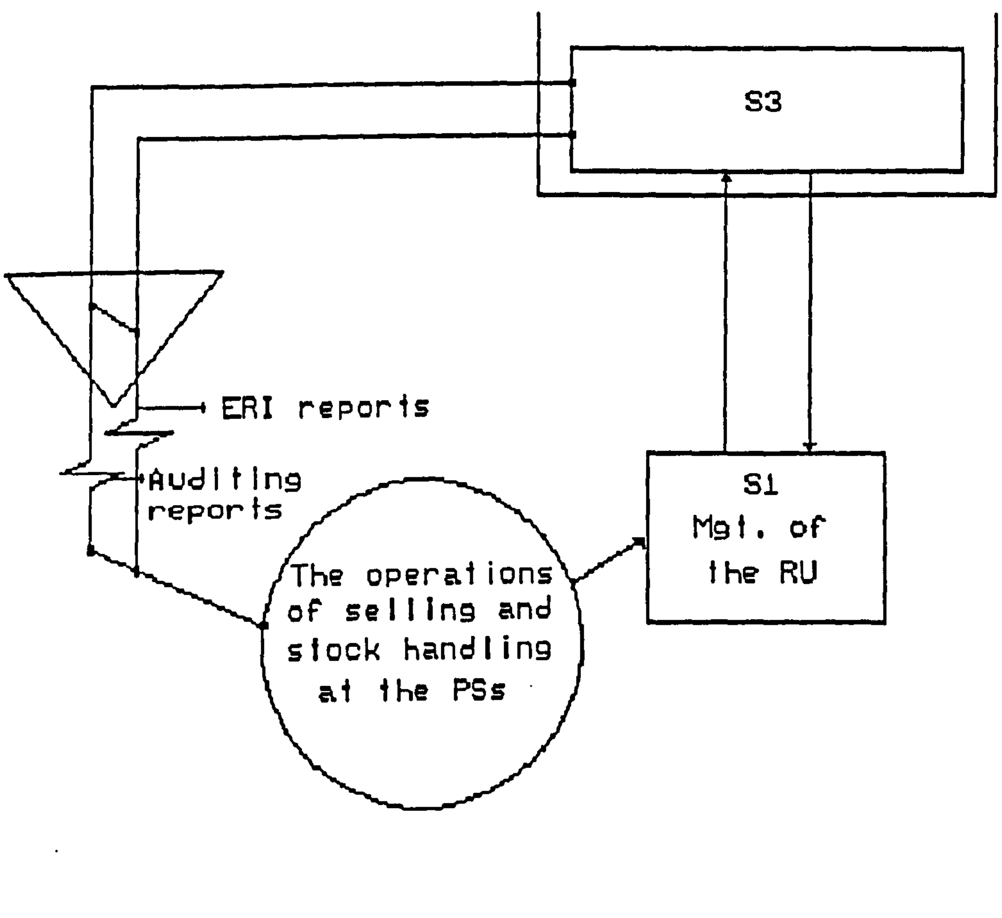

Fig.14.17. The place of the monitoring channel on the information network of GCL.

PSs, or the need for improvement in the inventory system of a PS, will come to the management of an RU from S3 as an instruction through the intervention channel, and as a detailed set of stock control procedures via system two (section I.1 above).

In this figure the findings of the monitoring activity are shown as attenuated on their way to S3. This is to reflect the fact that the report resulting from an investigation need not be a detailed account of the investigation itself. Rather it should be an account by the specialist (an accounting auditor for example) of what changes should be made by the PS(s) to improve the situation. Having S3m in place is not just an alternative to the metasystemic intervention channel. It is also, as part of S3's apparatus for the internal regulation of GCL, a filter of variety destined for S3, with regard to auditing and inventory control.

The question we must now ask is: does the arrangement of fig.14.17 above provide S3 with requisite variety in relation to auditing and inventory control? The answer must be in the negative. S3, as the control function of GCL, should act to prevent malpractice, not wait until penalised by the metasystem of a higher recursion level. Also, there are some aspects of the organisational task of the PSs not really covered by the control function, S3.

We touched upon the problem of the safety of the workers directly involved in the handling of stock in the depots above (S2 for personnel management). Even if we assume that the safety guidelines are there, it does not automatically follow that they are strictly adhered to. Lack of respect for safety guidelines can arise for two main reasons: carelessness on the part of the management of the PSs and lack of the resources necessary to render the safety rules meaningful, for example to provide a sufficient number of helmets and gloves. It is necessary for S3 to have a monitoring activity to look after this aspect of the operation of stock handling at the PSs. The first step for S3 is to ensure that sufficient resources are allocated for the promotion of the safety of personnel. This is undertaken through the metasystemic intervention channel. The monitoring channel S3m will ensure that the allocated resources are spent properly and the safety rules are observed.

Another aspect of the PSs task not adequately monitored is to do with the maintenance of the equipment, transport vehicles, buildings, etc. On the organisation chart of an RU (Appendix B) we find a whole technical division (division regionale technique) in charge of running the technical aspects of the PSs in the regions. Yet, people at the operational level complain that there is a chronic shortage of spare parts and also a lack of qualified personnel to do the repairs and ensure proper maintenance. The metasystem claims that, if there is a shortage of spare parts, it is due to government curbs on imports (most of the spare parts come from abroad). The RUs have, therefore, to learn to rationalise and live with what they have.

On the face of it, both sides have a case. However, since the RUs do not yet enjoy full autonomy, the metasystem is responsible for the situation. On the question of qualified specialists to do the repairs and maintenance, the

PSs have a strong argument against the metasystem, particularly perhaps in the remote parts of the country where qualified technicians are rare since there is little motivation to go and work in such places. The real solution to this problem lies beyond the metasystem of GCL. However, the latter could allow free interactions between the RUs and PSs. If it could provide even a little extra money to the PSs suffering most, to enable them to buy services from other RUs, the situation could be improved considerably. Regarding the question of spare parts, the scope for action by the metasystem is even wider. Even if there were no curb on imports and the RUs could get all the spare parts they need, there would still be a need to rationalise the use of these spare parts. There are technical norms for how long certain parts should last. A quick check on the norms would reveal that the technical divisions in the RUs do not ensure proper maintenance of equipment.

The mode of operation of the technical division of an RU is that it holds a statistical file of the equipment in use by the PSs in the region; it passes up orders for new equipment from the PSs to the department of technical management (department de gestion technique) at the central level; and it supervises the delivery of new equipment to the PSs. In short, the role of the technical division is not much more than an intermediary between the PSs and S3.

The lack of proper maintenance of equipment and the absence of rationalisation of spare parts is costly to GCL. It is imperative that some rigour be introduced into the technical management of assets. This rigour must go beyond the activation of the existing structures; the operational level should be made accountable for the proper utilisation of the equipment under its responsibility. However, to have workable accountability, the structures in charge of looking after the equipment, i.e. the technical section (section exploitation) at the PSs and the technical division at the regional level [GCL (S/D MI), 1985] need to have more autonomy and discretion in the implementation of their task than they have at present. For example, the technical division should be allowed to procure equipment for which there parts are available in the local market, without having to get permission from the central management. A significant outcome of more autonomy for the RUs, and the PSs within them, would be to reinforce the linkages between the operations (the squiggly lines between the circles). In this case the neighbouring PSs (and RUs) would be able to exchange experience and lend each other technicians for the repair of idle equipment; or even lend equipment itself, like transport vehicles, cranes, etc., if the need arose. Nevertheless, this cannot be a substitute for the monitoring function of S3m. This should be undertaken by specialists designated by the metasystem and not necessarily with prior notice to the PSs.

There is one last duty for S3m. This concerns the depots themselves. True, they may not rank high in the priorities of the monitoring function. Nevertheless, they deserve some attention if they are to last for their normal life-span, and, after all, maintaining a building is not as technically demanding as the more sophisticated equipment mentioned above.

The contention that S3 need not seek the assent of the

RUs in monitoring certain aspects of their operations is understandable in the context of current practice. The RUs are not as accountable as they should be: they have not yet had the opportunity. However, apart from the accounting aspect, for which the metasystem has the responsibility to eliminate malpractice, other interventions should be reduced once the RUs are made fully accountable for their actions.

In fig.14.18 the full range of monitoring activities of S3m is described. The variety of equipment utilised by the PSs will lead to high variety monitoring by S3m. As such this variety needs to be attenuated. There is no need for S3 to know the technical details of all the equipment. What matters is how the equipment is utilised and maintained.

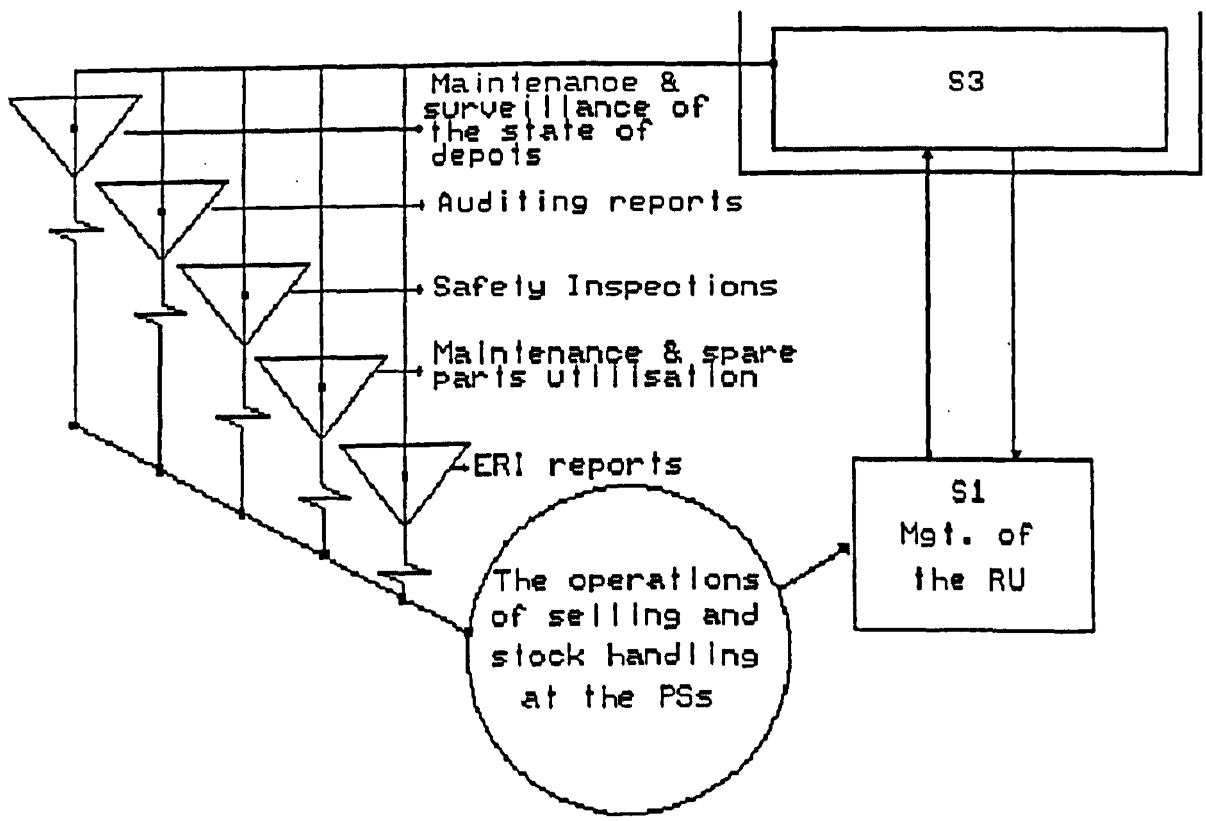

Fig.14.18. The full range of the monitoring channels S3m.

III. THE CONTROL FUNCTION OF GCL: S3

It is hoped that ch.13 and sections I and II above have provided a clear picture of the vertical variety engineering of GCL; namely the metasystemic intervention channel, the coordination channels of S2 and the operational monitoring channels of S3m. Throughout our presentation, we have implied that the channels above lead to one common destination, namely System Three (S3).

In this section, we try to elucidate the way the control function is carried out within the present structure and then consider the cybernetics of how the vertical variety generated by the RUs might be absorbed by S3. It was stated in chapter 13 (section I) that S/D MI is responsible for the operations of the RUs. Referring to the organisation chart of GCL (Appendix C) we see that, in fact, the RUs are in a directly subordinate position vis-a-vis S/D MI. Any communication between the RUs and the other sub-directorates of GCL must be through S/D MI.

If we follow the logic of this organisation chart, we must conclude that S3 is in fact S/D MI and model the control function accordingly. However, the organisation chart mentioned above is only a starting point, a guide in so far as it is necessary to take into account the organisational realities of GCL. In this respect, S/D MI is part of the control function S3, but it does not exhaust all aspects of the internal control of GCL. The financial affairs of the latter are run by S/D FCO and the administrative and personnel affairs are the domain of S/D Administration and Personnel. These are aspects of the control function and they are attributes of S3. In other words, we must consider S3 as the fusion of these three sub-directorates. It is also necessary to include some aspects of S/D GP and S/D EPO, and the department of statistics and documentation which is at present attached to S5 (direction general).

Before we proceed to the branching of the metasystemic intervention channel, the monitoring channels and the coordination channels to S3, we need first to reorganise the control function of GCL.

III.1 GCL'S CONTROL FUNCTION RECONSIDERED

In our endeavour to fuse the existing structures and shape them into S3, we have to take into consideration the question of the requisite variety of what is to be S3 vis-a-vis the variety generated by the RUs, rather than worry about what becomes of the present organisation chart. In the attempt to identify the various facets of the control function, i.e. the content of S3, we distinguish each aspect by a separate structure, as we did with S2 in section I above.

III.1.1 THE FINANCIAL AND BUDGETARY CONTROL STRUCTURE

Let us refer once again to the organisation chart of GCL (Appendix C). We see that the proliferation of financial activity across the chart is very apparent. Apart from the S/D Administartion and Personnel, the presence of financial control is ubiquitous. This is a reflection of the orthodoxy in GCL that financial control is the only meaningful control. In the context of the evolving VSM of GCL, the proposed structure of S3 has to house and take over all the financial aspects of the operations of the RUs.

One may resist this proposal on the grounds that it is difficult to conceive of one structure as being able to replace the multiple departments and services already in place. However, this should not be worrying. On the one hand, we have prepared for such an arrangement in that much of the variety flowing from the RUs is filtered and not allowed to overload S3 as is the case at present. On the other hand, there is already duplication of work between the departments and services of the separate sub-directorates. That is to say that much of the variety generated at the metasystem level from the duplication of work is unnecessary and should not have existed in the first place.

It will be noted later that under the new cybernetic design, accounting is no longer omnipresent in S3 as it is at present. That does not to imply that it has no place in the control function. Its importance is not in any way diminished as a means of control. However, accounting in the bookkeeping sense is the practice of the RUs not that of S3. What is expected of the latter is to ensure the adherence of the RUs to the established rules and accounting procedures, through S2 and S3m.

III.1.2 THE STRUCTURE FOR PERSONNEL AFFAIRS

In designating this "structure", we have omitted the denomination "administrative". Eliminating the name administration is meant to imply the real elimination of excessive bureaucracy. Since we dispense with a mass of bureaucratic paperwork by letting the RUs look after their own local affairs, there is no cybernetic reason to carry on with the status-quo in the management of personnel affairs. This particular structure in the new arrangement is a fusion of the S/D Administration and Personnel and the personnel department of the S/D MI.

III.1.3 THE TECHNICAL STRUCTURE

There are economic and organisational realities which require the existence of this particular structure. Import regulations, and equipment procurement conditions operating in the economy, make it impossible for the RUs to acquire the equipment they need without referring to the metasystem. Government regulations stipulate that permission for the procurement of new equipment is granted to organisations with a recognisable administrative identity, i.e. independent organisations. In this sense even GCL, let alone its RUs, is under the administrative control of ENS. We remember that GCL has the monopoly of importing and exporting SMPs. However, to obtain or procure its own equipment, it has to operate under the administrative name of ENS. The administrative complications arise because licences for the importation of capital equipment are the domain of the Ministry of Finance and, as far as the latter is concered, GCL has no administrative independence.

This state of affairs necessitates the existence of a special structure within S3 to ensure the proper use of capital and also to make sure that the equipment needs of the RUs are taken care of. We have to be careful, however, not to confuse the function of this structure with that of S4 (refer to the next chapter).

In time, the technical structure may disappear. All the signs are that the process of liberalisation of the economy is expected to go beyond just the restructuring of the major public companies (an indication is the decision to abolish the Ministry of Planning). It will include relaxation of the regulations, referred to above, regarding procurement of capital. This will make it possible for the RUs to acquire their own equipment in the future, especially as some of the equipment (transport vehicles, cranes, etc.) is being produced locally. Nevertheless, in the short and medium term, having a technical structure within S3 is fully justified.

III.1.4 SALES CONTROL

Sales, undoubtedly, is the main aspect of the control function of S3. In this structure we group all the control activities relating to sales, i.e. ordinary sales from stock, direct sales and the operations related to credit for clients (recouvrement). Given autonomy for the RUs, and having an S2 in place for each of these three functions (refer to section I above), will necessarily attenuate the variety concerning sales reaching S3. Therefore, it is logical to have only one structure to oversee all aspects of the selling operations. This can be done without generating unnecessary variety at the S3 level.

To give an appreciation of the structuring arrangements in S3 and the relationships between the components, consider the diagram depicting the S3 box in fig.14.19 below.

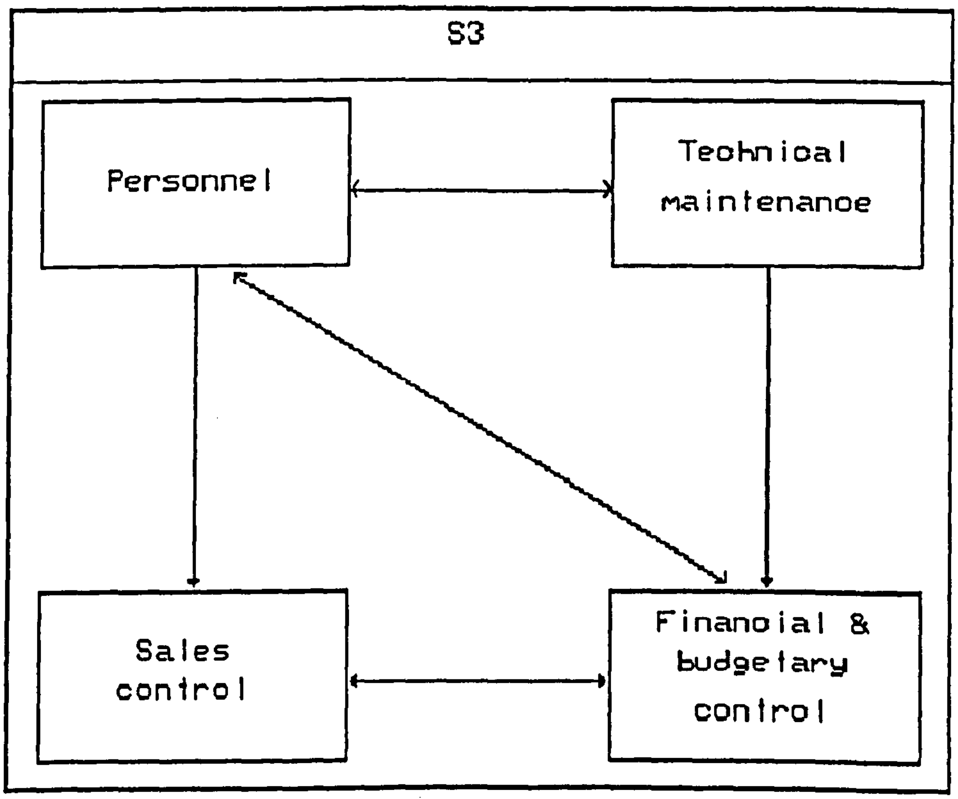

Fig.14.19. The S3 components and the interactions between them.

We come now to the important part, which is the closing of the loops of S1, S2 and S3m at the control function S3. For purely diagrammatic reasons we rearrange the boxes inside S3 of fig.14.19 to form a vertical column, without implying any hierarchical seniority between them. Refer to fig.14.20 below. It is a synthesis of all the channels hitherto exposed as leading to S3.

There is an addition however. This is to do with the mechanism for integrating the various aspects of the control function. This mechanism is embodied or symbolised by the manager of the internal market, i.e. the equivalent of the present sub-director of the internal market (le Sous-Directeur du Marche Interieur).

With fig.14.20 we have the whole internal information network in place. As already mentioned, there are three specialised types of channels converging on S3; each carrying variety relevant to a special function. With this arrangement S3 can have an overall view of the operations of the RUs, which enables it to ensure the internal stability of GCL.

Through the coordination channels, S3 sends the feedback information the RUs routinely require to run their selling and stock handling operations, for example, information concerning the confirmation or delivery of products, or concerning action to be taken by a particular RU about clients with long overdue credit payments.

