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RESOURCE PLANNING STRATEGIES AND PERFORMANCE IN STATE HOLDING COMPANIES

by

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CONTENTS

ABSTRACT

The essential characteristics of the "state holding company" form of organisation are explored by application of general theory to three cases.

An analysis is made of the strategies that can be followed by state holding companies in order to meet government demands for industrial intervention. Special attention is given to 'service companies' set up within the group. A strategy of slack resources to face a probable series of enforced takeovers is discussed.

Information concerning the National Enterprise Board of the UK., the Statsföretag of Sweden and the Istituto per la Ricostruzione Industriale of Italy is presented and a comparative analysis is made.

Using the rate of return on capital as objective function, a quantitative approach to 'company rescue' operations is developed. A computer programme calculates the performance of standard companies under recovery together with the resources needed by the rescue system of the group when faced with a continuous flow of acquisitions.

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INTRODUCTION

The main purpose of this study has been to devise a strategy for a state group of companies faced with a probable series of enforced acquisitions and divestments. The origin of this research may be traced back to the years 1971-73 in Chile. During Dr Allende's Government a policy of high State intervention in industry was applied. The Chilean Steel Corporation (CAP), the country's largest nationalised industry, was in charge of intervention in the metallurgical, engineering, and mechanical sectors. At the end of the 30 months in which that policy was in effect around fifty companies were incorporated into the CAP's structure. The process had consisted of a series of takeovers, mergers and rescue operations.

Due to the importance of these takeovers the CAP was obliged to change its organisation adopting a holding structure and a divisional organisation. Nevertheless, the increasing number of takeovers, each in response to Government directions was interfering with the main activities of the company: mining and steel production. On the other hand the new companies - new either in that they were established "from scratch" or in that they were recently taken over - required urgent centrally based support. Bearing in mind that Chile is a country with scarce industrial resources, and because other sectors of the economy were looking for the same kinds of experts (managers, financial experts, analysts, engineers, technicians, etc.) the CAP began to provide resources of expertise taken from its own organisation.

At that time a new division was set up and placed in charge of the subsidiaries. However, very soon the structure showed that it could not cope with the problems arising from the firms recently taken over. Nor did it seem sensible to further weaken the central structure of the company by draining it of key personnel.

The lack of resources was particularly serious in management, engineering, maintenance and construction services. For this reason it was decided to set up, within the group, specialist companies that were able to provide these services to the subsidiaries.

The new organisation started working in a far better way than before, especially when compared with other industrial sectors that did not utilize the same structure (as, for instance, the textile, the building materials and the food and agro-industrial sectors).

Two features of the CAP's improved structure are of particular interest:

1. Companies with high technology and/or with foreign partners were maintained with mixed ownership.
2. Intra company trade (i.e. between the group's companies) began spontaneously and was encouraged by the headquarters.

The period of intervention in the industrial sector was interrupted too soon to allow a valid judgement of the potential achievements of the system, and it is not the central purpose of this study to attempt an analysis of the Chilean experience. However, it seems worth pointing out that this study had an empirical origin.

Although the specific form in which the problem of organisation had been met in Chile concerned a state-owned enterprise it was felt that at least partial parallels must exist in large private sector holding companies. In addition, the state holding company form had existed in Europe for many years (notably in the Italian IRI, "Istituto per la Ricostruzione Industriale") and therefore it might be expected that appropriate application and development of organisation theory to the problems perceived in the Chilean experience might be worthwhile.

The literature specifically concerned with state groups is sparse. For this reason we turned our attention to the state groups set up in different European countries and by analysing their structures we attempted to characterize, although provisionally, what is understood as a state holding company (from now on: SHC).

In brief, we adopted the following definition:

A SHC is a group of companies characterized by:

1. A pyramidal structure comprising a parent company, subsidiaries, and associated firms, which retains the independent legal status of each firm.
2. The companies under the parent company have mixed ownership in the sense that partnership between private and state capital is allowed and encouraged.
3. The parent company is wholly owned by the State, which is also majority shareholder in the subsidiaries. In the associated firms (so-called "operating units") the State may be a minority shareholder.
4. The enterprises are grouped into "divisions" within the structure and follow certain rules intended to improve the overall performance of the group. The divisional structure (or M-form) attempts to reconcile decentralization with the achievement of a strategic corporate plan established by the

parent company staff. The operating units - in general highly diversified - maintain full management autonomy and it is assumed that there must not be intervention from above in day-to-day decision making.

Looking for the different potential SHC's strategies we collected information about the Istituto per la Ricostruzione Industriale (IRI) in Italy, the Statsföretag in Sweden, The National Enterprise Board (NEB) in the United Kingdom, the Vereinigte Aluminium-Werke AG (VIAG) in West Germany [42] and the Instituto Nacional de Industria (INI) in Spain [33].

Particularly useful has been the experience of the NEB during the last four years, and the opportunity to obtain information concerning this new state-group going right back to its foundation.

We realized that the organisational device adopted by the metallurgical sector in Chile at that time was similar in many of its aspects to the structure adopted by the European SHCs. Of course, there are differences of emphasis which relate largely to differences in history, purpose and perhaps ideology. It is essential also to bear in mind the huge differences between developed and developing countries, Chile being an example of the latter.