There will be cases when information emanating from S2 indicates a shift from what is considered as the normal running of the operations, such as an increase in the frequency of stock-outs at the PSs or a sudden rise in the

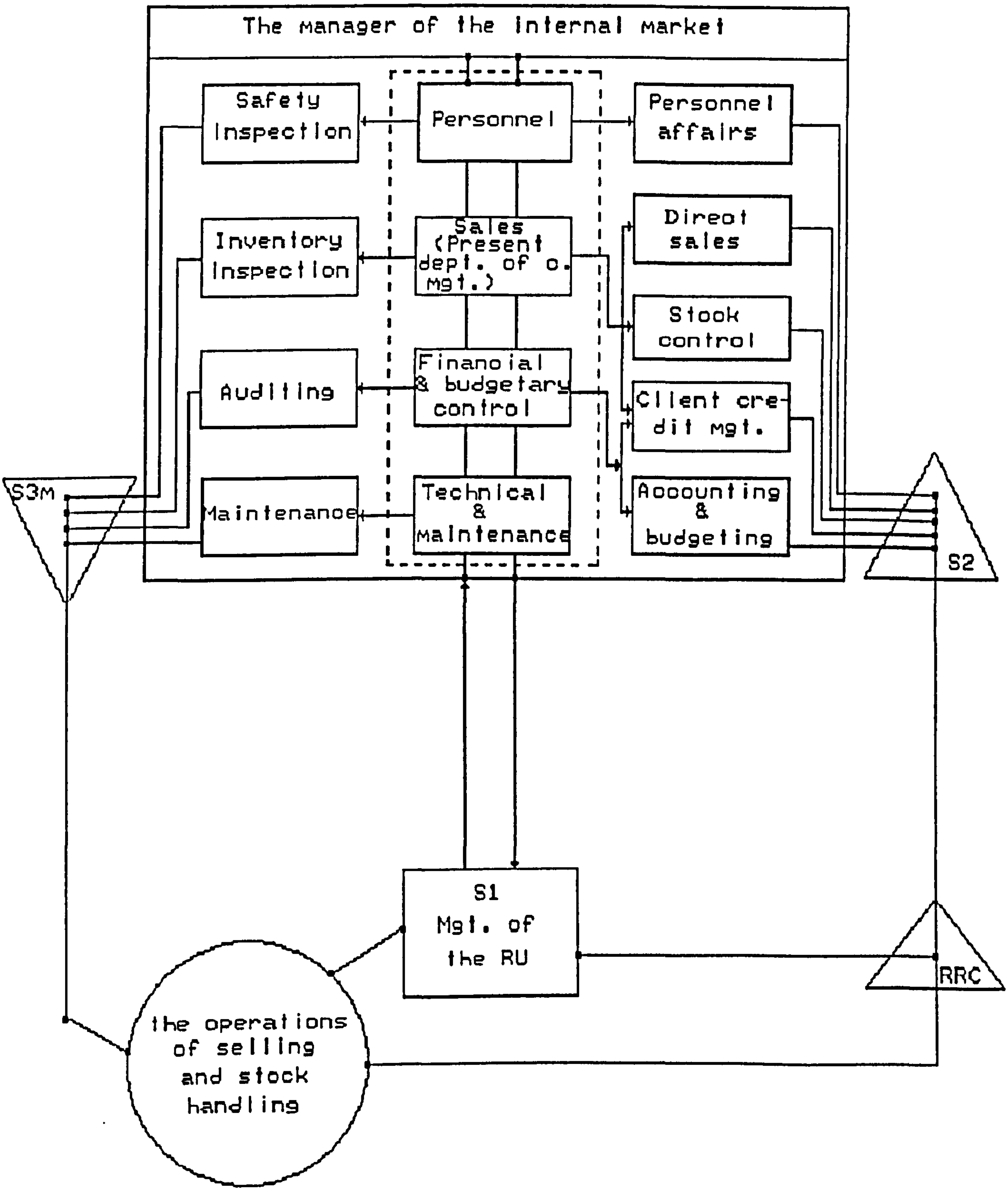

Fig.14.20. The information network for the internal regulation of GCL.

number of accidents at one particular RU, as reported by S2 to personnel management. In such cases, S3 can activate the monitoring activity of S3m and launch an investigation at the operations (the PSs) of the RU in question. With the report of the investigation duly presented to S3, after proper filtration, a decision might be taken, in the accident example, to introduce new safety rules to be amplified, on the return channels of S2 for personnel management, to all the RUs.

The ability of S3 to maintain the stability of GCL does not solely stem from its metasystemic position vis-a-vis the RUs. Although fig.14.20 does not make it explicit, S3 has a direct input from S4 (refer to the next chapter). This input from S4 is necessary to provide proper responses to certain situations arising at the RUs. Take for example the changes in the parameters of the forecasting model operated on the S2 (for stock control) <---> RRC loop. Assume that the information arriving from the RRCs (via S2) is informing S3 that stocks are falling faster than expected (unfortunately for GCL this is not mere hypothesis). Also the information received from S4 indicates that the increase in demand cannot be satisfied by the local suppliers. Given the curbs on imports, of which S3 is fully aware, one option open to S3 to meet the situation, is to act through S2 to modify the parameters of the forecasting model; namely to increase the lead times and the stock-out levels. Another option is to intervene directly through the command channel and instruct the RUs to increase the distribution limits of the samples in question (refer to ch.13).

The examples cited here are not hypothetical, they are meant to give a picture of the real situation. What is implicit in the examples is that under the present situation, the control function is usually activated after things have happened. However, we know from chapter 7 and chapter 8 that the internal regulation of GCL is supposed to take place now, i.e. while events are taking place, not afterwards. We expect the redeployment of the information network of GCL, as presented by fig.14.20 above to improve the timeliness of the information flowing to S3.

With S1, S2, S3m and S3 in place, as depicted by fig.14.20 above, we have completed the "inside and now" of GCL.

Chapter 15

THE INTELLIGENCE AND POLICY FUNCTIONS OF GCL: S4 AND S5

It will become clear from reading this chapter that much of the effort is directed towards portraying what S4 and S5 ought to be in order to facilitate the process of getting GCL out of its present state of stagnation. Nevertheless, before we can say what S4 and S5 ought to be, it is thought desirable to discuss the present situation of GCL, then proceed to the diagnosis, as we have done with the previous subsystems of the VSM (i.e. S2, S3m and S3).

I. THE INTELLIGENCE FUNCTION: S4

In the context of the VSM, system four of GCL is undoubtedly the most confusing of all the structures so far encountered. As was demonstrated earlier (ch.9), S4 is the subsystem of the metasystem which looks after the needs of the viable system (of which it is S4) for adaptation in the face of the changing conditions of the environment. An attempt was also made to show how S4 steers the viable system in the unfolding complexity of the environment. If we remember what S4 is and what it should do in the VSM context, we can safely state that our system in focus (GCL) does not have a S4.

Before we enter into the discussion of S4, let us identify the environment in which GCL operates. Remember from chapter 13, that the environments of the RUs (the OEs of

GCL) were defined and delimited geographically. All aspects of the supply side of SMPs were excluded from the environment of the RUs. The decision to exclude the supply aspect of the environment of the RUs reflects a metasystemic edict directed by considerations relating to the world market. This edict is beyond R1. In short, all aspects concerning the supply of SMPs, at whatever recursion are taken care of by S4. It looks as if the distinction between levels of recursion in GCL, regarding the function of S4, is made in terms of supply and demand. The supply transactions are the exclusive domain of S4, whereas all the transactions with customers and clients are the well-established task of the RUs and their PSs.

In addition to importing SMPs for the local market, S/D TRC (an aspect of S4, as we shall see below) has the responsibility (and the monopoly) to export the surplus of SMPs produced locally. The monopolistic position of GCL in buying and selling SMPs, combined with the centralising character of its organisational structure, has led to a certain confusion in the level of recursion to which S4 should belong. On the one hand, it assumes the role of S4 of R2 where it is the intermediary between the RUs and the suppliers of SMPs. On the other hand, it operates as the S4 for the next level of recursion up (i.e. R0), by exporting the surplus of SMPs produced by the other units of ENS. These functions are additional to its normal position as the S4 of GCL (R1).

To recapitulate, the environment of S4 (R1) is that part of the outside world (not necessarily in the geographical sense) relevant to the organisational mission of GCL (refer to ch.11). This environment is multi-dimensional; it encompasses market supply, market demand, and technological changes in the manufacturing of SMPs, etc. In the cases of GCL, S4 cannot play its role in relation to this environment because it is trapped in a world belonging to more than one level of recursion. This serves to show, yet again, that the organisational structure of GCL is in a pathological state. To demonstrate the pathological state in which GCL finds itself, refer to fig.15.1 below.

We have attempted in this figure to include three recursion levels. At R0 we see the indeterminate composition of the metasystem. Orthogonal to it, we find our system in focus (GCL) standing in the position of S1. The S1 of GCL, the RUs, are at the next level of recursion down (i.e., R2). From the VSM point of view, S4 of GCL stands in an impossible position. It assumes the role of S4 in the three levels of recursion: in R0 because GCL has the monopoly of importing and exporting SMPs; for the RUs (R2) because they have no access to the supply side of the market. and for GCL as a whole. The pathological state made apparent by fig.15.1 reflects, to some extent, the power politics exercised to keep GCL part of ENS (refer to ch. 12). It also shows how S4 is virtually nonexistent in the sense of an intelligence function and a device for adaptation.

I.1 THE STATUS-QUO

It would not be an unfair statement to say that GCL is a typical inward-looking organisation. Refer to its organisation chart (Appendix C). From this chart, we can see

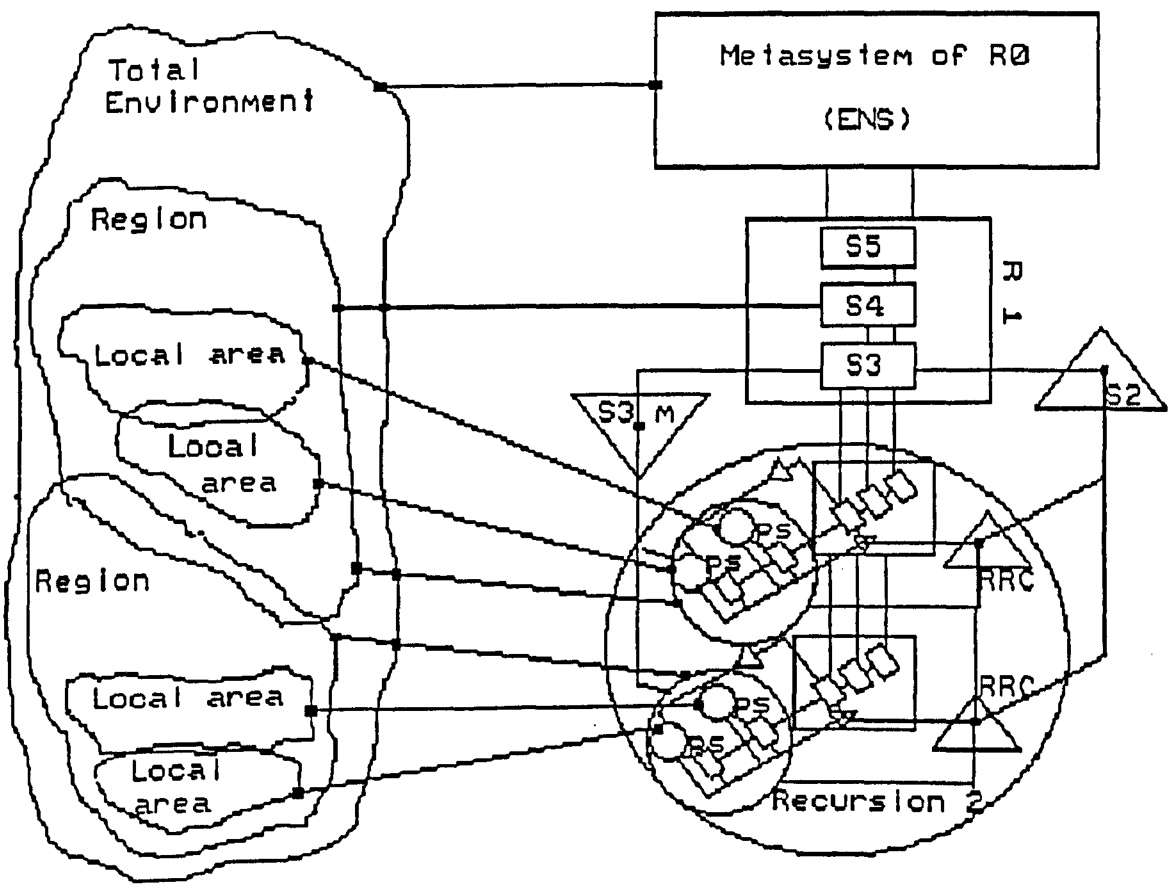

Fig.15.1. S4 of GCL as belonging to more than one level of recursion.

that GCL is linked with the outside world by two sub-directorates: the sub-directorate of commercial transactions (sous-direction des transaction commerciales, S/D TRC) and the sub-directorate of studies, programming and organisation (sous-direction etudes, programmation et organisation, S/D EPO).

S/D TRC has total responsibility for importing SMPs from the world market, and negotiating long term contracts for the purchase of raw material for the factories producing steel and metallurgical products in the country [ENS/GCL, 1985(a)]. The import division assigned this organisational task has the mission of fulfilling the orders presented by the factories of ENS (and the other companies of the old SNS) through the department of commercial programming of S/D EPO, in addition to the orders presented by the RUs of GCL (refer to ch.14). This division is organised into various departments and services [ibid].

In addition to the import division, S/D TRC also has an export division. This has the task of exporting the surplus of nationally produced SMPs. Its mission is to:

.Carry out market research, and open up new opportunities for the promotion of exports; "etudier les marches etrangers et d'elaborer une politique d'exportation a long terme tant sur le plan de pays clients potentiels que des produits a exporter dans la gamme offerte par les usines" [ibid: p.20].

.Take charge of the negotiation of contracts with clients.

The organisational task of S/D EPO is implemented through three departments [ENS/GCL, 1985(b)]:

a.The Department of Commercial Programming (department de programmation commerciale) is in charge of:

.Striving to work out a stable equilibrium between the supply and demand (expressed by the RUs).

.Programming of orders and deliveries of SMPs from the local suppliers to the PSs and GCL's clients (in the case of direct sales).

.Establishment of import and export programmes.

b.The Department of Organisation and Computer Applications. (departement organisation et informatique). This provides consultancy services to other structures of GCL in the field of computer systems applications [ibid]. It is also supposed to provide a maintenance service to the GCL's "specific systems". Maintaining the general systems (such as SCBF) is the responsability of GOI (refer to ch.11).

c.The Department of General Studies and Planning (departement etudes generales et planification). This has the organisational mission of [ibid]:

.Ensuring the compatibility and coherence of the plans and programmes of the operational structures of GCL (these operational structures in the present context are S/D MI, S/D TRC, and S/D GP, refer to ch.13) with the orientations emanating from the upper echelons of the hierarchy.

.Assuming a liaison role between the management of GCL and the functional structures of ENS.

Fig.15.2 below gives a graphical account of the S4 activities as they relate to the supply and demand of SMPs.

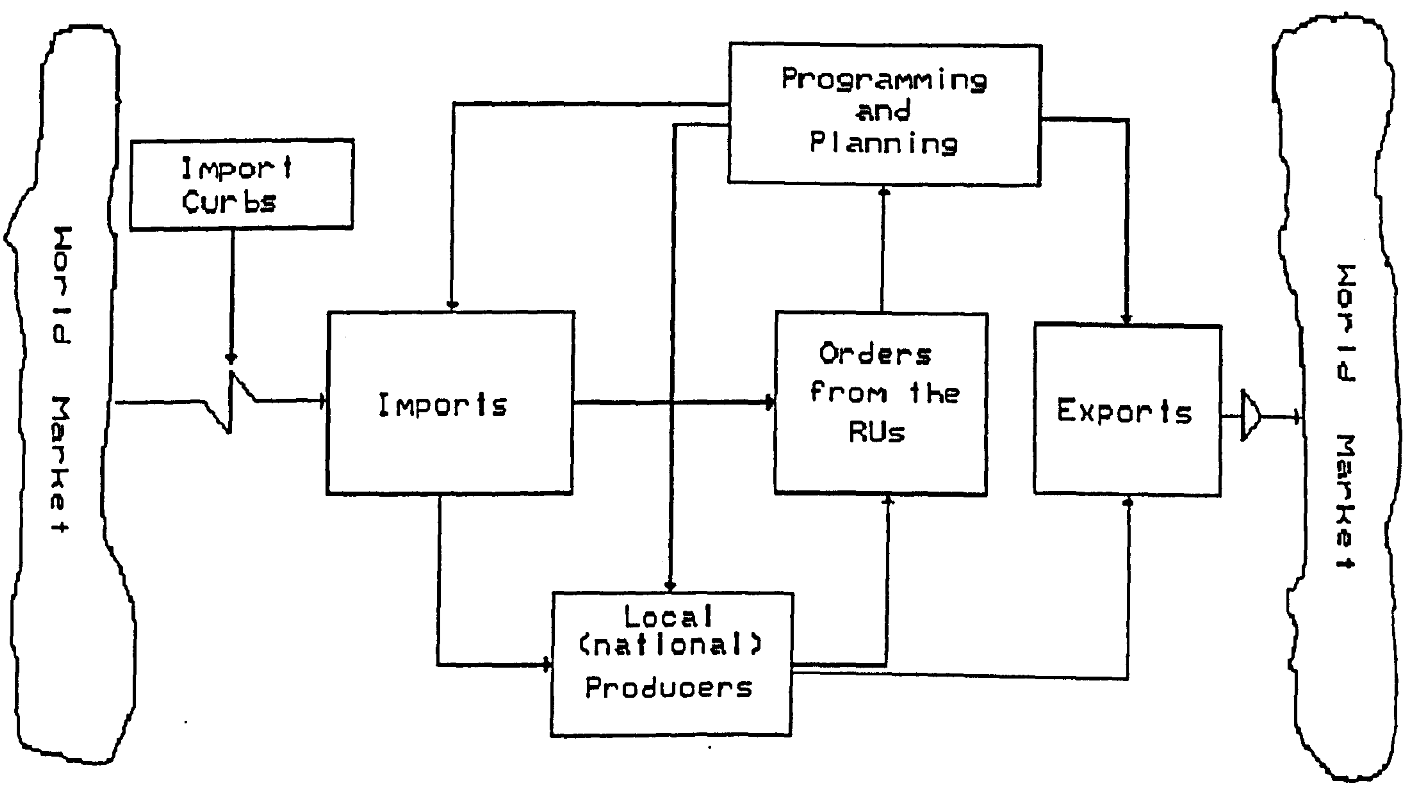

Fig.15.2. S4 activities as they relate to the world market.

This brief exposition of the two structures (S/D TRC and S/D EPO) directly in charge of the relationships of GCL with the outside world, is derived from the declaration of intent of the senior managements of both GCL and ENS [ibid]. However observing the performance of the two sub-directorates, one discovers that the actual practice is not an exact reflection of metasystemic declarations.

Take for example the S/D EPO. To begin with, it does not have the logistic means to carry out its intended mission, such as providing consultancy in the area of computer applications. It cannot even provide maintenance for existing applications, let alone invent new ones. There is another, alarming cause for the two sub-directorates not being able to fulfil their missions properly. It is alarming because it is inherent in the organisational structure itself. The multiplication of structures (meaning services and departments), and the consequent lengthening of information chains is almost beyond belief. In the two sub-directorates, there are fifty services, departments and divisions [ibid]. This stretches communication links to the limit.

I.2 REORGANISATION OF S4

The intention of this reorganisation is not to restructure the present S/D TRC and S/D EPO; rather it is meant to provide GCL with a device or a mechanism by which it can better cope with and adapt to the changing conditions of its environment. These changing conditions are reflected, on the one hand, by a considerable increase in the demand for

SMPs, in terms of the number and type of product samples sold by the RUs, and on the other, by the challenge of exporting to the world market, which is much more challenging than operating at home. The comfortable and easy going conditions ensured by its monopolistic position are not available for GCL on the world market. To take just one example of the kind of challenge facing GCL, there are new mills nearing the stage of production (refer to ch.11) which are expected to export part of their production. This means that market research is necessary to find new clients. It is also imperative for GCL to promote the new products and to prepare the home market for them.

After studying carefully the present situation, it appears that the first step towards the reorganisation of S4 should be to clarify the level of recursion at which it is supposed to operate. Since it is a subsystem of GCL (the viable system in focus), its level of recursion is, by definition, R1. However, owing to the fact that GCL is part of ENS (if only formally), it is also relevant to redefine the protocol binding S4 to the next level of recursion up (R0), and those outside ENS, i.e. the other enterprises created from the restructured SNS (refer to ch.11). The existing relationships with these other enterprises, are determined within the context of the rules and procedures regulating the monopolistic role of GCL. Without going into detail on the deficiencies of the present arrangement, we are compelled to question this arrangement if we are to put S4 in its proper cybernetic perspective.