Going further in our analysis it was understood, as suggested earlier, that the case of a SHC is in some respects a particular case of a large corporation of the private sector: but one which is used as an instrument of Government economic policies. The most common request may well be to give support to industries in either the private or state sectors, that are in a weak condition, by incorporating the companies within the group structure (i.e. a takeover "forced" on the SHC by the Government). Alternatively, the Government may request the expansion of the group in a certain branch of industry which they judge to be strategic, or to invest in a certain region where unemployment is high. More rarely the Government may also ask the group to sell its stakes in certain companies, or to withdraw completely from certain branches of industry (NEB's case in 1979-80).

The comparative study of different European SHCs revealed that this feature does not give rise to problems for the group if it is not at the same time required to achieve profitability goals. But as soon as the performance is assessed by the consolidated profits and losses of the individual companies - both subsidiaries and associated - this gives rise to a conflict of objeotives which is then reflected in a conflict between the Central Government and the State group.

While the Central Government tries to internalize, within the group, certain of the problems that the national economy is facing, the state-group tries to externalize the Government demands. This conflict may be expected to generate particular organizational structures and evidence of this was found in the state groups that were examined.

Two different trends were found, one in Britain's NEB and the other in Sweden's Statsföretag.

The case of the NEB has been striking for its particularly loose organisation. A divisional structure was specified but has been largely only formal. No specialist companies were set up, within the structure to give support to the firms in key activities such as: management services, project engineering or marketing. Collaboration between the companies of the group was left to their own initiative.

The NEB's guidelines are quite strict and demand the achievement of a rate of return on capital employed equal to the average of British manufacturing industry. Understandably the NEB was keen to avoid responsibility for any rescue operations during the three years 1977-79 and did so (apart from the big and continuing rescue operations for which it was responsible from its foundation, i.e. mainly the Rolls Royce, the British Leyland and the Alfred Herbert cases).

On the other hand, the Statsföretag's case was remarkable for the quantity and size of the rescue operations with which it was charged. Its structure has been in permanent transformation and, as is reported in its annual statements, there is a major tendency to group companies with related activities, under the umbrella of a parent or subparent company which performs the functions of a divisional head-quarters.

The interesting feature for this study was the growth of service companies, either grouped under a common parent company, or included in the structure of a divisional headquarters. These service companies provide the rest of the group with some specialized resources, but it is not clear whether or not they are also expected to maintain an inventory of resources to face a flow of rescue operations. What is made clear in the reports is that the rescue operations are accounted for separately from the normal operations of the group. So the assessment of the Statsföretag performance may be done in a fairer or at least more informative way, and rescue operations may produce less conflict of objectives and less tension between the group and the Government.

This experience led us to the last part of our study: an attempt to develop a model of a SHC which tries to adapt its structure to a continuous flow of rescue operations.

What we hope has been achieved is a system of analysis of the various problems that a SHC has to face. We have used general data from the British economy to build the model. However, it would be easy to modify them in order to make the model suitable to a different environment. The same cannot be said of the numerous hypotheses that were made in building the model. It quickly became apparent that a SHC, particularly in a developed industrial economy, represents such a complexity in terms of structure and roles that any worthwhile analysis must proceed by reasonable assumptions and simplifications. Moreover, our concern is with the SHC concept and the strategies appropriate thereto. Any fully-specified model could represent only a very limited and transient part of the range of possible forms.

At any point at which we faced alternative assumptions we have always chosen that which led to a simplification of the model. Only where this approach could endanger the close relationship with reality which we wished to maintain, have we accepted a more complex assumption.

When the analytical model was concluded, it was written in the form of a computer programme and run with assumed data. Two versions of the programme are included: the first and simplest which was subject to the more exhaustive testing, will be used for explaining the model and its equations. The second, and more complex in computing technique, was used in a sensitivity analysis.

CHAPTER I

THE STATE HOLDING COMPANY AS A DISTINCT TYPE OF ORGANISATION

1.1 Methodological Problems

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1.1 METHODOLOGICAL PROBLEMS

There is an enormous literature about the organisation problems of the private sector, but very little has been written about SHC and in general about the so-called "mixed enterprises". As Musolf writes: "Mixed enterprise has received little popular, or even scholarly, discussion. The literature on development, with few outstanding exceptions largely passes it by. Writings on public administration in English have tended to treat mixed enterprise as a type of Public or Government corporation" [27]. Practically the only book that deals with this subject is the collection of essays published under the direction of Stuart Holland in 1972, entitled "The State as Entrepreneur. New dimensions for public enterprise: The IRI State Share-holding Formula". This book is the product of collective work at Sussex University, and as its title shows it is mainly a description of an existing SHC in Italy [14].

The recent book by R. Mazzolini, "Government Controlled Enterprises" has mainly to do with the "multinational expansion by companies owned by EEC's national governments" [25].

There are many reasons which can explain the scarcity of written studies of this topic perhaps the most important one being the highly ideological content of the theme [22]. However, there exists an evident methodological problem connected with the ambiguous definition of state-holdings' objectives and structure, and with the difficulties of measuring the results. On the other hand, SHCs are a relatively recent phenomenon. The fact is that there are few SHCs in the world and these are distributed in countries with a wide spread of environment and degree of development. As a result, most of the research methods used in organizational theory, which require large samples of firms, are difficult to apply in the SHC's cases.