The monopoly position of GCL in terms of the buying and selling of SMPs is a fact that we cannot revoke given the level of recursion at which we are focusing our analysis. Now this position, if it has certain advantages, also carries responsibility. In addition to its present tasks of negotiating export and import contracts for SMPs, and programming orders and deliveries in the home market, S4 is expected to extend its responsibility to finding new opportunities for further exports. Also, by extensive market research at home, it is supposed to guide local producers towards the objective of substituting local production for imports.

The monopoly regulations came into existence a long time ago, in the days of the old SNS. The law, then, did not and could not stipulate or predict the conditions and the state of technology of the steel and metallurgical industry of the late eighties and beyond. It was written when there was only SNS in the field. Since then, conditions have greatly changed, an example of the change being the disintegration of SNS itself. There has been a shift in the ideology of the government and its economic priorities are not the same. The industry has been restructured and central planning, embodied by the Ministry of Planning, was abolished in late 1987. All these conditions necessitate that GCL has a proper intelligence function to replace the bureaucratic structures of S/D TRC and S/D EPO.

Using the ideas of the VSM, however, we can determine what S4 should look like if it is adequately to reform the function of looking "outside and then" for GCL. We consider, now, market research, planning and R&D activities and the extent to which they are carried out in GCL.

I.2.1 MARKET RESEARCH

Demand analysis at present is limited to short term forecasting, and is carried out at the next level of recursion down (refer to ch.14, section I). The statistics of GCL sales show that demand has doubled in less than ten years [GCL/EPO, 1984(b)] and shortages of certain types of products (particularly those used in construction) have become a common feature at the depots of the PSs. If GCL had been monitoring the economy (growth trends of the different sectors, population growth, etc.) it would have been possible to foresee, at least partly, this huge increase in demand. There is obviously a need for market research. This market research can be subdivided into two main areas of concern: home market research and market research abroad.

With regard to market research in the home market, it can be said that up to 1987 this activity was virtually nonexistent. The preoccupations of the department of commercial programming (of S/D EPO) were confined to programming of orders and deliveries, rather than concern with future trends in consumer demand. However, in October 1987, a campaign for estimating the demand for SMPs in the home market for 1988-89, the first of its type, was commissioned by S/D MI [GCL (S/D MI), 1987(a,b)]. The intended objectives of this investigative campaign were to acquire detailed knowledge of GCL's clientele in order to constitute a database relating to the utilisation and transformation of SMPs and to ensure an equilibrial distribution between the different clients. In other words, the declared objectives were: "la connaissance la plus detaillee que possible de notre clientele, et par suite la constitution d'un fonds documentaire technique relatif a l'utilisation et a la transformation des produits siderurgiques et metallurgiques, ... La guarantie d'une repartition equilibree des produits siderurgiques et metallurgiques" [GCL (S/D MI), 1987(a): p.2].

The mode of contact with and the classification of the clientele in question are shown in table 15.1 below:

Category / Type of contact	I	II	III	IV
Press advertising	X	X	X	X
Publicity posters	X	X	X	X
Questionnaire at the PSs				X
Direct (personalsed) visits	X	X	X	

Table 15.1. Classification of GCL's clientele.

where:

Category I are the clients considered as strategic by GCL, for example local authorities (wilayates) or important public sector operators.

Category II are the important clients, not necessarily of the public sector.

Category III are referred to as "sous-traitants" or contractors.

Category IV are the ordinary small clients.

The data was collected through a questionnaire (see Appendix H). In the case of category IV, this was given to the clients at the PSs, while for the other three categories, I, II and III, the questionnaire was handed over to the client (or a representative) during a visit by a representative of GCL on a pre-arranged date. To allow computerised processing, the data was encoded from the questionnaires onto special documents designed for the purpose (bordereaux de depouillement, A, B, and C) as follows:

.Document or"bordereau" A:

Row UC (Unite Commerciale): carries the data for the identification of the RU in question.

Row IE (Identification Entreprise): reserved for the data to identify the enterprise to which the client belongs (for categories I and II).

Row IU (Identification Unite): for the identification of the client unit itself (for example a service in a Wilayate) dealing with GCL.

.Document or "bordereau" B: is reserved for the collection of detailed data regarding the clients of direct sales.

.Document or "bordereau" C: carries detailed data for every LPC held in stock at the PSs (refer to ch.13). This "bordereau" is reserved for the clients or customers of category IV.

The information resulting from the processed data was organised in terms of clients and products or LPCs (see Appendix I) as follows:

Clients:

Sales / Client	Direct	From stock
xxx	X	X
xxx	X	X
xxx	X	X

Products or LPCs:

Sales / Description of LPCs	Direct	From stock
xxxx	X	X
xxxx	X	X
xxxx	X	X

Except for the computerised processing of the data, all the operations of the demand estimation campaign have taken place at the R2 level (i.e. the RUs), but with the direct supervision of the S/D MI (which we have seen is part of S3). In other words, from the way it was conducted, it seems that the campaign was not considered in any way as a part of the function of S4. This mix-up of organisation tasks, between the present elements of GCL, is a reflection of the dominance of S3 and the near absence of S4.

As to market research of the outside market, it is already written into the organisational mission of the export division of the S/D TRC. In reality, however, the existing export agreements between GCL and its clients abroad are an outcome of political efforts on the part of the Ministry of Commerce, mostly as part of a package of bilateral exchanges.

A quick look at the internal organisation of the export division reveals why it is not fit to undertake any market research. It is the image of a bureaucratic machine rather than a structure for carrying out market research. It is made up of three departments [ENS/GCL, 1985(a)]. One specialises in the export of steel products, another is concerned with exporting non-iron products, the third manages the sales, a duplication of the role of S3. To put it in just one sentence, this export division has a very poor model of the world market. It is not equipped with the means or mechanisms by which to probe the market or understand the trends signalling changes in the outside world.

I.2.2 PLANNING

In the present organisation chart of GCL we have the structure for planning, but not the function. Refer back to the stated organisational mission of the department of general studies and programming of S/D EPO above. This might be expected to perform the function but, in practice, we cannot discern that it does so, at least in any cybernetic sense (as advocated in ch.9). The whole existing apparatus (S/D TRC plus S/D EPO) is designed to process paperwork. The view these two sub-directorates hold of the world is that it is static and timeless.

It is repeatedly emphasised by the government that one of its main long term objectives is to achieve self reliance and substitute locally produced SMPs for imports. The role of S4, as we know, is supposed to be to initiate plans to engage and steer GCL towards attaining this long term objective. The role of the two sub-directorates above (expected to act as S4) is, however, extremely passive. They are reduced to structures for receiving others' plans, then working out the course of action to take in accordance with the received plans. In terms of its medium term objectives (as we saw in ch.14, section I) GCL has shifted from that of satisfying customer demand to that of managing the queues of orders from waiting customers. This overall situation can only be improved if S/D TRC and S/D EPO get outside their bureaucratic shells and act together as S4.

Within the context of our evolving VSM model, S4 should be provided continuously by S3 with knowledge about the requirements and the capacity of the RUs to stock and sell SMPs. At the same time it has, or should have, its own knowledge of the external conditions, obtained through market research. For example S4 should be able to project the supply capacity of the local factories and the import ceiling for the coming year. The latter can be deduced from forecasted foreign currency revenues from exports of other sectors of the economy (oil, natural gas, etc.) and from extrapolation from the previous year's data. If this kind of information can be, and is, made available to S4, it can formulate plans to direct the overall activity of GCL, and prepare for the coming year rather than waiting for events to happen then adjusting to them.

Forecasting is a necessary element of planning. The only form of forecasting practiced at present in GCL is short term forecasting, and that is the domain of S4 of R2 (refer to ch.14, section I). It is quite possible for S4 to introduce simulation, in the systems dynamics sense, to probe its environment. The computer facilities are available. Given the sums spent on computer software, acquiring a systems dynamics simulation package should not pose a problem. The usefulness of a simulation model is that it would allow S4 to envisage a multitude of scenarios for the future and improve on its plans as that future unfolds.

I.2.3 RESEARCH AND DEVELOPMENT (R&D)

As an activity of S4, of GCL, this should not be confused with the laboratory-type R&D undertaken by manufacturing organisations. What is expected of R&D is along the lines of the "organisation et informatique" activities (i.e. organisation and computer applications) already existing in S/D EPO. However, this department of organisation and computer applications is very much reduced in scope. Its present activity is aimed almost exclusively at the maintenance and, to some extent, improvement of the existing, specific systems of GCL. The general systems (remember system here refers to a software package) are the domain of GOI (refer to ch.11). Given the dependence of management at all levels of recursion on these systems for information, there is a need to enlarge the scope of this department. We could for example extend its activity to developing a forecasting model for S4, adapting the systems dynamics techniques (referred to above) to the specific requirements of GCL.

We find that almost the same activity, i.e. organisation and computer applications, is pursued by the department of procedures and systems implementation (departement procedures et exploitation des systemes) of S/D MI. This duplication of tasks (remember that S/D MI is part of S3; see section III, ch.14) reflects the lack of integration of the metasystemic functions of GCL, which is in itself a sign of the ambiguity of the role of S5 as a metasystemic integrator. Reorganisation of S4 would necessarily imply including the development activity of the department of procedures and systems implementation as part of the R&D function of S4. The same is true of the development department of S/D MI (refer again to the organisation chart of GCL). Its present organisational mission is to plan the future development of the distribution network over the territory. As such, it should be an integral part of the R&D function of S4. These two departments are poorly staffed with trained personnel, which makes them nearly redundant in so far as the implementation of their mission is concerned.

In order to develop further an adequate S4 for GCL we must consider its specific and general rnvironment. We begin with the specific environment.

I.3 THE SPECIFIC ENVIRONMENT OF GCL

For the VSM, the distinction between the general and the specific environments is important in the sense that the strategies needed to tackle each are different. We attempt here to show how this needs to be taken into account in designing the S4 of GCL.

There are aspects of the environment which S4 can influence and in which it can induce changes. Its monopolistic position of buying and selling SMPs is of immense importance. For example, it can manipulate, at least partially, imports of SMPs and raw materials for the local producers which can induce, in the long term, qualitative changes in demand and in the product mix of their output. It is that environment, within which GCL can exert influence, which is referred to as specific. It is an environment which encompasses all the problems relevant to the supply and demand of SMPs in the country and the flow of imports from the world market. The general environment of GCL is broader extending beyond the country. Within the country, it is that part shared by the rest of the economic agents (of other sectors) operating in the economy. In other words, this environment is the social economy as a whole, with all its multiple aspects. As to the outside world, GCL's relevant environment is the market for SMPs and related industries and technologies.

Needless to say, then, the environmental complexity with which S4 is faced (from both specific and general environments) is enormous. To match this complexity S4 must introduce some sophistication into the static model held by the present bureaucratic structures, where much of the relevant variety of the environment is filtered out. Fig.15.3 below is an attempt to present graphically the specific (or problematic) environment within the general environment.

Given that S4, in the VSM sense, is almost absent from the scene, the practical approach to follow to launch S4 is to concentrate effort on the specific or problematic environment, but without forgetting that the latter is part of a wider environment. Owing to its monopolistic position in the buying and selling of SMPs in the country, the problematic environment of GCL extends, geographically, all over the national territory.

There are two possible ways in which to approach the complexity of this relevant environment. The first is that S4 could recognise that the static view of the world held by the present bureaucratic structures is inappropriate and that it is necessary to have models adequate in terms of complexity, such as systems dynamics simulation models, if it is to regulate its environment effectively. The alternative open to S4 is to operate with models of low complexity at the expense of speedy adaptation to change. This second alternative is in fact what S/D TRC and S/D EPO are doing at present. However, this is not really an option, and the state in which GCL finds itself is an indication why. For

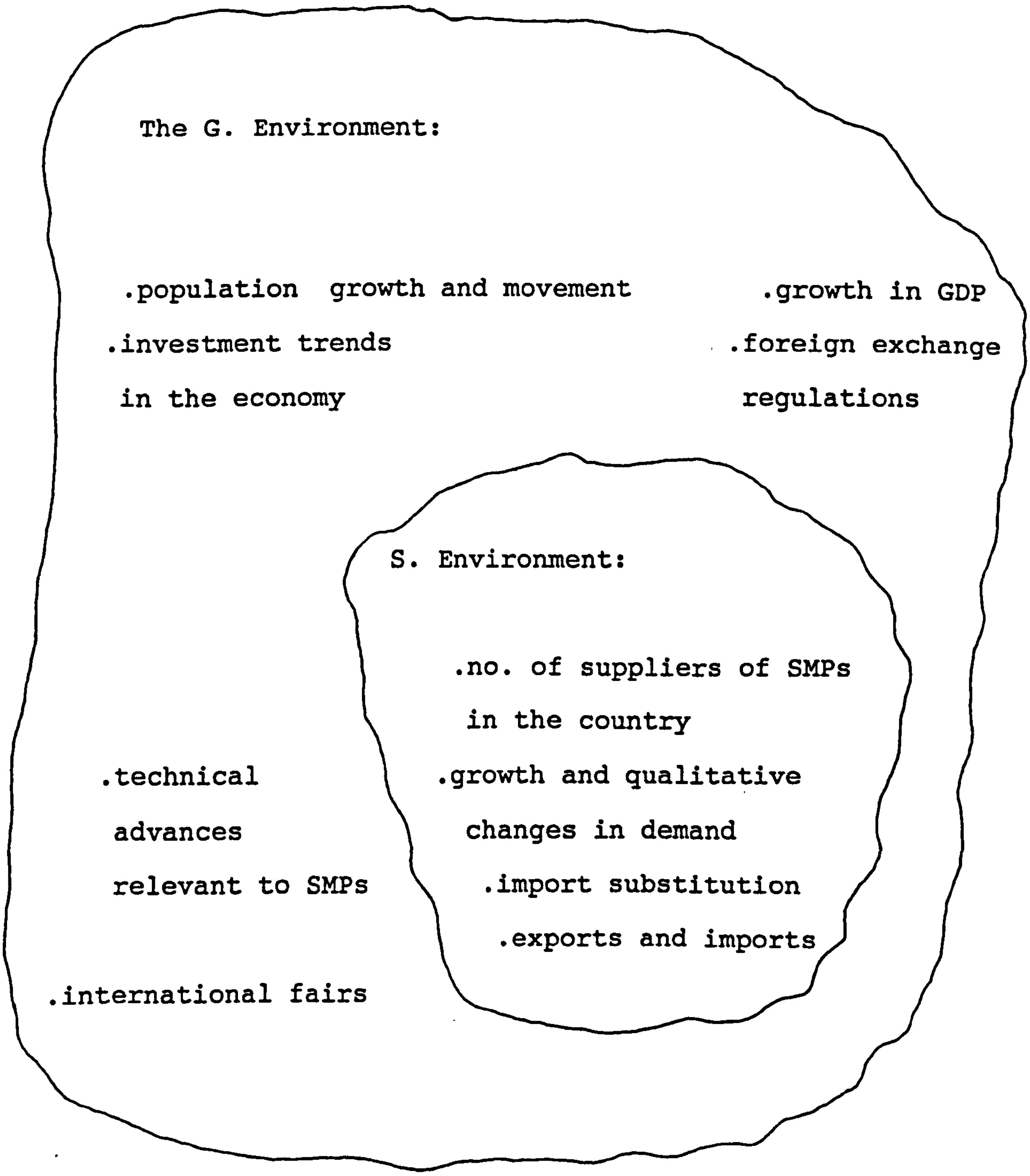

Fig.14.3. The two types of environments of GCL.

practical purposes we might say that GCL is forced to operate at low complexity levels because of lack of resources. However, if this is the case it should at least be aware of the complexity involved, which is different from ignoring or being unaware of the complexity altogether.

Consider fig.15.4 below. It represents what we have so far advocated for S4. The distinction between the two components of the environment implies that the strategy for dealing with the specific environment needs to be separate from that relevant to the wider environment. The set of filters "F1" and the set of amplifiers "A1" deal with the complexity of the specific environment. The set "F2" and the set "A2" are directed to the wider environment. Also, inside the box labelled S4 we have foresworn the present organisation chart (S/D TRC, S/D EPO, etc.) and emphasise instead the activities that should make up S4 (planning, forecasting, market rsearch, etc.) and the necessary integration of these activities.

Let us now continue to pursue the logic of the two alternatives open to S4 vis-a-vis its specific (or, for that matter, general) environment. Given the present practice of operating at low complexity levels does not work (if long queues of customers' orders are any indication), S4 must develop a good, i.e. sufficiently complex, model of the specific environment. We know that attempts at cybernetic regulation necessitate a model of adequate complexity if the regulatory efforts to be successful [Conant and Ashby, 1981]. The first step towards building a good model of the environment is for S4 to properly integrate its activities

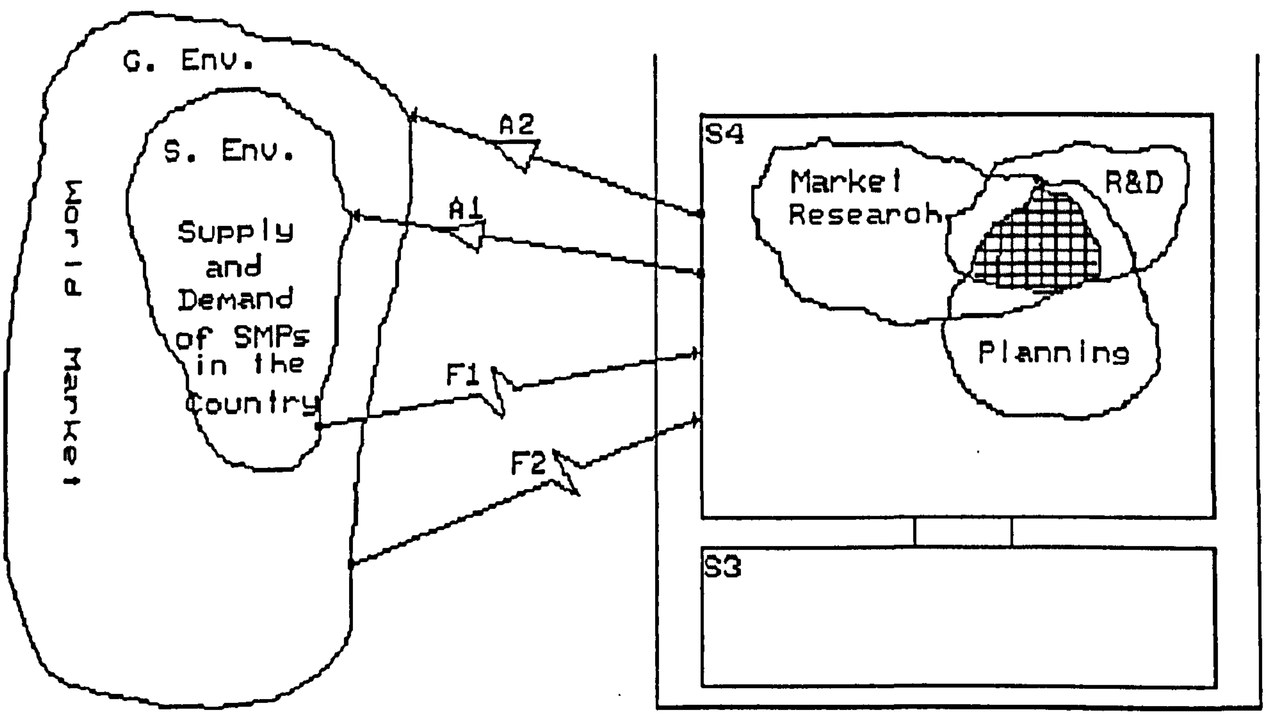

Fig.15.4. The integrated activities of S4 and the environment.

and avoid the fragmentation prevailing at present.

Refer to fig.15.5 below. Here we try to portray the loop by which S4 probes its specific or problematic environment. This loop represents the demand estimation campaign undertaken at present by S/D MI which is part of S3. "A" symbolises the variety amplification accompanying the campaign, i.e. the publicity in the press, the posters at the PSs and the personal visits to important customers by GCL representatives. The attenuator or filter "F" represents the questionnaire itself. It is an attenuator in that the high variety of all possible demand is reduced to that expressed largely by categories I, II, III and partially by category IV. The potential clients of GCL in the future are completely ignored. The questionnaire as it stands, therefore, is designed to filter out all that is not known. The information yielded (Appendix I), i.e. the estimated demand, is only relevant to the period concerned (1988\89). Further, the information cannot be 100% reliable because there remains a proportion of demand related to the small customers who were not accounted for during the campaign. Also, there are other unknown aspects of the market, which could prove of considerable importance, not taken into account by the questionnaire. Take for example the newly concluded contract with a foreign firm to build a car factory in the west of the country, and the opening of a new railway line towards the south. Both these projects require considerable quantities of iron and steel products. This kind of environmental variety is systematically filtered out by the questionnaire.

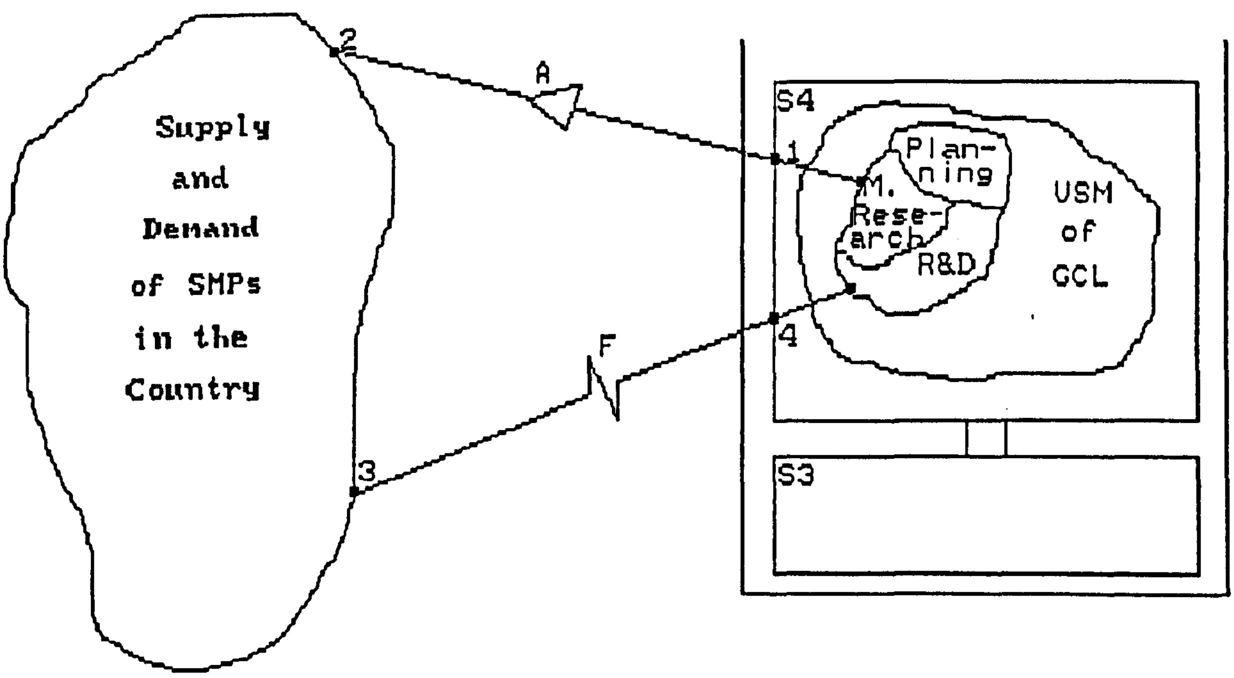

Fig.15.5. S4 probing the specific environment.

It is also important to remember that monitoring the environment, in the cybernetic sense, is supposed to be a continuous process. Doing so in a campaign-like manner is costly and inefficient. If GCL is to launch another campaign next year or the year after, it is very likely that the same approach will be adopted. An on-off approach to environmental monitoring cannot help in the learning process necessary to improve the amplifier "F" of fig.15.5 above. By having a continuous inflow of variety on the channel S3 ---> S4, the latter can be informed of the actual demand at the operational level (i.e. the RUs). In the light of this information emanating from S3, S4 can modify its amplification strategy on the outgoing amplifier "A" by, for example, introducing publicity on television to reach the wider audience of the small customer.

Since the demand estimation campaign has been undertaken by the RUs (S1) under the direct supervision of S/D MI (part of S3), the feedback about the state of actual demand arrives at S4 on the channel S3 ---> S4. However, if the campaign for estimating demand had been performed in a S4 manner, we would expect the feedback to come through the filter "F", rather than from S3 which is not designed to handle environmental information.

To take into account the continuous changes in the environment, the amplifiers and filters on the loop joining S4 with the environment should reflect the learning process necessary for a stable equilibrium of GCL with its environment. Refer to fig.15.6 below. Again "A" represents the amplification activities of S4 in terms of the demand estimation. The flow of variety filtered by "F", which would include other forms of filtration in addition to the questionnaire, such as monitoring the statistics of key economic Ministries, will enable S4 to adjust or modify its amplifiers "A". Equally, the results of variety amplification are fed back to "F" so that it can be better tuned to filter information from the environment, which otherwise might be missed. That is to say, the design of the filters "F" should take into account the purposes and the targets of the amplifiers "A". This mutual feedback between the amplifiers "A" and the filters "F" is shown in fig.15.6.

As we can see from the figure, although demand estimation is a task of market research, the latter performs the task of demand estimation as an integrated part of S4, not as an independent activity totally divorced from the others in S4. Also made explicit is the fact that the monitoring activity of the intelligence function should be carried out against the background of GCL as a whole, i.e. its VSM. This implies that monitoring the market by S4 is not an end in itself but is meant to secure favourable conditions for the system (GCL) of which it is system four. Having the model of GCL (VSM) in the background is a necessity without which S4 cannot appropriately define the level of environmental complexity at which it must operate. This level of complexity can be properly determined only if it knows the internal capacity of GCL to match the complexity of the environment. This it can know only if it understands the cybernetics of GCL, i.e. has its VSM in place.

From the exposition in this chapter and the knowledge gained from chapter 14, one cannot fail to note that GCL is inward looking type of organisation. It is open to the

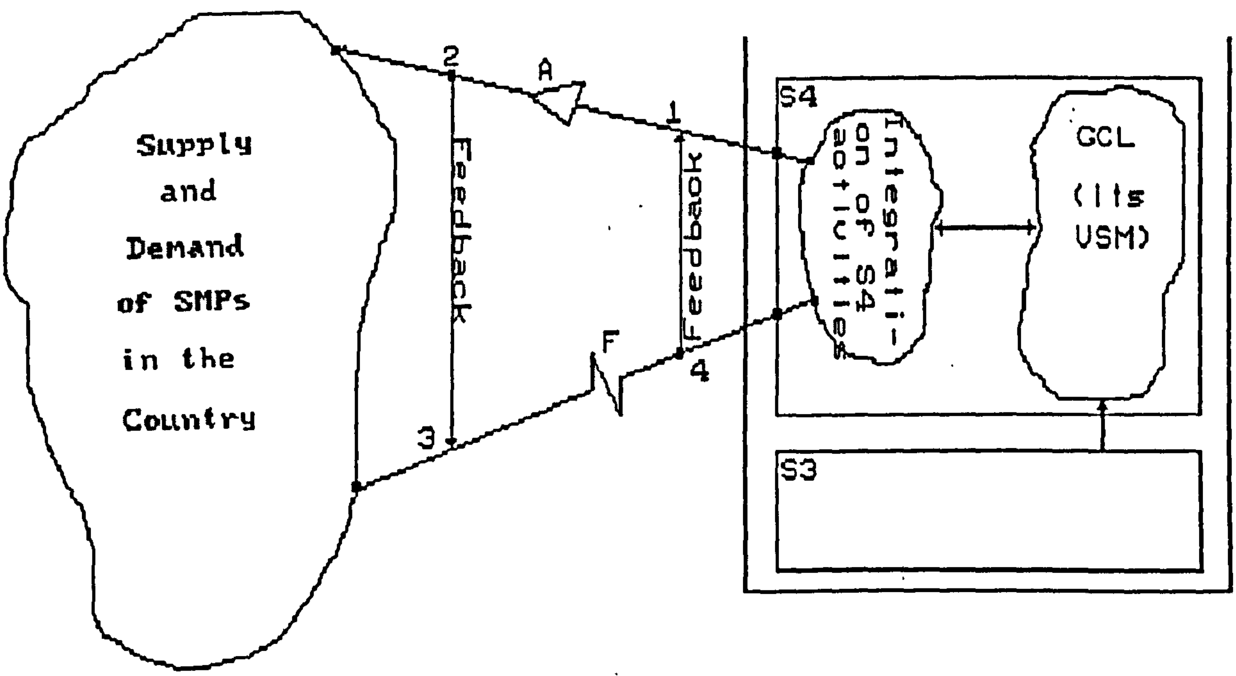

Fig.15.6. Mutual feedback between variety amplification and filtration.

outside world, but not in a way that can allow it adapt quickly to the challenges facing it. Establishing S4 in GCL seems to require more effort than for any other subsystem already dealt with (ch.13 and ch.14). For the internal regulation of GCL (i.e. S2, S3m and S3) most of the requirements are already there; the real task is to restructure them. The situation for S4 is different. The requirements for an intelligence function, in the VSM sense, are mostly absent. Putting S4 in place needs a major overhaul and poses many difficulties. It is likely that the activities proposed for S4 (market research, system dynamics simulations of the market, etc.) will not be met with great enthusiasm. However, it is widely agreed within GCL's management that GCL is not keeping pace with the realities of its changing environment. This fact in itself should be an incentive for management to shake up the system and reshape it in the proposed fashion.

II. THE POLICY FUNCTION: S5

It was stated in chapter 11 that the standard structure of management of any public sector operating unit (generally referred to as a productive unit) is determined by the charter of the socialist management of enterprises (la gestion socialist des entreprises, GSE). GCL, as an operating unit of ENS, complies with this charter, that is to say its management (i.e. its S5) is made up of [GSE, 1974]:

1. The General Director (le Directeur General, DG).
2. The board of management (le conseil de direction). This consits of the heads of all the sub-directorates (see the organisation chart of GCL in Appendix C), and two extra members elected by the staff.
3. The workers' assembly (l'assemble des travailleurs).
4. The permanent commissions (welfare, security, etc.).

In theory, all four constituents of S5 are involved in policy decisions. The actual practice, however, is different. It is common knowledge that the views of the workforce in running GCL are taken into consideration only in relation to disciplinary action taken against one of their members. They can in their assembly voice their views or objections about whatever decision the director takes, but they cannot do anything else; strikes are outlawed. Also, members of the board can have independent views. However, these views carry little weight when in conflict with the DG. For all practical purposes, S5 of GCL is no more than the Director General (DG).

Further, although the Ministry of Planning was abolished in October 1987, the economy still operates under the existing plans, formulated prior to 1987. This implies that, under the status-quo, the policy decisions of GCL, in the VSM sense are really taken at higher levels of recursion. The role of S5, as symbolised by the DG, is therefore limited to supplying closure, in the sense that, on the one hand, GCL's chain of command ends with him but, at the same time, he himself is a node in the chain of hierarchy which ends at the government. He remains, however, the symbol and representative of GCL to other official organisations.

We have seen from chapter 9 that the role of S5, in variety engineering terms, is to manage the variety engineering of the homeostat S3 <---> S4. This role is obscure at present. S5 is involved in the transactions taking place between S3 and S4 but not in the explicit role of a supervisor. This can be attributed to the fact that GCL is an inward looking type of organisation, where S4 is not seen as equally important as S3. S5 is therefore, more than necessarily, associated with the internal running of GCL.

II.1 MANAGING THE S3 <---> S4 HOMEOSTAT

Refer to fig.15.7 below. In this figure are shown the functions associated with S3 and S4, as they relate to one another, implemented by the various services and departments in the present organisational structure. The figure shows clearly the importance played by the department of commercial programming within S4 and between S4 and S3. Equally obvious is the pivotal role assumed by sales, in the shape of the department of commercial management, with its SCCC and SCVI, in S3. Most of the variety generated by S3 and S4 emanates

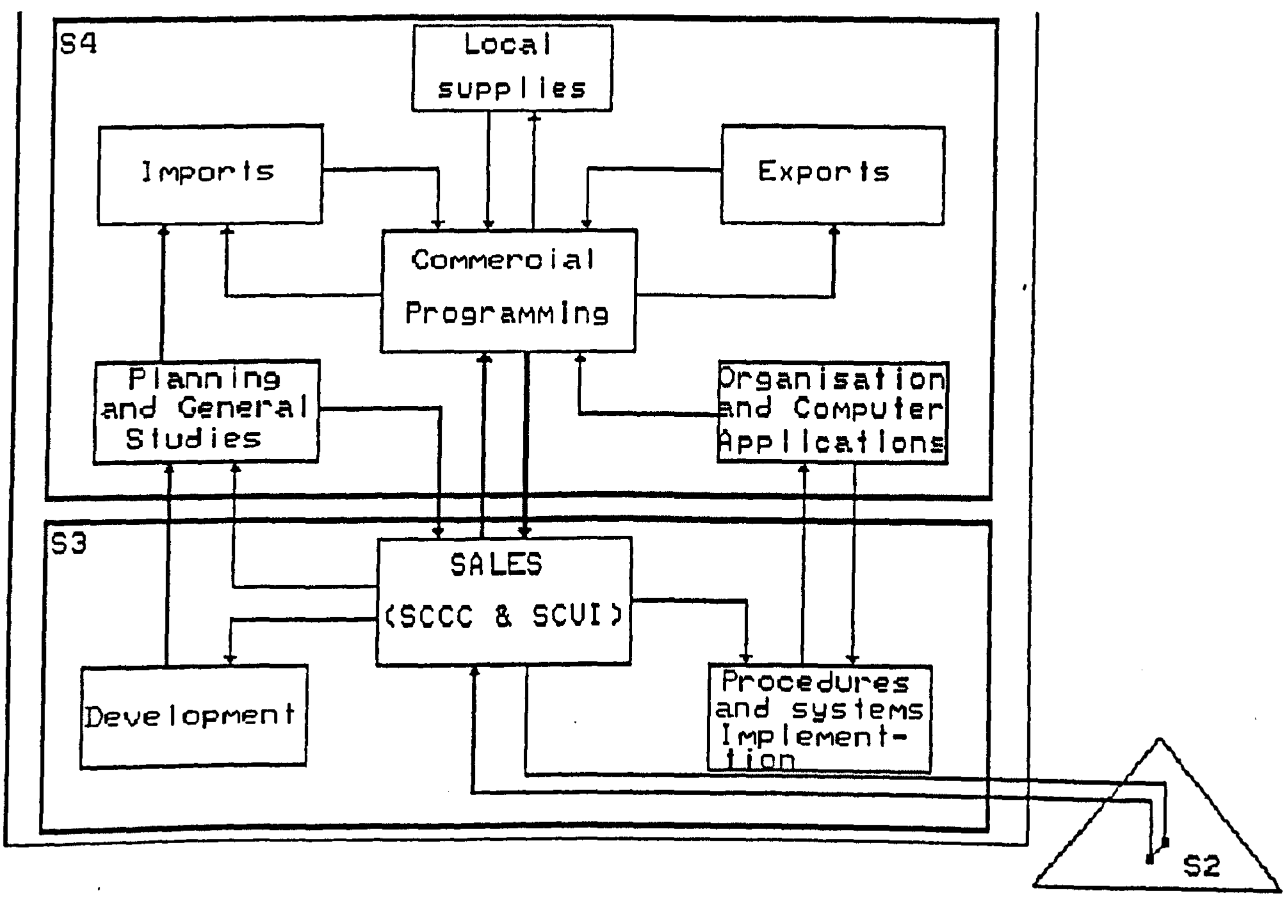

Fig.15.7. Variety commerce between S3 and S4.

from these two structures, as indicated by the heavy arrows. This state of affairs has important diagnostic implications. Basically these are that GCL is engrossed in day-to-day operations and does not give the necessary attention to long term prospects.

It is not possible to use this figure to explain the variety engineering between S3 and S4. One reason is that the structures making up S4 (in fig.15.7 above) belong to more than one sub-directorate, and include the department of development and the department of procedures and systems applications currently depicted in the S3 box. This implies that the focus necessary for the activities of S4 is absent. To properly engineer the variety of the homeostat S3 <---> S4, it is appropriate, first, to get rid of the fragmentation of present S4 activities.

To produce a full picture of the total variety transactions of the above mentioned homeostat, let us revert to the conventions of the VSM. Consider fig.15.8 below.

In this figure we concentrate on the variety flow, without so much reference to particular structures whether in S3 or S4. We begin at node "7". Here is the point of reception of the orders arriving at S3 from the RUs concerning stock for the PSs and orders for direct sales to the clients. This information, as we saw in chapter 14 (section I) is filtered through S2 for stock control and S2 for direct sales. Although the information is homogeneous for each S2, it is individualised for every RU. After due consideration, the information is then passed over to S4 via node "9". This is detailed information concerning each individual RU, and is received at node "1" in S4.

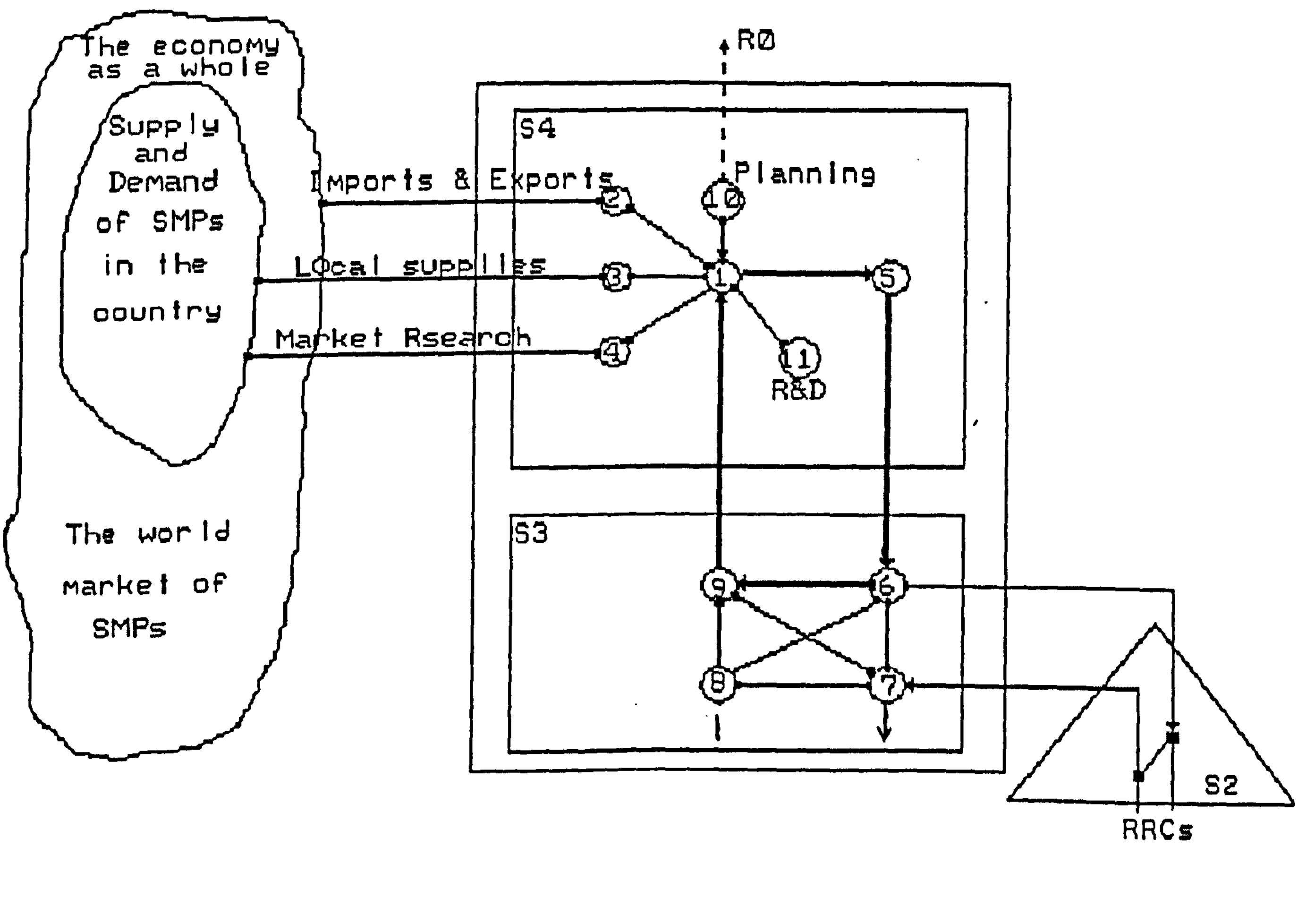

Fig.15.8. Variety engineering between S3 and S4.

However, this is not the only information carried on the channel "9" ---> "1". We have noted earlier that present demand from the home market for SMPs is greater than supply, owing to curbs on imports and insufficient local supply. This means that a system of priorities has to be introduced by S3, i.e. by the manager of sales of the home market. In other words, S3 supplements the orders of the RUs by its own appreciation of the priorities to be accorded to the various orders, particularly in the case of direct sales. Usually the priority is given to orders from the public sector, with emphasis on those for the construction industry (metasystemic ethos).