For these reasons, most of this research will be based on the comparative study of the three SHCs which exist in industralized countries. The case of SHCs in developing countries is a special situation that would have to be studied in different contexts that are beyond our purposes. However, it is worth pointing out that SHCs seem to be an important economic instrument in countries where industrial development is one of the chief priorities [6].

1.2 THE IRI MODEL

The IRI (Istituto per la Ricostruzione Industriale) in Italy is the oldest known organisation of this type and, it is said, was established really by chance in 1933 when three important banks became bankrupt and the Italian State had to take them over. The major part of those three banks' investments were industrial shares and so when the Italian State took over the banks it found itself the owner of an important group of industries, some of which were the most dynamic and profitable industries in the country [14].

Due to the long economic crisis in the thirties, and to internal political reasons, reselling the shares was not an easy task. Hence the Italian State took the decision to give a permanent structure to these assets.

The present structure of IRI is, however, the result of a complex evolution through different stages, which was essentially completed in 1948 when the present statute-body was introduced and its activities were well defined.

The IRI experience would have passed without any publicity at all - as at first it did if it had not been so successful between 1948 and 1972. During that period the IRI became a model structure for other countries in Europe. In fact many European countries have used IRI as a model and a reference made at the present time to the state-holding company model is a close reference to the IRI structure.

The IRI model can be regarded, at least in embryo, as a new kind of public institution in modern industrialised states. It compares with the technostructures of the mature corporations that Professor Galbraith has described in his book "The New Industrial State" [14].

The IRI model is characterized by a pyramidal multi-sectoral structure. At the top there is a small central management team which provides strategic planning for the whole group, while delegating tactical decision-making and autonomy to the operating companies.

The fact that Italy's most important commercial banks belong to IRI, and simultaneously those banks are share-holders of IRI enterprises, is not a necessary feature of the state-holding company model as applied to the industrial sector. This direct or indirect "mixed" ownership between the central structure of the state-holding entity and its own banks is not a basic feature of the model, nor is the fact that the financial institutions that provide credit to the private industrial sector and to the public also belong to the state-holding company. As a matter of fact the state-holding companies already established in Sweden, West Germany, Australia, Canada and Britain do not include any banks in their structure [24].

The IRI structure, as will be seen, has the bank sectors outside the central structure which incorporates the operating industrial units. A characteristic of IRI that is essential to the model structure and to those state-holding companies organized on the IRI pattern, is the fact that it is multi-sectoral, involving many industrial branches and also non-industrial activities.

There are sound reasons for this diversification and a detailed discussion of them will be given later. If a state organisation is the owner or a shareholder of companies belonging only to one industrial sector (as is the case of the British Steel Corporation), then it is called a state corporation, a state enterprise or a nationalized industry rather than a state-holding company, even though, in a formal way, they can be organised as holding companies.

From the perspective of a country's economic framework the state holding concept appears closely linked to the existence of mixed economic systems, that is to say, a system where alongside the pre-dominant capitalist economy there is also a state sector. Whether the purpose of a state-holding company is as a means of macroeconomic management of a mixed economy, or whether their sole raison d'etre involves an attempt to transform the economic laws and mechanisms of a capitalist society, is an interesting debate but is out of context in this study [22].

What appears as a common and explicit purpose in every state-holding company is the wish to modify or correct some structural aspects of certain strategic sectors of the economy. The industrial development of backward regions (regional development), the promotion of key industries that are basic for the whole economy, the introduction of new technologies, are all common objectives of state-holding companies.

The promotion of development, starting new projects and technological innovation are included among the objectives of all state-holding companies. Nevertheless, what are not always clearly expressed are the precise means that will be used to achieve those goals. A variety of measures and tools are mentioned without mutual exclusion, as, for example: direct investment, loans, efficient management, direct intervention, etc. As a conclusion, it can be remarked that the state-holding model can be easily described by its objectives, but it is rather difficult to define the form by means of its operating patterns.

1.3 SHC POSITION IN THE ECONOMY

A clearer view of the relative position of a SHC in the framework of a mixed economy has been prepared in Fig.1.