Consider now the variety arising at S4 level. It is carried from the environment by three different channels. The first emanates from the world market (general environment). This is exclusively reserved for imports and exports. The link between the world market and node "2" is a two-way circulation. The second loop, joining the local market and node "3", specialises in the programming of orders and deliveries for stock and direct sales with the local producers. Again the variety flow is both ways. The third loop is added to the diagram as a reminder and to emphasise two points. One is that the demand investigation that took place at the end of 1987 was an S4 not an S3 activity. The second point is that market investigation should include supply as well as demand and should be performed as a continuous activity rather than as an on-off exercise (refer to section I above).

Take the first loop, i.e. the activity relevant to import and export. Orders for imported SMPs are placed at node "2", which corresponds to the import division of S/D TRC (refer to the organisation chart of GCL in Appendix C). Here, the point made above about individualising the orders of the RUs becomes significant. With placement of the order, S/D TRC specifies to the supplier the port of delivery depending on the RU for which the particular order is destined. Incoming information from the outside regarding the delivery of an order (preceding the delivery) such as product specification, price, weight, delay in the delivery, or possible cancelling of the order, is also received at node "2". The information gathered at node "2" is then forwarded to node "1", which represents the focus of the activities of S4. From there the information is sent to S3, via node "5", to be received at node "6". This is not the final destination. From node "6" the information is despatched to the RU concerned through the channels of S2.

The same logic applies to the incoming information from the local suppliers received at node "3". However, there is an important difference. On this channel the rate of flow will be considerably higher than on the import channel. In addition to it being of a higher channel capacity, its design must also take into account the stated long term objective of government: to substitute imports by increasing the capacity of the local producers. This can be seen as a metasystemic ethos from the highest level, prevailing at all levels of recursion, including R1. Another feature, distinguishing this loop from the previous one, is that the information received at node "3" is highly elaborate. In addition to it being detailed for individual RUs, it also carries all the details concerning deliveries from every individual enterprise producing SMPs in the country.

Let us now consider the loop joining S3 and S4. The design of this loop should take into consideration the fact that the variety flow on the loop "1" ---> "5" ---> "6" ---> "9" ---> "1" is continuous. This is reflected in two ways. First, the orders, requests for confirmation of orders and requests for deliveries of products (refer to ch.14, section I.2), do not arrive at node "7" from the RUs at the same time. So for all the RUs taken together this flow can be considered as continuous. Second, when orders arrive at S4 (i.e. node "1") they are sent back to S3 (the department of commercial management) for consideration. For example at the end of the budget year some of the sizeable orders are referred back to S3 and postponed until the following year. Or some orders might be sent back from S4 because of lack of specification (exact quantities, dimension, etc.). After modification or correction these are returned once more to S4. In this context, it is important that the channel capacity of this loop (S3 <---> S4) is sufficient to handle the flow. The delays in the delivery of SMPs to the RUs experienced at present is partly due to the lack of channel capacity to take the excessive flow of variety going through this loop.

We referred above (section I) to the activities of planning, and research and development. Although they are not proper activities of S4 at present, in the sense that they have no clear contact with the outside world, design of the loop S3 <---> S4 should take them into account. In the case of the activity of planning, the present status of GCL vis-a-vis higher level recursions requires that some of the variety it manipulates flows on the vertical channels linking S4 to the higher level of recursion (node "10" of fig.15.8). As to the research and development activity, the variety it generates circulates internally at the metasystem level, i.e "11" ---> "1" ---> "5" ---> "6" --- > S2 ---> "7" --- "9" ---> "1" ---> "11".

One further point on the detail of the S3---S4 link needs mentioning. Although the bulk of information destined for the RUs is transmitted through the channels of S2, there are occasions when part of this information is passed to the managements of the RUs directly through the metasystemic intervention channel. The occasions referred to here are when the information from S4 indicates shortages in certain product samples from the local suppliers. In these cases, S3 (at present S/D MI) instructs the managements of the RUs to modify the limits of distribution of the product samples concerned (refer to ch.13) to cope with the expected shortages (node "7" of fig.15.8).

Given the volume of turnover of the RUs, which runs into millions of tons a year [GCL/EPO, 1983], we can easily deduce that the relevant variety exchanged between S3 and S4 is massive. We know from chapter 9 that S5 is expected to be the real variety engineer of the S3 <---> S4 homeostat of fig.15.8 above. In reality, however, its interventions are mostly on the side of S3. For example, it is more often than not that, when S5 intervenes in favour of a particular order, it instructs S4 (import division of S/D TRC or department of commercial programming of S/D EPO) to give top priority to that order regardless of the queue. A further clear indication of S5 not assuming its role of balancing the forces between S3 and S4 is the lack of attention given to improving GCL's capacity for adaptation to change. Apart from the activity of S/D TRC and the department of commercial programming in S/D EPO, nothing much happens at the S4 level, i.e. the same situation persists as in the days of SNS despite the changes GCL has witnessed over the years (refer to ch.11 and ch.12).

Put simply, the balancing influence we expect S5 to exert at the metasystem level (i.e. as the metasystem of the metasystem) is absent in the present arrangement of GCL. Its present role can be pictured graphically as in fig.15.9 below. The heavy arrows depict the massive flow of variety in the homeostat S3 <---> S4. As to variety absorption, the task of S5, this is concluded almost entirely on the vertical command channel. The variety reaching the DG (or S5) from the various departments and services of S3 and S4 is drastically attenuated by the staff personnel (secretariat de direction). The same staff personnel undertake variety amplification in the direction of S3 and S4. However, the unfortunate reality is that there is a high rate of staff turnover at the S5 level. The DG's staff treat GCL like any bureaucratically-run administration, for example a service in a central government. The usual case with important members of staff personnel, is that they come from outside GCL, mostly with the DG, and the latter does not last long enough for he or them to learn the nature of the business of GCL (very often they leave with him). This implies that the variety amplifiers and attenuators of fig.15.9 are, usually, badly designed. Not only do they not allow relevant variety to reach S5, but also they induce perturbation in the

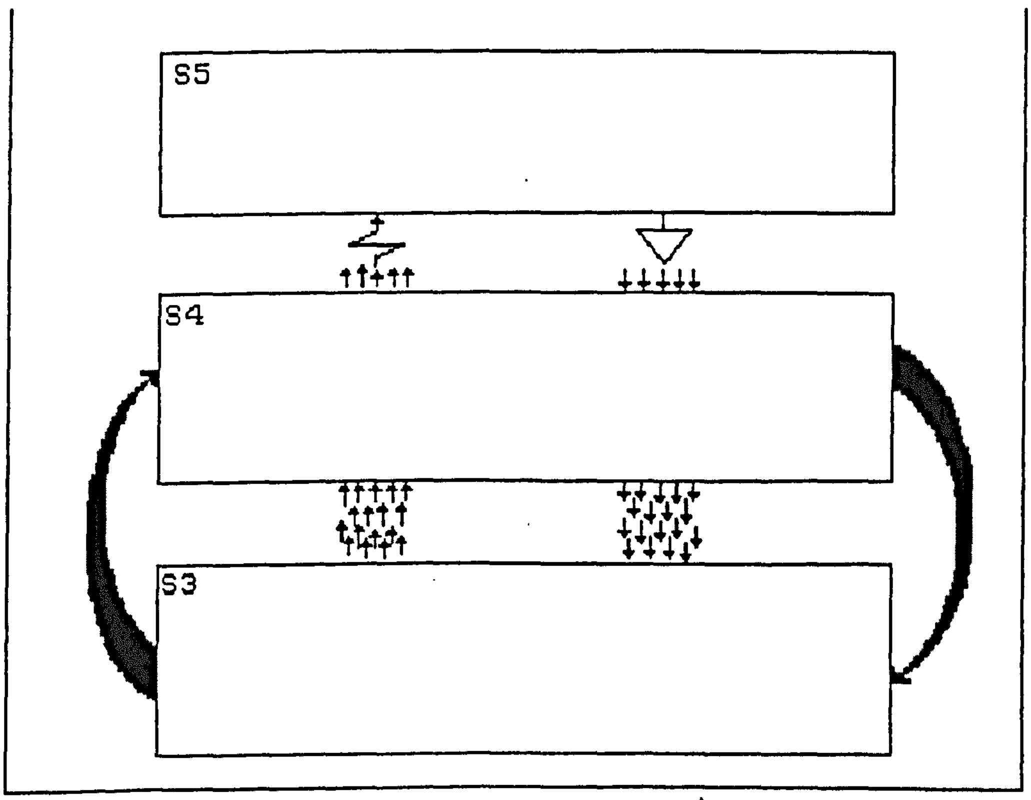

Fig.15.9. Variety amplification and filtration of S5.

affairs of S3 and S4 by amplified interventions in favour of certain customers.

We can include in the attenuator appearing in fig.15.9, the meetings of the Board (le conseil de direction). These are usually not regular, and are convened at the instigation of the DG. They are more frequent when the DG is newly arrived at GCL. The Board meetings are seen as attenuators for three reasons. First, they operate according to an agenda prepared in advance by the DG's staff. Second, not all the sub-directors involved in the meetings are equally informed about the issues discussed. Finally, the short time allocated to the meetings is a constraint in that it does not allow the participants to absorb the total variety of whatever issue is being discussed. Take for example the problem of an imported consignment being rejected by a client because of damage due to handling at the port, a frequent and troublesome problem for management. If the damage is slight, the client is usually persuaded to accept the damaged merchandise (remember the monopoly position of GCL and the short supply of SMPs). However, the solution to such problems is not easy when the damage is extensive and involves a public sector agent as a client. The board meeting cannot possibly have requisite variety to tackle this problem at short notice. It involves an insurance company, port authority, EPAL (Entreprise Portuaire ALgerienne) which has the monopoly of discharging ships, and import regulations. The board does come up with decisions, but the problems are rarely solved.

The verdict regarding the position of S5 must therefore be that it is far from assuming its role as variety engineer of the homeostat S3 <---> S4. Contrasting fig.15.9 and fig.15.10 below will make this assertion abundantly clear. In fig.15.10, S5 is seen as adopting the role allocated to it in the VSM which is, in addition to providing closure fo GCL, a variety engineer of the homeostat S3 <---> S4.

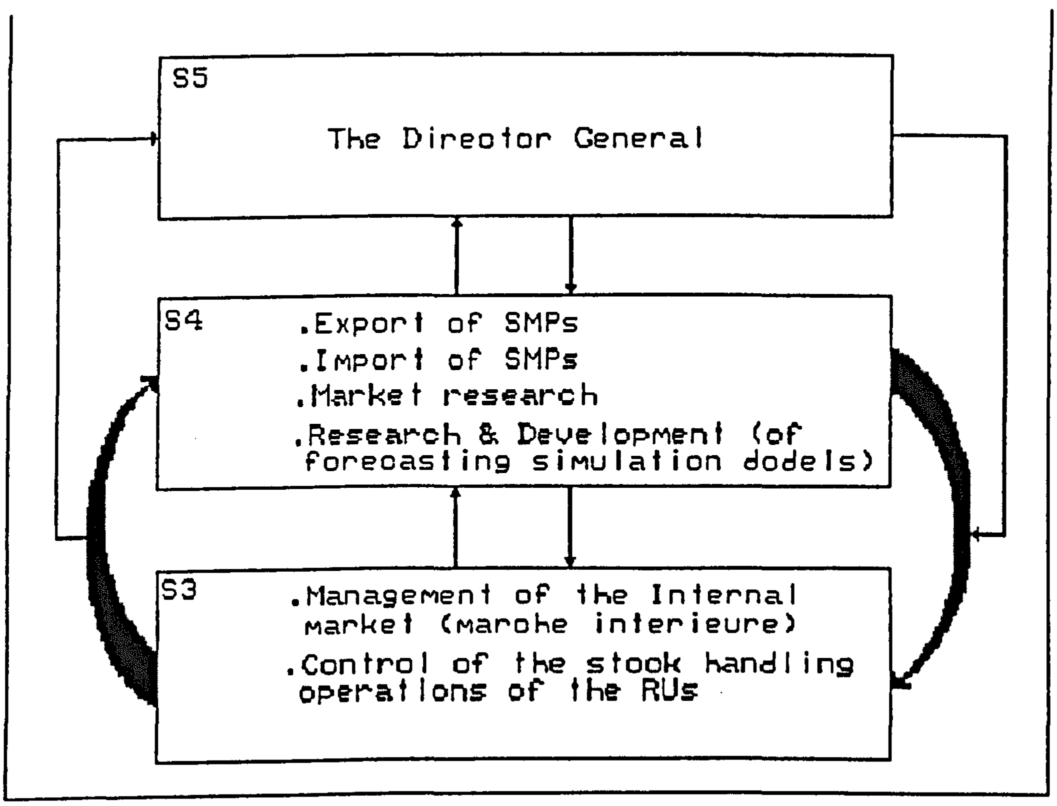

Fig.15.10. The proposed role of S5 as a variety engineer.

III. CONCLUSION OF PART III.

We conclude this part by giving an overall picture of how variety engineering would work in a GCL redesigned according to VSM. Consider fig.15.11 below. It represents the total VSM of GCL with two levels of recursion, R1 and R2. Owing to the lack of space, only two PSs are included in an RU. Before we proceed, it is appropriate to note that the algedonic signal appearing in the figure, running straight from S1 to S5 does not operate as the VSM would have it in the present mode of management. At present there is no immediate link to S5 for the local managements of the PSs. Nevertheless, this is not a reason to exclude this channel from the total information network; there may come a time when it can be properly designed.

To explain the dynamics of the model of fig.15.11, we take as an example a typical situation (or rather a problem) which is recurrent in GCL. It is to do with a client or customer reject of SMPs. It is a situation that could arise at any PS.

If the quantities of SMPs rejected are not significant and can be substituted from stock, or the customer can be persuaded and dealt with satisfactorily, no information is generated. However, the customer reject does become a problem when the PS cannot deal with it. In this case a whole cycle of data processing and information transmission regarding the rejected SMPs begins. It starts at the regulatory centre of the PS, node "1" (the first OE of fig.15.11), with the sending of a formal document, designed for this purpose, to the regional regulatory centre (RRC) at node "2". The ability of regional management (i.e. S3 of R2) to deal with the problem will depend on the nature of the customer reject. For example if the damage to the merchandise is not extensive and the customer is prepared to accept compensation, or accept to wait for another order, the information loop can be closed at the regional level.

However, if the customer cannot be dealt with satisfactorily, the matter is referred to the metasystem. The RRC forwards the form containing the details of the customer reject to the S2 for stock control (refer to ch.14, section I). This, in turn, passes the information up to S3 for action. The usual procedure is for S3 to designate an expert to go to the PS in question and assess the extent of the damage, in the presence of the customer. Should the damage be verified, there are two possibilities. Either the customer is simply put on the waiting list for replacement merchandise, or he/ she is compensated. In the latter case the statement of the settlement, accompanied by the report of the expert, is sent from the PS to RRC to be received at node "2". From there it is sent to S2 for stock control, and a copy to S2 for accounting and budgeting. From S2 of stock control the information is sent to S3 to be received at node "3". The information loop is closed by S3 when it informs the RU in question, i.e. a copy of the settlement is sent from node "3" to node "8", the management of the RU.

More difficult customer rejects are those arising in relation to direct sales involving big orders. The business partner of GCL in this case might be an important economic agent of the public sector, or a local authority. In addition, customer rejects of this type may include a third party, such as an insurance company, a shipping company, EPAL (Entreprise Portuaire ALgerienne), etc. As with the case of sales from stock, it might be possible to settle the problem with the customer at the RU without referring to the metasystem. In a case where metasystemic intervention is required, the information loop starts at the RRC. The document containing details of the customer reject is then sent to S2 for direct sales. Meanwhile, the merchandise is returned to the depots of the nearest PS. Then, as in the previous case, an expert is designated by S3 to assess the damage and determine the extent of eventual compensation. The information loop is not, however, closed by S3 this time. The issue is taken up by S4 with the suppliers of the SMPs. From node "4" the information is sent to S4 to be received at node "5", which corresponds to S/D EPO, in a case where the rejected SMPs are supplied nationally, or the information is sent to node "6", which corresponds to the imports division of S/d TRC, if the rejected merchandise has been imported from abroad. The information link S4 (node "5") <----> local (national) suppliers could eventually be attached to S4 of the RUs, once full autonomy of the RUs is established, which would leave S4 only foreign suppliers to attend to.

At node "7" we have the beginning of the return side of the loop. The necessary arrangements having been made with the suppliers or, as the case may be with EPAL, regarding the cause of damage and the method of compensation, the information is sent back to S3, to be received at node "3". From there it goes back to the RRC in question, through S2 for direct sales, to be received at node "2".

Assume now that the frequency of customer rejects of sales from stock (i.e. from the depots of one of the PSs) has reached a threshold that S3 considers unacceptable. Here the monitoring function, which we know is sporadic, is activated. An inspection exercise is initiated at node "4". An inventory inspector (refer to ch.14, section II) is sent to the PS in question (node "9"). The report of his/ her investigation (i.e. ERI, refer to ch.14, section II) is received back at S3 at node "4". If the findings of the report justify change in the stock handling procedures at the PS, S3 will intervene through the command channel. The instruction is sent to the management of the RU in question from node "3", and it is received at node "8". However, we know that the command channel is of low capacity. That is to say, the S3 instruction is a low variety statement. It is left to the control function (S3) of the RU, through its RRC, to revise the stock handling procedures with the PS and devise a new protocol.

Suppose now that the flow of variety (concerning customer rejects) between S3 and S4 has reached proportions Which S5 considers to be excessive. At this stage S5 intervenes, for example, by instructing S4, at node "7" to review its procedures in dealing with GCL's suppliers of SMPs, and insist that they observe and respect their obligations towards GCL in getting the SMPs on time and with the right specifications, also, to review the working procedure with EPAL to limit the damages inflicted by the latter on the imported SMPs. As regards S3, S5 directives may involve instructions (at node "3") to the effect that disputes regarding domestically supplied SMPs be dealt with, in the future, by the RUs concerned, without involving S4. By these actions, S5 could successfully reduce the unnecessary variety flowing on the channels of the homeostat S3 <---> S4.

From this example, a lesson can indeed be learnt from the way customer rejects are dealt with cybernetically. In terms of the VSM, variety is not automatically passed up to higher levels of recursion. The VSM gives scope for local intervention, and the possibility of absorbing variety at the level where it originates. Higher levels of recursion are involved only when necessary. As a direct consequence, the channels linking any two levels of recursion are not overloaded. These channels are designed so as to be compatible with the nature of the information itself: routine information (S2), monitoring information (S3m) and the command type information. The RUs' ability to process information at their level and the diversity of the information channels can make GCL immune to the problems of overload experienced at present.

The existing practice, however, tells a different story. We saw in chapter 11 that the logic of the hierarchical structure of GCL and its information system, which is an image of that structure, are designed to pass upward all the information generated at the regional level. We saw also in chapters 13 and 14 the masses of data SCBF transmits to the central management. The real difficulties of GCL's management are not those of lack of information. The information is there, but buried in the masses of data flowing from the RUs; the inventory inspector's report is one example. In addition to the problem of excessive volume of information, there are also the problems of channel capacity and transduction capacity. The widely-used channel at present is the command channel, and as we saw in chapter 13, this cannot cope with the massive amount information the RUs generate.

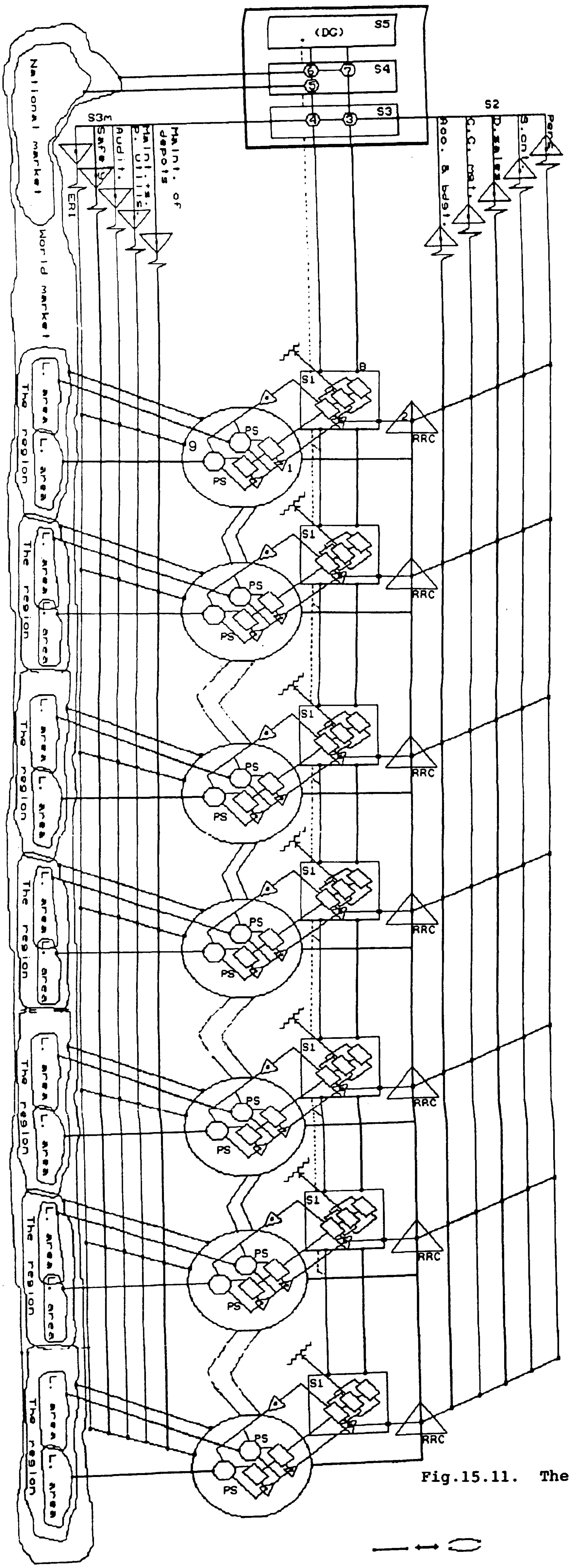

Fig.15.11. The full scale VSM of GCL.

PART IV

Chapter 16

CONCLUSION

In this conclusion we present a summary of our findings together with a brief note concerning how the recommendations of chapters 13, 14 and 15 might be implemented in GCL. Finally we set out our own response, on the basis of this research, to those who have criticised the VSM.

I. SUMMARY OF FINDINGS

Information systems design is a dynamic and growing field. Many people associate information systems with the use of computers and the development of relevant software [Hicks, jr., 1984; Senn, 1985]. This thesis is not intended as a contribution to the area of computer applications in information system design. What we have set out to do in this research is to attempt to bring into focus the need to consider the structural foundations of an organisation as a prerequisite for the design of its information system. Throughout this work the underlying assumption is that an information system is an image of the organisation which it serves, the organisation being referred to as the real system.

Chapter two was an introduction and an attempt to explore the area of information systems design. We attempted to discover the link between current models of information systems, the methodologies for information systems design and the underlying organisation or the supporting real system.

The understanding gained was that, before we attempt the design of an information system, we need to find an appropriate model of the real system (since the information system is no more than an image of the organisation for which it is intended).

The logical step to follow was to examine possible models of the organisation. The rest of part I was dedicated to this very issue. The models of the organisation considered were: the classical (or the rational) model, the behavioural model, the systems model, and the cybernetic model of the organisation [Jackson, 1985].

In chapter three we set out to explore the classical model of the organisation. Historically this model is a product of more than one strand of thought. It is mainly made up of the contributions of Weber's bureaucratic approach, Fayol's administrative management and Taylor's scientific management. The age in which the classical model was nurtured was dominated by mechanical concepts in every sphere. Men in other fields of scientific endeavour were trying taao reduce the world to certain fundamental elements and to employ causal frameworks in which events and phenomena could be explained accurately. The classical model grew out of that tradition. The classical theorists tried to model the organisation according to a framework inside which it could operate according to certain mechanical principles. Reducing the complexity of the organisation to proportions where it can be specified by a few well-defined governing principles is reassuring to management, because it helps managers believe that there are only limited possibilities, and good management has simply to understand the principles and apply them properly.

Built into the classical model is the notion of hierarchy which, in the end, determines the norms of communication and control in organisations built according to classical principles. In this model the organisation must have a high point, i.e. an apex at which the purpose of the organisation and the means-end mapping are decided. From that apex emanates a chain of command, operating through successive levels, with each level aiming to control, coordinate and organise the levels below. Further, for every superior, at each intermediate level, there is, according to the classical model an optimum and limited span of control.

An information system built around the classical model is an apex-oriented system. It tends to supply higher echelons of management with information to the point of overload [Ackoff, 1967]. Given the limited capacity of managers (as with all human beings) to process information, we have as consequence managers unable to keep pace with the flow of information. The relatively long time it takes management to process the excess pf information (if they bother to process it all) will result in time lags. The feedback information which the information system is expected to carry downward to subordinates arrives too late. Since the real system or the organisation, modelled along classical lines, allows lateral communication, which could remove some of the information overload at the top, only on an exceptional basis, its image (i.e. the information system) is characterised by bottlenecks and is infested by time lags.

In the fourth chapter the behavioural model of the organisation was presented. In contrast to the classical writers, behavioural theorists consider that members of an organisation are not a mere economic resource. They can affect as well as be affected by the organisation. The Hawthorne experiments [Mayo, 1960], and a myriad of other subsequent studies, have emphasised the importance of social processes in the organisation. The informal organisation which surrounds the formal one is no less important to the proper functioning of the organisation.

As for the individual, the behavioural model challenges the classical view that economic needs are the prime mover of individuals in the organisation, and that they are therefore the only needs worthy of concern. The behavioural view asserts that, in addition to economic needs, human beings also have psychological needs. An individual needs to be responsible, autonomous and to have his/ her job enriched in a manner that allows individual input and contribution to the job and the way it is performed. Human relation theorists [McGregor, 1984; Likert, 1961] maintain that an effective management is one which creates conditions where satisfying individual needs can, at the same time, lead to satisfying those of the organisation.

The theme of participation is prevalent in the behavioural model. However, one cannot help but note that the notion of participation cannot go very far. The hierarchical character of the organisation is taken for granted in the behavioural model. This, by its very nature, engenders unequal status positions and favours those in the upper levels of the organisation. If this is the case, in what sense can an ordinary worker participate in the same way as the individual manager? No doubt the behavioural model has made a major contribution to the improvement of work conditions in terms of job design. It stresses that understanding and satisfying individual needs (physiological, psychological and social) is not against the well being of the organisation. However, the basic skeleton of the hierarchical structure of the organisation remains intact. The information system reflecting this formal structure is not, therefore very much different from that reflecting the classical model, and suffers from most of its faults.

Chapter five dealt with the systems view of the organisation. It was found that the systems model is fundamentally different in perspective from the two previous models. The open systems perspective of the systems model (as opposed to the closed systems approach of the other two previous models) stipulates that the environment is an essential ingredient affecting organisational performance. The rigid framework of the classical model is seen by systems theorists as restricting the organisation and as a hindrance to adaptation and change. For these theorists, accommodating change in the environment is vital for an organisation's survival.

Another contrast to the classical view is that systems writers insist that making individual parts of the organisation efficient does not necessarily ensure the efficiency of the total organisation. In other words, the organisation is a collection of interrelated parts or subsystems; efforts at improvement must take these interrelationships into account and consider the organisation in its totality.

The systems model does not acknowledge as paramount the concepts of hierarchy and authority structure in quite the way that the classical model does. However, one fails to find true substitutes for these concepts. The control structure of the organisation is based upon hierarchically linked layers. It inevitably follows that the information system (the image) of the organisation, as it is presented by the systems model, is also hierarchically organised. It maps the three levels of managerial decision making in the organisation: operational, tactical management and strategic planning. There is progress, however, in that the systems model explicitly recognises that the information requirements of each decision making level are different, according to the type of problem situation each management level faces. In particular, the success of the techniques of information gathering, processing and transmission applied at the operational level, in highly structured situations, should not lead us to adopt them blindly at the upper levels.

Discussion of the cybernetic model began in chapter six. It has some similarities with the systems model in that it operates within the open system tradition. Throughout chapter six, however, we attempted to present the cybernetic model in such a way as to pinpoint its distinguishing features with regard to all the previous models. The difference from previous models is most manifest in the manner in which the cybernetic model deals with the command and control structure of the organisation.

To highlight this point it was thought appropriate to distinguish two strands making up the cybernetic model [Jackson, 1985]. The first strand, managerial cybernetics, does not totally break away from the traditional approach to control. The second strand, termed organisational cybernetics, uses cybernetic ideas in a radically different way to break completely with traditional thinking. A number of authors have been involved in the development of organisational cybernetics. However, Beer's model of any viable system is taken as the outstanding product of this tradition.

The point of departure for organisational cybernetics is that organisations are exceedingly complex and probabilistic systems. Because of this high complexity, managers cannot possibly intervene in every aspect of organisational life. Organisations are, to some extent, black boxes. The cybernetic model recognises that complex social systems already possess the capacity of self-regulation and self-organisation. However, from their very nature as artificial or contrived systems, it follows that design is necessary to help organisations use their capacity for self-regulation and self-organisation to achieve desired levels of performance and to adapt and face up to their environments.

Beer's model, namely the VSM, provides elaborate recommendations to facilitate information flow between the organisational parts, and between the organisation and its environment so as to promote the processes of self-regulation and self-organisation. So, unlike the previous models, the image of the cybernetic model of the organisation (i.e. the information system) is not a mapping of an hierarchical structure. Rather, the information system is built to meet the requirements of organisations for self-regulation and self-organisation. This characteristic suggested that it could, potentially, provide a superior organisational model upon which to base information system design than any of the other three considered. Chapter 2 has shown us that existing information system design approaches - with all their faults - are predominantly based on the hierarchical model. It would at least be interesting to examine an alternative. It was this hypothesis, that the VSM could provide a sounder and more profound basis for information system design, that was further explored in part II, and tested in part III.

The totality of part II was dedicated to the elaboration of the viable system model (VSM). It was thought necessary to give a full account of the model before we could begin the modelling of an actual organisation (part III). After a brief introduction dealing wth the matter of defining a system in focus, chapter seven showed how to model the primary activities of any viable organisation. These activities are known in the VSM vocabulary as the operational elements (OEs) which make up system one. The following chapter was, then, devoted to the subsystems that look after the internal regulation of the organisation; namely, coordination (S2), monitoring (S3m) and control (S3).

The VSM is incomplete without its mechanism for adaptation and environmental monitoring, i.e. S4. In chapter nine we explained the workings of this mechanism and, at the same time, showed the ways in which it is linked in to the mechanisms in charge of internal regulation and control. Chapter nine also explained how the policy function (or S5) supervises and keeps in check the antithetic tendencies of system four and system three.

Part II made apparent just how the hierarchical relationships between the operational entities (S1) and the metasystem of the organisation, in the VSM, differ from the classical notion of hierarchy. Hierarchy in the VSM is understood to be logical rather than relating to the conventional hierarchy of superior to subordinate. Equally, S5 is not considered as "the boss". The double role of S5 is to monitor the S3 <---> S4 homeostat and to supply closure to the viable system. Neither of these implies an an authority relationship.

Chapter ten provided a summary of part II. In it we put the subsystems of the VSM together and showed them as a working whole. The vehicle for this presentation was a hypothetical example, which provided an appropriate means for demonstrating the dynamics of the VSM.

In part III we devoted our effort to applying the VSM to an actual organisation, namely GCL (Group Commercial). The same sequence of elaborating the subsystems of the VSM adopted in Part II was followed in part III. We started the modelling process with the primary activities and proceeded progressively to end up with S5. At every stage of the modelling process (i.e. for every part of GCL corresponding to a subsystem of the VSM) an attempt was made to diagnose the existing arrangement, then to proceed to demonstrate how the system might operate cybernetically.

However, before any modelling could take place, it was necessary to describe the organisation in question (i.e. GCL) and to give an appreciation of its evolution from where it started to the present situation. This overview of GCL was dealt with in chapter eleven. In this chapter we also presented a picture of the economic landscape within which GCL operates. This was considered important for gaining an understanding of the magnitude and scale of the operations of GCL. The chapter ended with a presentation of the information system of GCL. This was, obviously, necessary background for analysis of information flows in the subsequent chapters.

With the background information of chapter 11, it was possible, in chapter 12, to identify cybernetically, GCL as the system in focus. Also, in this chapter, we examined the possibility of GCL existing in more than one recursive dimension. An attempt was made to show why the particular recursive dimension adopted was the right one for GCL, after which identification was carried out of the levels of recursion, namely: R0, R1, R2.

Having identified GCL as the system in focus, and established the appropriate levels of recursion, it was possible to proceed with the modelling of its OEs (i.e. the primary activities). These were identified as the regional units (RUs) of GCL. The whole of chapter thirteen was dedicated to this end. Owing to the manner in which the selling operation for steel and metallurgical products (SMPs) is conducted, it proved necessary to drop another level of recursion down, i.e. to the level of the points of sale (PSs, which are the OEs of an RU). With this knowledge of how SMPs flow in and out of the depots of the local PSs and how the latter are linked recursively to the RUs, we were able to understand and to seek to redesign cybernetically, the information flows across S1 of GCL. We could also address the information links on the direct command channel between an RU and senior management (or the metasystem) of GCL.

In chapter fourteen we concentrated our efforts on suggesting how the existing information network of GCL could be redeployed in a manner which would fit the evolving structure of the VSM of GCL. For S2 properly to perform its task of coordinating the RUs it proved necessary to subdivide it into distinct subfunctions. However, they remain under the banner of one S2 responsible to the control function. As to the monitoring activity inside GCL, the diagnosis showed that this activity is not fully developed. It is performed in a rudimentary way at present. The recommendation was that this activity should be organised into subactivities, each in charge of monitoring one aspect of the operations of the RUs.

With the coordination, monitoring, and the direct command channels in place, the subsequent step was to consider the control function, S3. Diagnosis of the existing arrangement showed that reorganisation of the control function of GCL was necessary. This was done taking fully into consideration the redeployment of the information network of S2 and the introduction of the monitoring activity.

In chapter fifteen we undertook the task of elaborating the intelligence and policy functions of GCL. It was found from the diagnosis that S4 is not well equipped to tackle the challenges of the environment. On the basis of the requirements of any viable system for a proper mechanism of intelligence (i.e. S4), it was recommended that the reorganisation of the present structure is needed. The same conclusion was equally valid for the policy function (S5). In other words, it was found that GCL has a boss, but not a proper S5 supervising the variety engineering on the S3 <----> S4 homeostat. Again, there is a need to reconsider the present function of S5 in GCL. However, undoubtedly it is more difficult to reorganise this policy function than any of the previously mentioned functions.

Our contention is, therefore, that part III provides support for the hypothesis put forward at the end of part I. It demonstrates that the VSM provides much more sophisticated organisational model to underpin information systems design than any of the three other models, all of which retain the hierarchical concept at their hearts. It has been shown that the major information processing problems of GCL stem from an adherence to this hierarchical concept. Further, it has been shown that the design of effective and efficient information flows simply cannot be undertaken while the hierarchical structure remains. Only the VSM, of all the organisational models, challenges the traditional hierarchical concept and so, as we saw in part III, only the VSM can provide the basis for proper variety engineering and logical information processing in support of GCL's purpose.

We know from chapter 11 that GCL has been part of a restructuring process, seen as a necessary answer to the needs of growing economy. This new situation resulted in GCL gaining greater autonomy of decision making. However, this did not improve GCL's capacity to process information. This can be explained by the fact that the restructuring did not go far enough to question the organisation structure of GCL. As it stands at present it remains basically a classical organisation, and we know from chapter 3 that the classical model is limited in providing a basis for information processing. If time lags and information overload, experienced by the management of GCL at present, are any indication, we could say that GCL needs to go another step further to change its outlook and move away from the classical organisation.

In our discussions throughout chapters 13, 14 and 15 we learnt how the VSM can be of immense help to GCL. On the basis of the VSM's elaborate information network it is possible to rid GCL of the ills it suffers from regarding information flows. The remedy for the existing flaws is not investment in new software systems, the action taken by GCL in the past; the battery of the specific information systems is impressive as it is (refer to ch.11). We demonstrated on many occasions in part III that GCL's problems are not caused by a lack of software capability, they reside in the fact that GCL's structure itself cannot support the masses of data expected to flow in the system. The VSM is very explicit about how to deal with this challenge; its recursive arrangement is a perfect answer to the pressures exerted on the structure of GCL. This is particularly appropriate for GCL since autonomy of the operational parts (the RUs) is considered as a natural extension of its autonomy vis-a-vis ENS.

We have asserted our main conclusion. However, before finally concluding this research, the author feels impelled to make some brief points about the implementation of the recommendations of chapters 13, 14 and 15 in GCL, and to respond, on the basis of this research, to some critics of the VSM.

II. IMPLEMENTING THE RECOMMENDATIONS IN GCL

Before we end, it is worth emphasising the importance of this whole research for GCL, and suggesting a course of action which might facilitate eventual implementation of the changes suggested. The reader will be aware that the recommended changes have already been dealt with at length in the course of the discussion in chapters 13, 14 and 15. We deal here only with the more general issue of implementation.

As we inferred in chapter 11, there is a whole debate going on in Algeria at the moment about the possible reorganisation of the companies operating in the social economy of the country. A consensus is developing that new ways of managing the economy are needed and centralisation is no longer the order of the day (the Ministry of Planning was abolished at the end of 1987).

In this new "ambiance", it is much more likely that this research contribution will find its way to implementation. Given the advantage of the author having access to management in GCL (particularly managers in S2 and S3 positions), it would be quite possible for this work to find the support of those in senior positions. However, it is the author's considered opinion that the best way to go about applying the VSM to GCL is to start at recursion 2 (i.e. the regional level) or even at recursion 3 (the PS level).

The argument for such a course of action is that it is technically more feasible, especially as the RUs operate at the periphery of the centralised management information system (as we saw in chapters 13 and 14). Power politics at the lower levels of recurion is less acute than at recursion one (R1). People at this level are more practically minded than at the central level. They are the ones who actually do the job of selling the SMPs to the customers. Starting the implementation of the VSM at the lower levels of recursion is a way of making the widely publicised government campaign of decentralisation a practical proposition rather than simply a part of political discourse. In other words, doing so will be an opportunity to demonstrate the usefulness of the VSM as a tool for inducing change in a practical and scientific manner.

As a prelude to such a course of action we recommend that GCL should not commit new resources to acquiring new software systems to be run at GOI (like the proposed system for automatic ordering of SMPs) until the status of the latter (i.e. GOI, refer to ch.11) is clearly defined. Organisationally, GOI belongs to ENS (R0), but this is only administratively the case, by a ministerial edict after the restructuring of the old SNS. In reality, a good share of its services are destined to other organisations outside ENS, which, like ENS, were born out of SNS. GOI in fact behaves more like an independent company. It would be more prudent, therefore, for GCL to limit its dependence on GOI for data processing. Much of this data processing should be left to the RUs.

To be consistent with this course of action, resources need be spent on micro computers (and the relevant software) for allocation at the lower levels of recursion. These are relatively cheap and can be easily introduced at the RUs and PSs, or even at the depots of the PSs.

III. CRITICISMS OF THE VSM

The Viable System Model has been the subject of criticism [Checkland, 1980, 1986; Ulrich, 1981, 1983; Rivett, 1977] ever since it came out in its first version (or rather its first presentation) in "Brain of the Firm" [Beer, 1981]. Some of the criticisms directed at it, concerning unwarranted analogy with the human nervous system, have been put to rest by the full development of the model from cybernetic first principles [Beer, 1979, 1985].

However, it is possible to level some criticisms at the VSM in respect of the question of the purposes which are to be served by GCL. It is argued that there is nothing to stop the VSM from being exploited and used by the elite in an organisation [Adams, 1973; Ulrich, 1981, 1983; Rivett, 1977]. This appears to be, to some extent, a point worthy of attention in the context of GCL at least in the short and medium term. We have seen in chapter 13 how resource allocation and accountability for them can be negotiated between the senior management of GCL and the RUs. Even if we assume that the latter are genuinely autonomous, it is not clear how they can really resist the seemingly authoritarian posture of the senior management (i.e. S3). An authoritarian S3 would prevent true autonomy of S1. This autonomy, as we have seen in part II, is a necessary condition for the continued viability of the system as a whole. However, the drive for autonomy in decision making in public sector enterprises (of which GCL is one) is a government edict. There is no guarantee that the management of GCL will wholeheartedly conform to the metasystemic ethos of the government. The existing power relationships are definitely in favour of the senior management of GCL.

We saw in part II that the VSM emphasises the issue of organisational design. This proved a significant and helpful characteristic of the model in so far as facilitating the elaboration of the information network of GCL (see part III). However, if we take a broader view one can argue that this emphasis on organisational design should have been accompanied by an equally important aspect which is the role of the individual in an organiasation. There is an explicit recognition of the importance of individuals in organisations. Beer explicitly emphasises that it is in the interest of the viability of an organisation to grant maximum autonomy to individuals [Beer, 1979]. Nevertheless, the VSM does not offer ways to structure the process of negotiation between the different viewpoints making up the organisation.

The neat and well established linkages between the components of the VSM certainly make it a valuable and efficient control device in GCL. However, if perceived only in these terms it may encounter problems of implementation. As advocated above there is a case for taking up the task of implementing the VSM in GCL at the lower levels of recursions. However, by doing so one should not overlook the fact that GCL is an integrated whole, attempting to design the lower level recursion should take into consideration the linkages of the latter with the metasystem, namely the senior management. The VSM makes transparent the working of the metasystem and makes explicit its service role vis-a-vis S1; an idea that might not be taken lightly by the existing management of GCL.