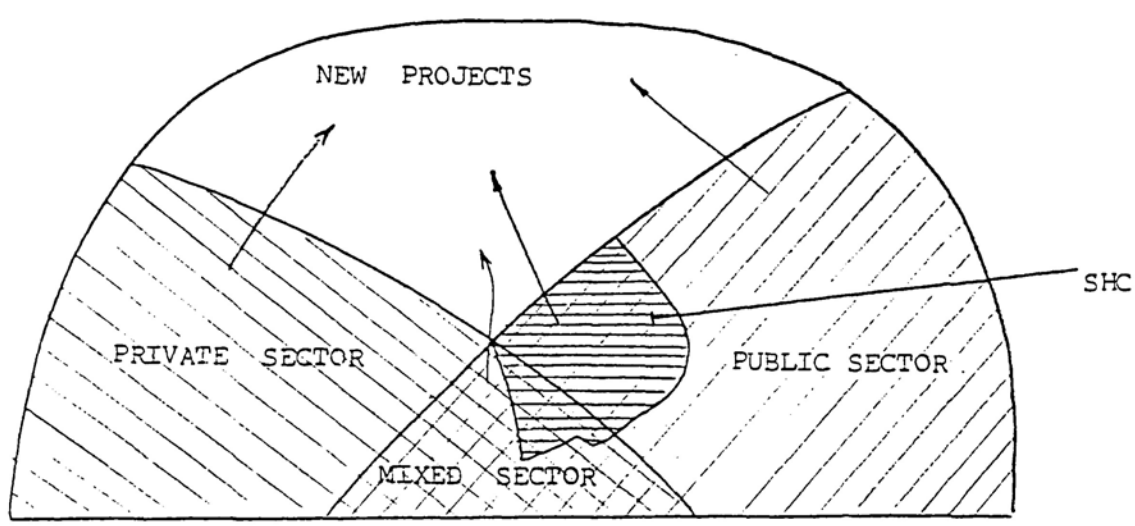


FIG.1 THE SHC's POSITION

In this figure it can be seen that in a mixed economy three basic sectors co-exist: the private, the public and the mixed sector. Following Musolf [27](page 3) we can apply the term "mixed enterprise" to ..... "any body in which there is an informal mixture of public and private influence". In a more restricted sense, the term would be applied only to commercial or quasicommercial units, that have participation in the form of capital, or appointments to the board of directors, or both, by both government and private enterprise. Therefore, the mixed sector is composed of this last kind of mixed enterprises.

The SHC is an organisation which overlaps the mixed sector and the public sector. It can have wholly state-owned companies or mixed companies in which the state is only a partner with the private sector, and in which the state may be either a majority or minority shareholder.

The top part of Fig.1 corresponds to new projects, i.e. to the zones into which the economy can be expanded. All sectors have the opportunity to initiate new projects and, in theory, the enterprises belonging to each sector may compete among themselves.

Another important characteristic common to all SHCs is that of having within their structure some enterprises that have gone bankrupt or were on the verge of bankruptcy before being incorporated into the SHC structure.

1.4 THE HOLDING COMPANY CONCEPT

Summarizing our first approach to SHC characteristics, we have to recognize that it is not possible to give an immediately precise definition of this kind of organization. Its concept changes from one instance to another and historically it appears very closely associated with the so called IRI model.

As we have seen, an SHC is a special case, or class of cases, of the "holding company" form. Many of its features and problems it will share with holding companies in general. The concept of a "holding company" should therefore be examined.

It seems that one of the reasons why the concept of a SHC is difficult to explain derives from the fact that there is no clear concept of what a "holding" is.

The term "holding", when it is used to describe a form of company has two contradictory statements: one related to the absolute autonomy and legal status that subsidiaries have inside a "holding"; the other refers to the consideration of "holding" as a divisionalized enterprise, where a relationship does exist between subsidiaries and the parent company.

Generally speaking a "holding company" is one that has been formed specially to own other companies. For many years holding companies in US. were a means of hiding the real owners of certain firms. The holding company is in fact a passive enterprise without any real productive activity. It is mainly a development for bringing a number of firms under a common ownership and as a modern concept "it describes a purely financial institution which uses its capital to acquire controlling interests in other firms - often in different industries to give greater diversification of product - generally by taking up 51 per cent or more of their shares to form what is known as a group of companies" [13].

Although the parent company has control over its subsidiaries, it can, however, retain their original names and the goodwill attached to them. Another characteristic associated with this form of organization is known as "pyramiding", that is, the control of a huge amount of capital by a person who may possess only a relatively small proportion of it. In theory the control of a company can be obtained only through the control of 50 per cent (plus one) of the shares. In practice, because there is a certain dispersion among the shareholders, and because part of the ordinary capital may be in the form of non-voting shares, with a proportion considerably lower than 50% of the total equity capital it is possible to have control over a company. If the control over the former company is used to buy shares of another company, in turn, it is possible to control this second company despite being a minority shareholder; then it is easy to see the repetition of this process may lead to control of a larger amount of capital than is owned in the first instance.

In Fig.2 is seen the basic mechanism of the pyramidal structure.

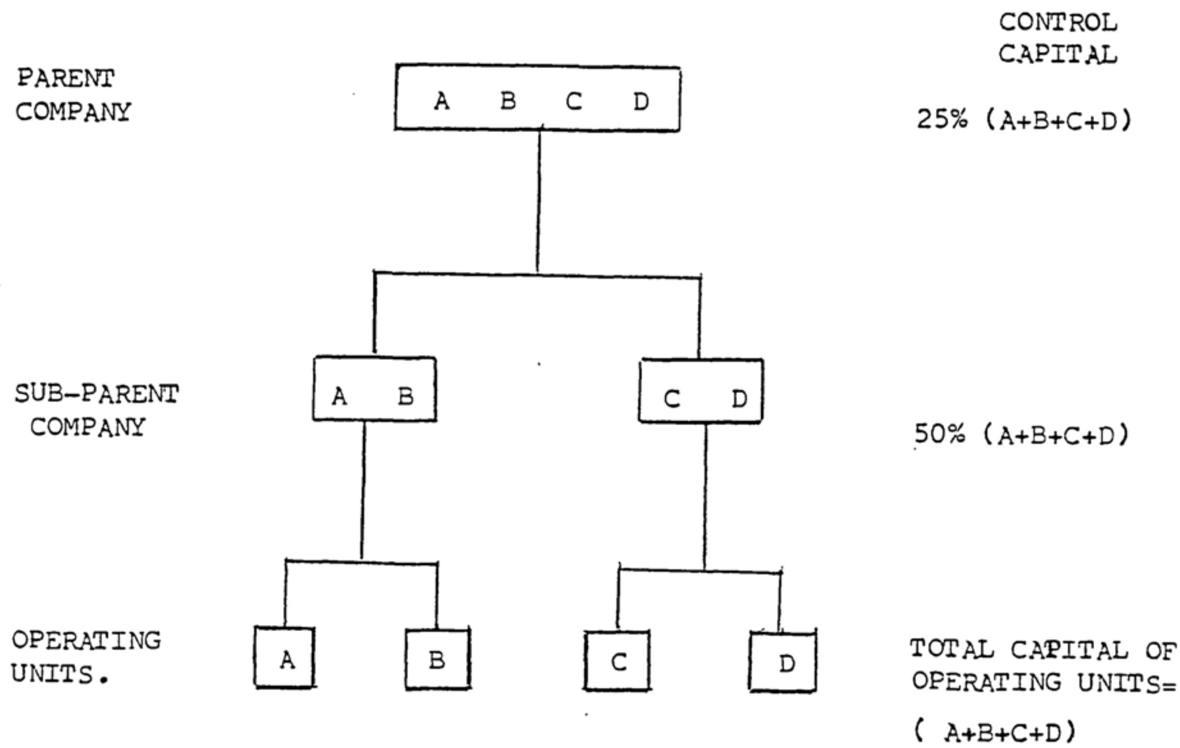


FIG. 2 CONTROL CAPITAL IN A HOLDING COMPANY

If this financial concept of a holding company were to be the only one which is valid, it would be easy to reduce this type of business organization to one office and a few clerks, just sufficient to maintain the legal fiction (as in fact happens in some holding structures belonging to the private sector).

Of course, such a limited concept cannot be applied to a state-holding company, because it can be assumed that the State does not need to maintain legal fictions or to hide its properties. Perhaps this is the reason why Statsföretag A.B. in Sweden calls itself a "group" or a "conglomerate" and has abandoned the expression "holding" [38, 1976 Annual Report].

The concept of "holding" becomes even more contradictory if, following O. E. Williamson [43], it is defined in the context of the large modern companies which are structured in the so-called multidivisional form of organisation. A thorough explanation of this kind of structure is given later in this study. At the moment, it seems to be sufficient to refer to this type of structure as one in which the large company has been divided into operating divisions, each of them being an almost completely autonomous unit, equipped with a self-contained organisation having complete jurisdiction over manufacture, sales, finance, etc., subject to control from a central authority, named "the headquarters" [44].

Williamson says that, "the holding company form of organisation is one with very limited internal controls, that is to say, with a loosely divisionalized structure in which the controls between the headquarters and the separate operating parts are limited and often unsystematic" [45, page 133].

This type of organizational form is commonly associated, in the private sector, with a risk-sharing agency. As Williamson explains, this kind of definition " is a special use of the term "holding company" and sometimes it has been suggested that this type of organisation should be referred to as a "federal form" structure. But this term has also been rejected because it poses at least as many problems" [45, page 133].

Finally, Williamson defines the holding company as a divisionalized form in which the general office (or headquarters) does not involve itself in strategic control. This definition is exactly the opposite of the IRI model, where the headquarters unit is mainly concerned with the strategic decisions.

In summary, it can be concluded that the use of the term "holding" has been an unfortunate one in the case of state-holding companies. The explanation of this misuse can be found in the fact that great importance seems to be given to the formal pyramidal structure which characterizes both the IRI structure and the holding company structure, despite the important differences in internal relationships which have been pointed out. In holding-companies the individual firms maintain their autonomy when they are incorporated in the structure. This is also the case of companies in the IRI model. But, while in holding-companies the subsidiaries have operational and strategic autonomy, in the state-holding companies they have only operational autonomy. Considering the importance of this matter the use of the term "holding" has no justification in the IRI model, particularly if it is borne in mind that there are many other types of business organisation in which the individual firms maintain their operational autonomy (among them, the conglomerates).

In fact, the relationship between the headquarters and the subsidiaries in the state-holding model is very close to the relationship between the main office and the divisions of a multidivisional corporation in the private sector.

1.5 USEFULNESS OF ORGANISATION CHARTS

However the more significant aspects of the internal organisation of a SHC are concerned less with the organisation of the separate individual companies than with the organisation of the group of companies and with the relationships between those companies. It is a fact that organisational charts can also be used to analyze the structure of holding companies, but the following difference of interpretations have to be borne in mind. When an organisation chart is related to an individual company it shows formal lines of authority and responsibility and it outlines the hierarchy of management in that company, but when it is related to a group of companies the organisation chart mainly shows a relationship of property, that is to say, the pattern of ownership of companies. In a holding company the parent company is the owner (total or partial) or has at least control over a subsidiary company. This subsidiary, in its turn, can be the owner of other companies which are, in this respect, its subsidiaries. But the relationship between parent and subsidiary is not always a hierarchical relationship. Often the companies are reciprocally and/ or partially owners of each other or partners as common owners of a third firm.

In that sense, then, the organisational chart cannot reflect the reciprocal relationships existing among the companies. Its greatest value may be to facilitate comparisons among different holding-companies and permit the user to follow the successive modifications of structure. The organisation charts to be shown in this study are subject to these limitations and these will need to be borne in mind.