It is hard enough to make people understand the structural arrangement and the variety engineering involved in implementing the VSM. There are perhaps greater difficulties in getting people to switch from the measuring units of conventional management information systems to the concept of variety as the measuring metric. The cultural barriers standing in the way of adopting variety as a measure are likely to take time for people to surmount. Our last remaining task is to respond to some criticisms of the VSM.

IV. IN DEFENSE OF THE VSM

A theoretical defense of the model has been duly made elsewhere [Beer, 1983; Clemson, 1979; Jackson, 1986, 1988; Anderton, 1989].

Jackson, for example, considers the criticisms in the context of his two strands or variants of the cybernetic model (refer to ch.6), and argues that most of the criticisms directed at the VSM are misplaced. They can be justified if directed at managerial cybernetics, but "organisational cybernetics largely escapes".

Our defense rests on the practical efficacy of the VSM. In supporting the VSM in this way we are at one with those many others who have demonstrated that the VSM can be a useful tool for dealing with practical situations and the design of organisations [Britton and McCallion, 1985; Tripp and Rainey, 1986; Tripp, Pearson and Rainey, 1986; Espejo, 1979]. These various applications are visible proof of the applicability of the VSM as a diagnostic and design tool, of great sophistication and importance, which cannot be ignored by designers and managers of modern organisations.

We have witnessed throughout part III the performance of an actual information system built on the premises of the classical model. In terms of the quantities of information the system provides, one can say it is impressive. However, the control system of the organisation always lags behind, i.e. it operates on what GCL was like in the past because the information is, almost invariably, out of date. Investment funds have been injected into the system over the years (refer to ch.11) but the result, in terms of better information for speedier decision making, remains poor. By mapping the VSM onto GCL it was possible to discover the inadequacies and ills of its information system. The VSM allowed us to diagnose these ills, which are inherent in the organisation structure itself.

The VSM is not only a powerful diagnostic tool. Equally important, the organisation structure it provides for GCL can be built so as to facilitate the information flows between the parts of GCL on the one hand, and between it and the outside world on the other. Also, with its recursive arrangement the design effort can be reduced considerably. The same information links of recursion one (R1) can be reproduced at the regional level (i.e R2) without any major modification.

The VSM has been shown therefore to be a sophisticated tool for achieving diagnosis and redesign. There are some other points worthy of note. We clearly saw in ch.15 how the present (classical) structure can be rigid and nonresponsive to change. Although GCL is supposed to be autonomous vis-a-vis ENS, its parent organisation, because of the information system inherited from the disintegrated SNS, with its centralising protocol, this autonomy is heavily mortgaged. If, however, SNS had been built on cybernetic principles as advocated by the VSM, the recursive logic of the latter would have ensured the autonomy of its operational parts, and have spared GCL and ENS the discomforting situations in which they now find themselves. SNS might also, of course, have spared itself the fate of disintegration.

One can learn important lessons from SNS's experience. Without proper mechanisms for adaptation, as expounded by the VSM, an organisation cannot last very long. SNS lasted as it did only at a cost: it was heavily subsidised by public money. If it had been built on cybernetic principles, it could have avoided the fate of disintegration. The recursive logic of the VSM would have made it easy for SNS to redefine its primary activities, i.e. its OEs, to meet the requirements of the higher recursion level (government) for decentralising decision making in the economy (this due to change in the political direction of the country which could not have been predicted by SNS).

We learned from chapter four that worker participation is an important and necessary ingredient for the success of an organisation. In GCL this participation is not only advocated but it is also required by law (i.e. la Gestion Socialist des Entreprises, GSE, refer to ch.11). In practice, however, this participation is heavily constrained. These constraints are imposed by the organisation structure, and the availability (or rather the non-availability) of information regarding the affairs of GCL. The structure determines in advance the task of an organisation member and those in the organisation to be served by the information system (refer to ch.13, ch.14 and ch.15). In the context of the VSM, however, the logic of autonomy of the RUs vis-a-vis senior management, and that of the PSs vis-a-vis the RU, ensures that organisational members at the lower levels have a say in the running of the operations at their own level. This amounts to saying that the VSM can provide the structural requirements to accommodate the information flows necessary for participation to have any practical meaning.

It has been argued that because participation is encouraged only at the level of the task and not at the level of the whole organisation, the emancipatory role of the VSM does not go far enough. In other words, because it does not demand participation in setting the goals of the organisation, there is no guarantee that its application will not serve an elite group in that organisation (see section III above). The argument would be justified for an organisation built on the classical model's premises. However, an organisation modelled on VSM principles is self-regulating. This implies that the purposes of the organisation are, ultimately what it does, not necessarily what the senior people want to do. What the organisation does eventually converge on is a compromise of the purposes of its members, belonging to more than one level of recursion [Beer, 1985]. If implemented, therefore, the VSM can greatly increase an organisation's adaptive capabilities and encourage the participation of its workers and managers. Of course, there are barriers to implementation.

Whatever the barriers, it is the hope that this research demonstrates why it is worthwhile to overcome them. The structural recommendations embedded in the VSM are essential prerequisites for successful information system design. GCL in Algeria would do well to recognise this and to implement a programme of change founded on the cybernetic principles enunciated in Beer's VSM.

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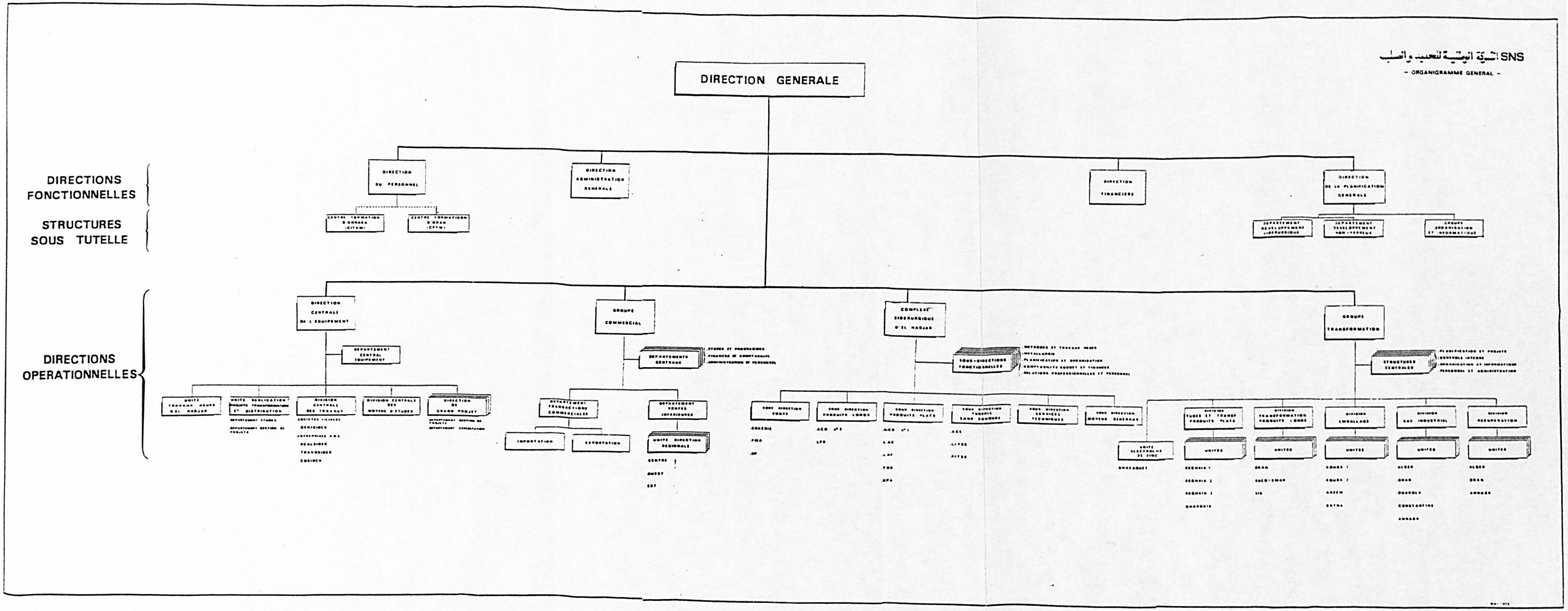
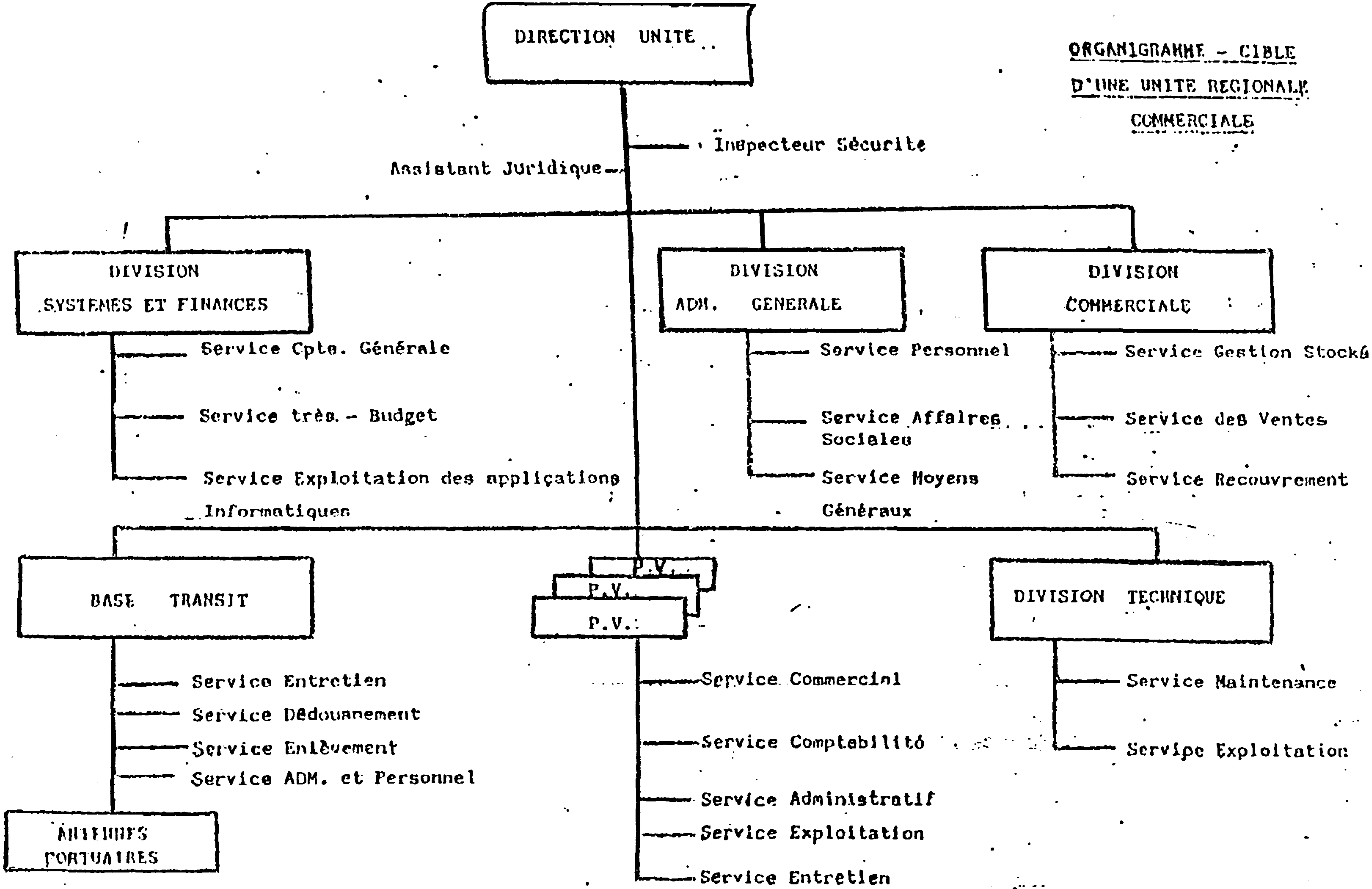
APPENDICES

APPENDIX A


SNS الشركة الوطنية للحديد والصلب
- ORGANIGRAMME GENERAL -
DIRECTION GENERALE
DIRECTIONS FONCTIONNELLES
STRUCTURES SOUS TUTELLE
DIRECTIONS OPERATIONNELLES
DIRECTION DU PERSONNEL
CENTRE FORMATION D'ANNABA (CITAM)
CENTRE FORMATION D'ORAN (CFTM)
DIRECTION ADMINISTRATION GENERALE
DIRECTION FINANCIERE
DIRECTION DE LA PLANIFICATION GENERALE
DEPARTEMENT DEVELOPPEMENT SIDERURGIQUE
DEPARTEMENT DEVELOPPEMENT NON-FERREUX
GROUPE ORGANISATION ET INFORMATIQUE
DIRECTION CENTRALE DE L'EQUIPEMENT
DEPARTEMENT CENTRAL EQUIPEMENT
UNITE TRAVAUX NEUFS D'EL HADJAR
UNITE REALISATION PROJETS TRANSFORMATION ET DISTRIBUTION
DEPARTEMENT ETUDES
DEPARTEMENT GESTION DE PROJETS
DIVISION CENTRALE DES TRAVAUX
SOCIETES FILIALES
GENISIDER
ENTREPRISES SNS
REALSIDER
TRAVOSIDER
COSIDER
DIVISION CENTRALE DES MOYENS D'ETUDES
DIRECTION DE GRAND PROJET
DEPARTEMENT GESTION DE PROJETS
DEPARTEMENT EXPLOITATION
GROUPE COMMERCIAL
DEPARTEMENTS CENTRAUX
ETUDES ET PROGRAMMES
FINANCES ET COMPTABILITE
ADMINISTRATION ET PERSONNEL
DEPARTEMENT TRANSACTIONS COMMERCIALES
IMPORTATION
EXPORTATION
DEPARTEMENT VENTES INTERIEURES
UNITE DIRECTION REGIONALE
CENTRE
OUEST
EST
COMPLEXE SIDERURGIQUE D'EL HADJAR
SOUS-DIRECTIONS FONCTIONNELLES
METHODES ET TRAVAUX NEUFS
METALLURGIE
PLANIFICATION ET ORGANISATION
COMPTABILITE BUDGET ET FINANCES
RELATIONS PROFESSIONNELLES ET PERSONNEL
SOUS DIRECTION FONTE
COKERIE
PMA
HF
SOUS DIRECTION PRODUITS LONGS
ACO n°2
LFR
SOUS DIRECTION PRODUITS PLATS
ACO n°1
LAC
LAF
TUB
BPA
SOUS DIRECTION TUBERIE SANS SOUDURE
ACE
L/TSS
P/TSS
SOUS DIRECTION SERVICES TECHNIQUES
SOUS DIRECTION MOYENS GENERAUX
GROUPE TRANSFORMATION
STRUCTURES CENTRALES
PLANIFICATION ET PROJETS
CONTROLE INTERNE
ORGANISATION ET INFORMATIONS
PERSONNEL ET ADMINISTRATION
UNITE ELECTROLYSE DE ZINC
GHAZAOUET
DIVISION TUBES ET TRANSF PRODUITS PLATS
UNITES
REGHAIA 1
REGHAIA 2
REGHAIA 3
GHARDAIA
DIVISION TRANSFORMATION PRODUITS LONGS
UNITES
ORAN
OUED-SMAR
SIG
DIVISION EMBALLAGE
UNITES
ROUIBA 1
ROUIBA 2
ARZEW
BATNA
DIVISION GAZ INDUSTRIEL
UNITES
ALGER
ORAN
OUARGLA
CONSTANTINE
ANNABA
DIVISION RECUPERATION
UNITES
ALGER
ORAN
ANNABA

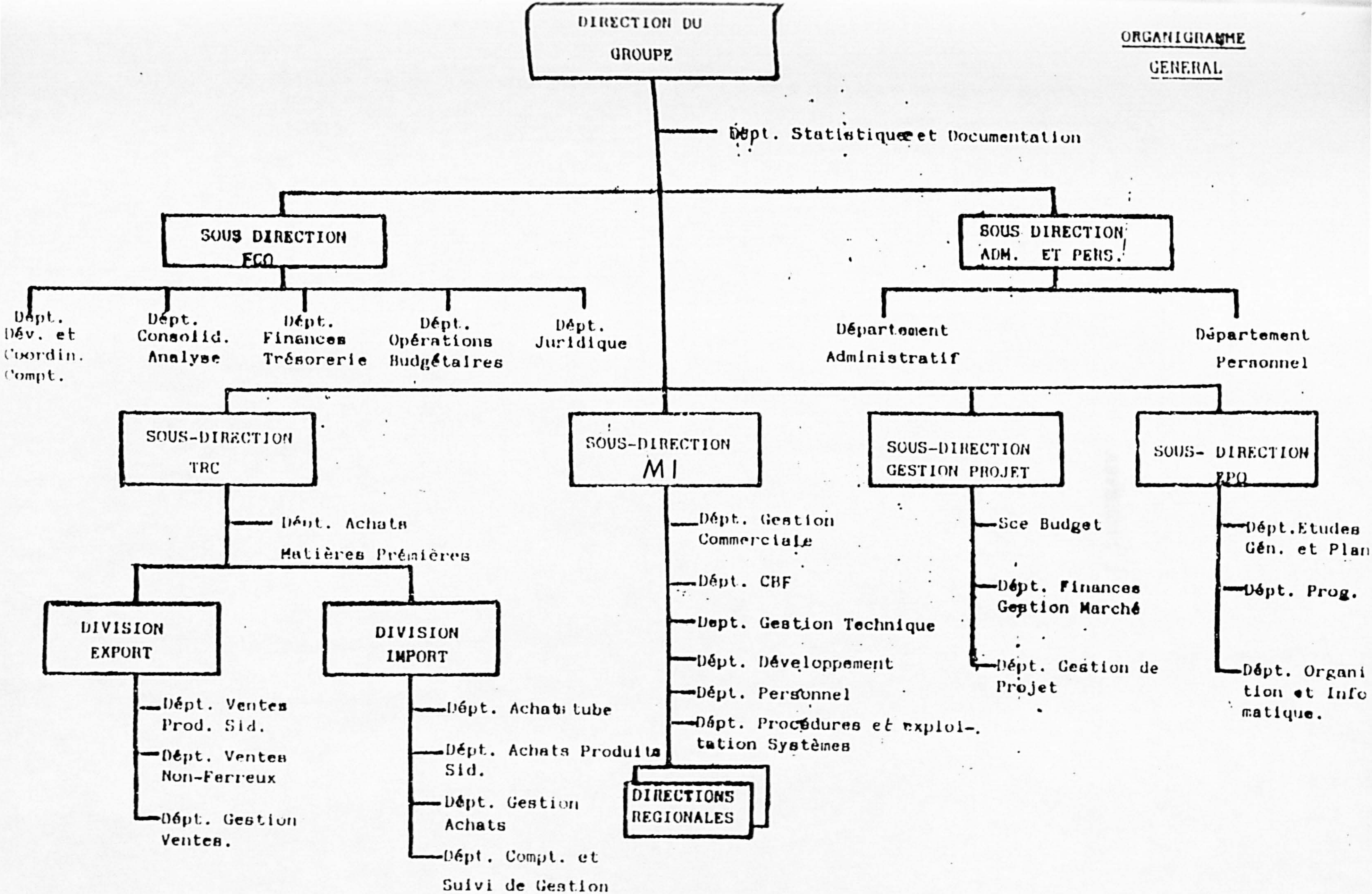
APPENDIX B

ORGANIGRAMME - CIBLE D'UNE UNITE REGIONALE COMMERCIALE



APPENDIX C

ORGANIGRAMME GENERAL



APPENDIX D

S.R.G.S. n°: ______________

FEUILLE DE CALCUL DE LA DEMANDE ESTIMEE
ET DU CUMUL DES VENTES DIFFEREES

L. P. : ______________

Mois de : ______________

α =

β =

	RESORPTION ET APPRECIATION DU CUMUL DES VENTES DIFFEREES					DEMANDE ESTIMEE ET ACTUALISATION DU CUMUL DES VENTES DIFFEREES							
	Cumul des ventes différées début de mois	Vente réalisée ce mois	Vente nette du mois	Cumul des ventes différées restant	Cumul des ventes différées retenu	Rupture actuelle	Rupture réestimée	Ancienne demande estimée	Ancienne demande prévue	Nouvelle demande prévue	Quantité de ventes différées ce mois	Demande estimée ce mois	Cumul des vente différées ce mois
ABREVIATION	Ri-1	Vi	Vn	Bres i-1	Bres i	τa	τe	Dei-1	Xi-1	Xi	ΔQD	Dei	Ri
Règle de calcul	(13) mois précédent		(2)-(1) si > 0 ou si (2)-(1) < 0	(1)-(2) si > 0 si (1)-(2) < 0	β.(1)		100% si (3) > 0 τa si ≠ 0	(12) du mois précédent	(10) du mois précédent	α(8) - (1-α) (9)	β(7).(10)	(8)+(11)	(5)+(11)
LP - CODE ET LIBELLE ECHANTILLON	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(92)	(13)

APPENDIX E

5 K 4 5 d [illegible]

FEUILLE DE CALCUL DE COMMANDE

α :

γ L :   L.P :

Mois de

δ : σ_L :

$\delta\, \sigma_L = a =$

$\gamma : 1.25 \cdot \sqrt{L} = b =$

	MISE A JOUR DE LA PREVISION						COUVERTURE REQUISE		COUVERTURE ACTUELLE					QUANTITE A COMMANDER			
	Ventes actuelles	Ancienne Prévision	Ecart Relatif	Prévision Actualisée	Ancien MAD	MAD actualisé	Couverture en délai	Stock de sécurité	Stocks aux parcs	Stocks aux ports	Stock région fin de mois	Attendue de la région	Cumul des Ventes différées	Couverture requise	Couverture Actuelle	Quantité à Commander	Décision de Commande
ABREVIATION	X_i	X_{i-1}	e_i	X_i	MAD_{i-1}	MAD	C_L	C_S			S	A	R	C_R	C_A	Q	
Règle de calcul		Colonne (4) feuille du mois précédent	(1) - (2)	$\alpha(1) + (1-\alpha)(2)$	Colonne (6) feuille du mois précédent	$\alpha/e/ + (1-\alpha)(5)$	(4) . L	a. (4) + b. (6)			(9) + (10)			(7) - (8)	(11)+(12)-(13)	(14) - (15)	
CODE ET LIBELLE ECHANTILLON	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)

APPENDIX F

CONTROLE DE LA QUALITE DE LA PREVISION

ECHANTILLON:

α =

	ACTUALISATION DE LA PREVISION						CONTROLE DE LA PREVISION		
	VENTE OU DEMANDE	PREVISION	ECART RELATIF	ECART ABSOLU MOY. LISSE	ECART TYPE	ECART RELATIF MOY. LISSE	CUMUL ECARTS RELATIFS	INDICATEUR DE DECENTRAGE	VARIABILITE DE LA DEMANDE
ABREV.	V_i	X_i	e_i	MAD_i	σ_{Di}	SE_i	CUSOM	TS_i	v_i
REGLE DE CALCUL	REPORTE DE LA FEUILLE DE CALCUL	$\alpha(1)+(1-\alpha)(2)$	$(1)-(2)$	$\alpha(3)+(1-\alpha)(4)$	$1{,}25\cdot(4)$	$\alpha(3)+(1-\alpha)\cdot(6)$	Σe_i	$(6)/(4)$	$(5)/(2)$
MOIS-AN	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)

Référence TBQP

APPENDIX G

HISTORIQUE DE PERFORMANCE

ECHANTILLON:

CODE GESTION:

$\delta =$ $\gamma =$

AN: / MOIS	NIVEAU DE SERVICE %	STOCK MOYEN IMMOBILISE	
		TONNAGE	NBR MOIS
MOYENNE:			

Référence: TBH P1

APPENDIX H

A - IDENTIFICATION DE L'ENTREPRISE

1 — CODE SIDER ATTRIBUE : ....