1.6 A SHC DEFINITION

In this context it has to be observed that each individual company has a great deal of autonomy with respect to the other companies, yet the structure of a firm belonging to the holding structure will have some special characteristics determined by the structure of the group as a whole. A good example of this situation is the fact that where the state is the owner of the parent company this in itself affects the relationship between the management and the workers, between the firms and the customers, between the group companies and other companies of the public sector and the private sector.

Another type of holding structure is the multinational firm and here again, this particular characteristic of the group determines a general and special context for every firm belonging to the structure. The differences among firms are determined chiefly by environmental variables such as technology and markets. These differences are a part of the organisational problem of a SHC, but not the main feature of its structure. In the case of a SHC it is assumed that its activities span and embrace a great variety of enterprises; the main response of the system to these features is the co-existence of the group structure with autonomy for the operating companies.

In this respect the problem consists in the adaptation of the structure to produce an internal organisation which results in a better performance of the whole structure than could be achieved if each company were wholly independent of the group of companies.

This view of the problem reflects the concept of synergy which means the capacity of obtaining with the addition of resources from two or more firms, a better result than from the direct quantitative addition of the partial resources of each company.

Without this condition the entire concept of a SHC ought to be abandoned. Due to the complex environment in which a SHC has to act, the synegistic effect is rather difficult to achieve. The results in this field of activity are mainly the product of empirical efforts by not only IRI, but also by the SHCs in different countries. The SHC "formula" is essentially pragmatic. Even if it is true that ideology has dominated some of the applications, it is possible to analyze the results objectively and try to discover some general organisational features that have pre-eminence over other structural characteristics. However, considering that the SHC situation is very diverse (multi-sectoral, different regions and different technologies) then it can be expected that only a very elaborate mechanism of integration will be able to work appropriately in the group structure.

If at this stage of our study, we attempt to express in a compact equation the characteristics of SHCs that we have so far discussed, the resulting definition of the concept would be as in the following:

STATE HOLDING COMPANY	=	HOLDING'S LEGAL STATUS OF SUBSIDIARIES WITH MIXED OWNERSHIP	+	MULTIDIVISIONAL RELATIONSHIPS BETWEEN SUBSIDIARIES AND HEADQUARTERS

1.7 WHY THE IRI MODEL IS NECESSARY

Many attempts have been made to prove that the structural form of large and highly diversified companies is determined by certain logical or mathematical functions [43]. In the SHC's case most of the structural patterns have emerged from purely empirical and pragmatical development. What is clear is that the strategic goals assigned to SHC are interconnected with the structural features and vice-versa, these being very difficult to separate from each other, as in a 'chicken-and-egg' relationship.

This may perhaps explain Holland's [14] declaration that the main objective of a SHC is: "to create a state enterprise as efficient and dynamic as a leading private enterprise group, yet still directly serving the ends of government economic policy and the interests of society as a whole".

In that way he introduces an empirical model of organisation and simultaneously assigns to it certain strategic goals.

Using the Italian experience he assumed that the main problem that the IRI formula faced was the low investment and low growth syndrome. Holland [14] goes on to quote Pasquale Saraceno who argues that two processes in capitalist economic development determine this syndrome:

1. The competitive impulse of the growth process in a capitalist economy is restricted by monopolistic tendencies and,
2. The growth process itself may be restricted by structural deficiencies which the market mechanism alone is inadequate to overcome.

These two processes led to the necessity to create a suitable growth mechanism in order to overcome the following constraints of the market:

(a) Adequate capital may not become available for the full employment of the available labour force.

(b) Capital may be concentrated or available in some areas or regions at the expense of other areas.

(c) The overall rate of growth or level of consumption may be insufficient to ensure technical feasibility in all sectors.

Saraceno's general conclusion is that the State itself should intervene directly in key firms and sectors and assume direct responsibility for the fulfilment of investment programmes in co-ordination with the overall objectives of national planning.

Saraceno argues that the higher the actual growth rate and the better the initial intra-sectoral structure the less the need for direct intervention to ensure that the managements of the firms concerned fulfil the Government's sectoral growth targets.

As the need for capital seems to be the determining factor in constraints (a) and (b) and since a state loan policy may seem to be the most sensible solution, Holland explains that there are a number of interrelated reasons why a state loan policy may not be successful. He argues that during conditions of low overall growth of Gross National Product, "defensive" investment patterns tend to predominate. Characteristic features of these patterns are: a tendency to develop only minor process or product innovations, a tendency for the value of scrapped plants to be lower, and a tendency to avoid the higher risks in large (rather than small) innovations.

Holland [14] asserts that to secure a switch from defensive to enterprise investment patterns the loans policy may have to be on a very large scale and having serious macro-economic implications. Besides this, he writes, such a policy will also tend to be inefficient at a micro-economic level in that without detailed control of investment decision-making the Government will not be able to ensure that all loans result in enterprise investment, rather than the underpinning of poorly structured firms and the continuation of defensive investment patterns.

Later on he makes a comparison between the process of nationalisation of some economic sectors and the IRI formula, arguing that the former is concerned mainly with the basic industry and services - i.e., steel, fuel and power, transport, communications, insurance, banking, etc. - that mainly play a passive economic role. In contrast, the IRI model has to do with intermediate manufacturing, with mechanical and electrical engineering, with electronics, chemical products, plastics, etc. - that is to say, with "entirely new" sectors.

1.8 THE MULTISECTORAL STATE ENTREPRENEUR

Holland [14] considers that state enterprise within several firms in inter-related sectors can ensure that an intra-sectoral, capacity increase is matched by increased inter-sectoral demand. In this way he moves from strategic to structural considerations and he argues in favour of a conglomerate organisation with high diversification but with an integrated corporate plan. All these are ordinary concepts widely applied in the large private corporations. However, what is unusual is the way in which the argument continues, as Holland adds: "When the State controlled sector-leader moves, the others also move or risk loss of market share".

(Perhaps a good example and also evidence for this argument can be seen in the fact that when NEB started its micro-electronics project

"INMOS", another private company decided to go into the same business).

The importance given in this analysis to the multisectoral character of the IRI model is so great that it has to be considered as the main factor in the strategic and structural design of the company. The character of a multisectoral group such as IRI which is engaged in manufacturing and production rather than finance alone, enables it not only to draw at short notice on first-rate management but also to use its own experience in a variety of activities to determine the type of production into which the plant concerned could most easily be diversified. Linked with this point there is a strong argument in favour of the holding company structure in that it enables the organisation to cope with the institutional problem of providing a corporate framework within which plants can operate. In some cases where it involves firms with several plants, it can allocate different activities to different companies in order to maximise their diversification and growth potential. In some cases, where the group has no previous company in a given field, the brand name of an existing and successful company can be extended to the new activity, with the plant brought into the parent company or its financial holding. This is another good example of structural and strategic arguments being closely interwoven.

Accepting the advantages of the holding structure to manage this kind of problem, it might be questioned in this context whether multisectoral state entrepreneurship on the basis of public ownership of <u>some</u> rather than <u>all</u> firms in a given sector needs to be entrusted to a single state-holding company (such as IRI or the Stateförestag) rather than to several such holding companies or single corporations controlled vertically by the national planning departments.

There are strong arguments, following from Holland's considerations, against fragmenting IRI type state enterprise on a single sector basis.

First, one of the main gains from the IRI model in practice has been the mobilisation of enterprise investment in given sectors without state ownership of a large proportion of the companies in the sector concerned, or of the total shareholding of those companies in which IRI holds shares. This frequently depends upon the knowledge of private shareholders that the small ownership concerned is backed up by the larger resources of the multi-sectoral state conglomerate.

Secondly, while given sectors may have certain administrative convenience in the sense that they conform with national accounting definitions and therefore facilates co-ordination of planning objectives with the statistical services at the disposal of the planners, they make less sense in the context of management under modern competitive conditions. The survival and growth of the leading private companies in market economies has to a large extent depended upon product diversification and spin-off effects which overlap statistical sectoral boundaries.

To limit state enterprise where competition from the private sector is unrestricted would be to limit the potential of state entrepreneurship itself.

This could be a very powerful consideration in countries where the civil administration is excessively bureaucratic and tries to impose upon the state production system statistical or accountancy rules that militate against rational management. Once again note must be taken of the efforts made to eliminate from the IRI model any limitations or attitudes that might destroy the good private corporate features.

Thirdly, there is the question whether a trained planning official can also be a trained entrepreneur. In practice this is possible if the officials concerned spend some years with operating units and learn the mechanics of management at first hand - this may also assist them in establishing liaison with state or private entrepreneurs. But a planning official cannot simultaneously fulfil his responsibilities as planner and secure continuous information on the management of a particular enterprise. In all probability he will be able to do one job well at the expense of the other, or both jobs badly. The possibility of overcoming these problems and establishing a team of experienced managers ought certainly to be larger within a diversified and multisectoral organisation. However, problems arising from the relationship between the central government departments and the SHCs, that is between civil servants, planners and statisticians and the management team of the SHCs are permanent and particularly intractable.

The NEB experience has been difficult in this respect. Sir Leslie Murphy, its former Chairman, maintained as a basic principle to be accountable only to the Minister, arguing that its actions must be absolutely free of any political interference. But in reality a certain range of political pressures is always involved in state organisations. The NEB case has been aggravated by the fact that in the UK the legal system is one of the most restrictive among modern countries. Legislation has been necessary to put into effect every deed of nationalisation that has involved the forced transfer from private to public hands of industrial and commercial assets. As we will see later (Chapter IV) this could be one of the reasons why the

NEB pattern does not fit well in the IRI model we have described. What we will discuss in the next chapter are the structural alternatives that are open within the SHC model and the experience accumulated in the cases we have studied.

CHAPTER II

STRUCTURAL PATTERNS IN A SHC

2.1 METHOD AND REFERENCES

Since we have argued in Chapter I that the basic structure of a successful SHC has to correspond very closely to a multidivisional form, we will now consider the structural features that could be incorporated beneficially into a multidivisional framework. Little theory of significance can be found in the literature which relates directly to SHCs. For that reason, in our analysis, we have examined sources that have to do with the design of organisations in general - mainly of those assumed to be in the private sector - and we have tried to adapt their methods and analysis to the SHC case.

The books "Design of Organisations" by Khandwalla [20] and "Designing Complex Organisations" by Galbraith [9] have been utilized as the chief sources of reference for this part of the study.