2 — RAISON SOCIALE : ....

3 — STATUT ET FORME JURIDIQUE :

| 0 1 1 | ☐ Administration : .... | 0 1 3 | ☐ Privé National : .... | 0 1 4 | ☐ Mixte : ....

| 0 1 2 | ☐ Entreprise Nle : .... | 0 1 8 | ☐ Privé Etranger : .... | 0 1 9 | ☐ Autre : ....

4 — TUTELLE : ....

5 — LOCALISATION DU SIEGE : ....

Commune : .... Daïra : .... Wilaya : ....

B. Postale : .... Tél. : .... Télex : ....

6 — REGISTRE DE COMMERCE N° .... Greffe d'Inscription : .... Date : .... Code Activité : ....

Libellé activité : ....

7 — UNITES ET PROJET COMPOSANT L'ENTREPRISE (Dénomination, Adresse, BP, Télex, Tél.)

— ....

— ....

— ....

— ....

— ....

— ....

8 — EFFECTIF TOTAL DE L'ENTREPRISE : ....

9 — PRINCIPAUX INTERLOCUTEURS DE SIDER

Directeur Général : ....

Directeur des Approvisionnements : ....

B - IDENTIFICATION DE L'UNITE OU DU PROJET

1 — CODE SIDER ATTRIBUE : ....

2 — DENOMINATION : ....

3 — DATE DE MISE EN EXPLOITATION : ....

4 — LOCALISATION : ....

Commune : .... B. Postale : ....

Daïra : .... Télex : ....

Wilaya : .... Tél. : ....

5 — REGISTRE DE COMMERCE N° .... Greffe d'Inscription : .... Date : .... Code Activité : ....

Libellé activité : ....

6 — STATUT ET FORME JURIDIQUE :

01 — ☐ Administration : .... 03 — ☐ Privé National : .... 04 — ☐ Mixte : ....

02 — ☐ Entreprise Nle : .... 08 — ☐ Privé Etranger : .... 09 — ☐ Autre : ....

7 — SECTEUR D'ACTIVITE

01 — ☐ INDUSTRIE

02 — ☐ AGRICULTURE

03 — ☐ HYDRAULIQUE

04 — ☐ TOURISME ET PECHE

05 — ☐ BATIMENT

06 — ☐ TRAVAUX PUBLICS

07 — ☐ ARTISANAT

08 — ☐ AUTRES (à préciser)

8 — DOMICILIATION BANCAIRE OU CCP :

Code agence : .... N° Compte : .... Localité : ....

9 — EFFECTIF EMPLOYE : ....

10 — CHIFFRE D'AFFAIRE TOTAL BRUT :

SECTEUR / ANNEE	PUBLIC	PRIVE	EXPORTATION	TOTAL
1984				
1985				
1986				

11 — CHAMP D'ACTION

| L | ☐ LOCAL

| R | ☐ REGIONAL

| N | ☐ NATIONAL

12 — EXTENSIONS DE CAPACITE DE PRODUCTION PREVUES POUR 1988 ET 1989 SUSCEPTIBLES D'ACCROITRE LA CONSOMMATION DE PRODUITS SIDERURGIQUES.

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....

C - ESTIMATION DES BESOINS EN PRODUITS "SIDER"

1 — IDENTIFICATION DES PRODUITS UTILISES

Unité de Mesure = Tonne

PRODUITS "SIDER" / PRODUITS FINIS ELABORES							TOTAL
	* (1)						
	* (2)						

* (1) Quantité utilisée
(2) Code du secteur utilisateur du produit fini, suivant annexe 1.

2 — ESTIMATION DES BESOINS EN PRODUITS HORS GAMME "STOCK" (DIRECT)

Unité de Mesure = Tonne

N° Ordre * (1)	PRODUITS	QUALITE NUANCE	ECHANTILLONS	LPC * (2)	BESOINS DE CONSOMMATION 1987 PLACES AUPRES DE SIDER			PREVISIONS D'ACHATS LIVRABLES		
					PREVUE	REÇUS	R.A.L. *(3)	1988 S 1	1988 S 2	1989

* (1) A utiliser pour les observations éventuelles qu'il y a lieu de porter sur l'annexe 3.
* (2) Colonne à ne pas renseigner : réservée à SIDER
* 3 RAL = Reste à Livrer

3 — ESTIMATION DES BESOINS EN PRODUITS GAMME "STOCK" (DEPOTS SIDER)

Unité de mesure = tonne

N° Ordre * (1)	PRODUITS *		* (2)	CONSOMMATION 87		PREVISIONS DE COMMANDES LIVRABLES		
	FAMILLE	SOUS/FAMILLE	L C *(3)	PREVUE	REELLE (à fin Sep)	1988		1989
						S 1	S 2	

* (1) A utiliser pour les observations éventuelles qu'il y a lieu de porter sur l'annexe 4.
(2) La liste des produits de la gamme stock est donnée en annexe 2
(3) Colonne à ne pas renseigner : réservée à SIDER

D - AUTRES INDICATIONS

1 — Etes vous sous - traitant ? | OUI | | NON |

Si oui, citez : Les Entreprises pour lesquelles vous sous - traitez

Les types de produits élaborés

Les matières d'œuvre utilisées

2 —

3 —

NOMENCLATURE DES SECTEURS UTILISATEURS

SECTEUR	S / SECTEUR
1 — INDUSTRIE	43 — CONSTRUCTION METALLIQUE 44 — CONSTRUCTION MECANIQUE 46 — ELECTRIFICATION RURALE 47 — INDUSTRIE MILITAIRE 72 — ALIMENTAIRE 94 — ARISANAT 00 — AUTRES ⁎
2 — AGRICULTURE	41 — INFRASTRUCTURE RURALE 23 — IRRIGATION 31 — EXPLOITATION AGRICOLE 00 — AUTRES ⁎
3 — HYDRAULIQUE	21 — BARRAGES 33 — PETITE ET MOYENNE HYDRAULIQUE 23 — ADDUCTIONS 00 — AUTRES ⁎
4 — TOURISME ET PECHE	22 — HOTELLERIE 23 — THERMALISME 32 — INDUSTRIE DE LA PECHE 00 — AUTRES ⁎
5 — INFRASTRUCTURES ECONOMIQUES	24 — PORTS / AEROPORTS 21 — OUVRAGES D'ART 61 — STOCKAGE ET DISTRIBUTION 00 — AUTRES ⁎
6 — INFRASTRUCTURES EDUCATION ET FORMATION	31 — FORMATION PROFESSIONNEL 22 — ENSEIGNEMENT GENERAL 21 — ENSEIGNEMENT SUPERIEUR 00 — AUTRES ⁎
7 — INFRASTRUCTURES SOCIALES	22 — HABITAT 31 — SANTE 41 — LOISIRS / SPORTS ET CULTURE 00 — AUTRES ⁎
8 — INFRASTRUCTURES ADMINISTRATIVES	22 — BATIMENT ADMINISTRATIF 51 — DEFENSE NATIONALE 00 — AUTRES ⁎

⁎ AUTRES : A PRECISER

NOMENCLATURE DES PRODUITS GAMME "STOCK"

FAMILLE	S/FAMILLE
TOLE ACIER	LAMINE A CHAUD LAMINE A FROID
TOLE GALVANISEE	PLANE ONDULEE NERVUREE
POUTRELLES	LAMINES A CHAUD RECONSTITUEES SOUDEES (ACS)
CORNIERE	LAMINEE A CHAUD PROFILEE A FROID
LAMINES MARCHANDS	PLAT ROND U.G. CARRE TES (SIMPLE)
PROFILES A FROID	TUBES REJOINTS COULISSES
PRODUITS POUR BETON	ROND LISSE EN COURONNES ROND LISSE EN BARRES ROND HAUTE ADHERENCE IREILLIS SOUDES
TREFILES	POINTES FIL GALVANISE FIL RECUIT FIL PICK-UP
ACIERS FINS et SPECIAUX	PRODUITS PLATS PRODUITS LONGS
TUBES ACIERS (TOUS TARIFS)	SOUDES (TOUS TARIFS) SANS SOUDURES
TUBES SERRURIERS	RECTANGULAIRES CARRES RONDS
TUYAUX FONTES ET ACCESSOIRES	
NON FERREUX	ZINC CUIVRE LAITON PLOMB ALUMINIUM NICKEL

ESTIMATION DES BESOINS EN PRODUITS
HORS GAMME "STOCK" (DIRECT)

TABLEAU DES OBSERVATIONS

N° ORDRE PRODUIT	OBSERVATIONS

ESTIMATION DES BESOINS EN PRODUITS

GAMME "STOCK"

TABLEAU DES OBSERVATIONS

N° ORDRE PRODUIT	OBSERVATIONS

SIDER GROUPE COMMERCIAL MARCHE INTERIEUR	BORDEREAU DE DEPOUILLEMENT	CODE CLIENT	RUB	FEUILLE
		1	CLI 2	A /

SOUS - RUBRIQUES

UC	3	4	5	6	7	8	
IE	9	10	11	12	13		

IU	14	15	16	17	18	19	20	21

OBSERVATIONS ET VISA

PILOTE REGIONAL	PILOTE CENTRAL

SIDER
GROUPE COMMERCIAL
MARCHE INTERIEUR

BORDEREAU DE DEPOUILLEMENT

CODE CLIENT	RUB	FEUILLE
	ECH	B /
1	2	

IDENTIFICATION DU PRODUIT				REALISATIONS			PREV.	BESOINS EXPRIMES			
LC	LPC	CODE ECHANT	DIMENSION	1985	1986	1987	1988	1988	S1/88	S2/88	1989
3	4	5	6	7	8	9	10	11	12	13	14

SIDER GROUPE COMMERCIAL MARCHE INTERIEUR	BORDEREAU DE DEPOUILLEMENT	CODE CLIENT	RUB	FEUILLE	
			TOT	C	/
		1	2		

PRODUIT		CANAL	SECTEUR	SOUS SECTEUR		REALISATIONS			PREVIS.	BESOINS EXPRIMES			
L.C	LPC	VENTE	UTILISAT	UTILISAT.		1985	1986	1987	1988	S_1	S_2	1988	1989
3	4	5	6	7	8	9	10	11	12	13	14	15	16

APPENDIX I

ESTIMATION DE LA DEMANDE "CANAL STOCK"　　　　ANNEE : 1988

L.P.C	P R O D U I T S	ALGER	ORAN	SKIKDA	BEJAIA	ANNABA	MOSTAG	BLIDA	T O T A L
C0101	tole lac e.< ou = 2 mm.	185	420	145	10	60	55	395	1270
C0102	" " 2.< e. < 3.75 mm.	3620	4030	975	410	550	570	[illegible]	11330
C0103	" " 3.75 < e. < 8 mm.	5540	3090	980	540	705	980	[illegible]	14490
C0104	" " 8 < e. < 10 mm.	2285	1560	1450	310	315	155	1125	7200
C0105	" " 10 < e. < 20 mm.	3130	2050	720	250	460	310	890	7810
C0106	" " e.> 20 mm.	1155	535	160	80	65	120	420	2535
C0123	" " striee type A.	1300	695	325	140	120	350	300	3230
C01	TOLES LAC.	17215	12380	4755	1740	2275	2540	6960	47865
C0301	tole laf e.< ou = 0.8 mm.	4060	2975	1440	205	60	320	2260	11320
C0302	" " 0.8 < e.< 1.3 mm.	5380	1065	1515	260	325	760	2065	11370
C0303	" " e.> 1.3	8170	5770	5125	2850	1990	3375	6325	33605
C03	TOLES LAF.	17610	9810	8080	3315	2375	4455	10650	56295
D0104	T.P.G. e.< 0.8	2585	360	1760	290	330	460	800	6585
D0105	" 0.8< e.<1.3	960	670	170	80	230	220	470	2800
D0106	" e.>1.3	1960	1820	540	150	70	180	1100	5820
D0107	T.O.G.	3260	5500	4835	1155	1750	3500	3580	23580
D0108	T.N.40 GALVANISEE	6015	10570	4655	2560	2040	3590	5360	34790
D01	PRODUITS PLATS REVETUS	14780	18920	11960	4235	4420	7950	11310	73575
E0101	POUTRELLES	22260	17970	16870	6910	5865	5870	17475	93220
N0133	P.R.S.	4485	2050	385	0	670	350	1600	9540
	POUTRELLES	26745	20020	17255	6910	6535	6220	19075	102760
E0201	CORNIERES PAF.	14200	10610	4910	6080	6000	5600	10870	58270
E0204	COULISSES PAF.	1880	1270	0	0	0	190	1020	4360
E0207	TUBES PAF.	410	285	35	80	70	100	280	1260
E0209	CORNIERES LAC.	4655	3510	2980	250	890	530	1440	14255
E0210	TES LAC.	1980	1350	1175	250	235	460	1005	6455
E0211	US A CONGES LAC.	595	1010	675	180	110	110	600	3280
E0214	RONDS LAC.	2375	1420	345	60	150	210	695	5255
E0215	CARRES LAC.	2365	2580	1375	240	300	830	1380	9070
E0216	PLATS LAC.	7510	5230	3300	1200	1260	1440	3455	23395
E0220	BARRES PARACHEVES A FROID.	4000	100	0	0	0	0	0	4100
E02	LAMINES MARCHANDS LAC./LAF.	39970	27365	14795	8340	9015	9470	20745	129700

ESTIMATION DE LA DEMANDE "CANAL DIRECT " ANNEE : 1988

CPC	LIBELLE PRODUIT	ALGER	ORAN	SKIKDA	BEJAIA	ANNABA	MOSTA	BLIDA	TOTAL
A0132	COKE	0	4000	0	0	0	0	0	4000
A0134	FINE DE COKE	1000	0	1500	100	100	20	0	2720
A0135	COKE CRIBLE	1500	25	1550	435	1000	120	0	4630
A01	COKE	2500	4025	3050	535	1100	140	0	11350
B0102	FONTE D'AFFINAGE	2430	1000	1000	200	1000	2500	4020	12150
B0104	FONTE DE MOULAGE	4000	3500	4000	15	0	0	6550	18065
B0105	FERRO-ALLIAGES	50	0	0	0	15	0	100	165
B01	FONTE et F.ALLIA.	6480	4500	5000	215	1015	2500	10670	30380
C0101	TOLE LAC E>2	740	0	0	0	0	0	220	960
C0102	TOLE LAC 2<E<3,75	5250	1200	30	0	350	95	18	6943
C0103	TOLE LAC3,75<E<8	12400	1000	2230	0	410	2000	2260	20300
C0104	TOLE LAC 8<E<10	3400	200	1575	0	180	400	900	6655
C0105	TOLE LAC 10<E<20	9250	300	1695	0	430	450	330	12455
C0106	TOLE LAC E >20	320	50	2700	0	340	100	2510	6020
C0121	LARGE PLAT	0	0	0	10	100	40	0	150
C0123	TOLE LAC A RELIEF	0	30	0	0	0	1200	0	1230
C01	TOLE et LARGE PLAT LAC	31360	2780	8230	10	1810	4285	6238	54713
C0209	FEUILLARD LAC 2>E>3,75	0	0	30	0	0	0	0	30
C02	BOB.et FEUILLARD LAC	0	0	30	0	0	0	0	30
C0301	TOLE LAF E> 0,8	2190	1650	0	20	130	50	1755	5795
C0302	TOLE LAF 0,8>E>1,3	6700	920	50	0	55	50	700	8475
C0303	TOLE LAF E>1,3	4170	2050	1420	0	5600	600	3360	17200
C03	TOLE LAF	13060	4620	1470	20	5785	700	5815	31470

ESTIMATION DE LA DEMANDE "CANAL STOCK & DIRECT" ANNEE : 1988

LPC	LIBELLE PRODUIT	ALGER	ORAN	SKIKDA	BEJAIA	ANNABA	MOSTA	BLIDA	TOTAL
C0406	BOB.LAF S.PASS E>0,37	150	0	0	0	0	0	0	150
C0407	BOB.LAF S.PASS 0,37>E>0,8	450	0	0	0	0	0	50	500
C0408	BOB.LAF S.PASS 0,8>E>1,3	20390	0	200	0	0	0	0	20590
C0409	BOB.LAF S.PASS E>1,3	1460	0	0	0	0	0	0	1460
C0410	FEUILLARD LAF E >0,8	2230	70	460	210	255	10	595	3830
C0411	FEUILLARD LAF 0,8>E>1,3	725	40	560	0	270	0	380	1975
C0412	FEUILLARD LAF E>1,3	1110	100	450	0	1200	0	440	3300
C04	BOB. et FEUILLARD LAF	26515	210	1670	210	1725	10	1465	31805
D0101	FER BLANC NU E>0,37	0	1800	6000	0	200	0	2500	10500
D0104	TPG E >0,8	2835	460	1760	290	330	560	800	7035
D0105	TPG 0,>E>1,3	2060	705	170	80	230	220	770	4235
D0106	TPG E>1,3	2685	1900	540	150	170	180	1900	7525
D0107	T.O.G.	3260	5500	4835	1155	1750	3500	3580	23580
D0108	TN 40 GALV.	7015	10570	4655	2560	2140	3590	7760	38290
D0109	FEUILLARD LAF GALV.E>0,8	800	160	420	0	0	0	0	1380
D0110	FEUILLARD LAF GALV.0,8>E>1,	0	0	500	0	0	100	0	600
D0111	FEUILLARD LAF E>1,3	710	0	0	0	0	0	0	710
D0112	BOB.LAF GALV.E>0,8	600	0	0	2600	0	0	0	3200
D0113	BOB.LAF GALV.0,8>E>1,3	1300	0	0	3400	0	100	0	4800
D0115	AUTRES P.P.REV.ou NON	165	40	0	0	0	0	545	750
D01	PROD.P.REV.LAC ou LAF	21430	21135	18880	10235	4820	8250	17855	102605
E0101	POUTRELLES	23260	18270	16870	6910	6565	5870	21675	99420
N0133	P.R.S	4985	2550	385	0	970	350	3400	12640
E01	POUTRELLES	28245	20820	17255	6910	7535	6220	25075	112060