2.2 KHANDWALLA'S MODEL

Khandwalla has developed [20] a model of organisational functioning which has been used for the understanding of complex organisations and hence for application in organisational design.

The model, which is shown in Fig.3 combines system and contingency approaches, i.e. it is possible to identify within the structure a number of organisational components or subsystems that permit the organisation to function efficiently. Furthermore, the organisation is seen as being influenced heavily by its markets, its technology and the culture within which it operates. Since these factors vary widely, so must organisational structures and processes.

In the case of SHC these subsystems could be complete companies: subsidiaries or associated firms.

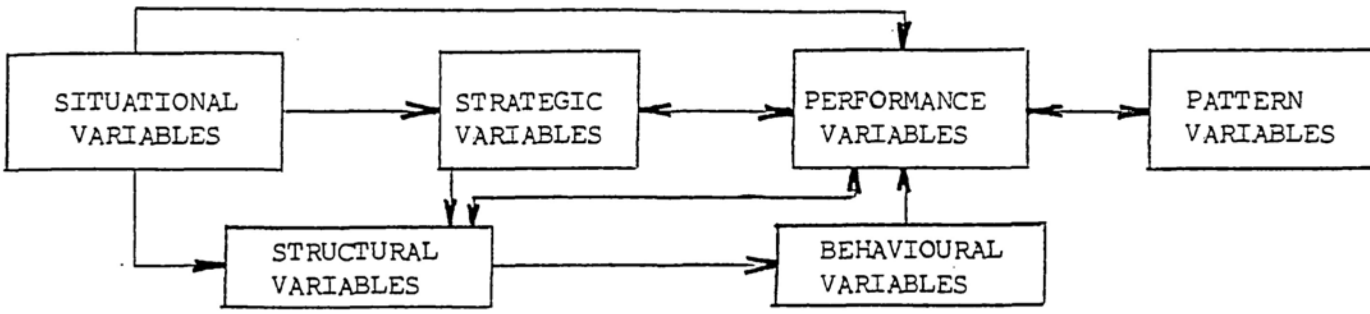


FIG 3 KHANDWALLA'S MODEL

The model postulates five classes of variables namely: situational, strategic, structural, behavioural and performance variables. The so-called "pattern variables" shown on the right side of the figure correspond to congruences or appropriate combinations of the other variables. It is not an additional class of variables.

Thus:

I) Situational variables cover:

1. External environment - (all contingencies originating outside the organisation): the type of economic system and market structure, the political system regulating the organisation, etc.
2. Demographic variables - (the principal ways in which a population of organisations may be classified): organisational size, age, nature of ownership, and the nature of output (product versus services).

II) The strategic (or policy) variables: (those that commit the organisation as a whole to a course of action), organisational goals, top management ideology and style.

III) The structural variables (those that form the skeleton of the organisation):

1. The superstructure of the organisation, the way people are grouped into departments or subsystems, technology, workflow, hierarchy, etc.
2. The infrastructure of the organisation, the system of control, staff functions, formalisation of communications, etc.

IV) The behavioural variables (the actual behaviour that takes place within an organisation) conflict, cooperation, innovation, motivated behaviour, alienation, etc.

V) The performance variables represent dimensions in terms of which the organisation's performance is evaluated from within or from outside the organisation. The more common variables are: efficiency, rate of growth, degree of market or community acceptance.

Like all other models of organisational functioning, this model is only a highly simplified version of an extremely complex reality. It is useful to the extent that it provides a framework for a systematic approach to organisational design. The model does not therefore embrace all possible variables that affect organisations. For example, it omits variables related to the geographical location or organisations, variables which could be important in the case of a SHC with a compulsory regional allocation of resources. But Khandwalla accepts that the research and conceptual base is lacking at present to integrate these variables into organisation theory.

Taken as a whole, the model incorporates the system and contingency viewpoints in particular. The organisation is viewed as a system of interacting parts, open to the environment and shaped by situational variables.

The model has been built treating causality, for the most part, as unidirectional. Of course, this is simplification, because in real life causality often runs in both directions between variables. But it can be assumed that the influence is stronger in one direction, and weaker in the opposite direction, so the arrows, in the figure, where they are unidirectional, show the direction of net influence.

It should be pointed out also that the arrows in the figure indicate no more than lines of influence, because all organisational research to date indicates that relationships between variables are stochastic or probabilistic in nature rather than exact or deterministic. Thus, the most that one can say is that if certain changes are made in, say, the situational variables, certain other changes in strategic and structural variables become more probable.

This characteristic of the model is particularly important, as a limitation, in the case of SHCs because as was mentioned in the introductory chapter with only a few cases of a phenomenon (i.e. here of SHCs) it is dangerous to use a probabilistic criterion. In contrast, a powerful feature of the model is that it applies to all the levels of an organisation: to the overall organisation, and to any department or division that shows the characteristics of an organisation. In the case of a SHC, in particular, the model can be applied between the different companies, between the parent companies and the subsidiaries of the same subsystem, or between operating companies and at any staff level existing in the organisation. However, it has to be pointed out that when applying the model to any given level, the remainder of the organisation constitutes a part of the so-called external environment or context of this division or operating company.

What this implies for organisational analysis is that to study an entire organisation that organisation must be studied at its highest levels first. What is found at its highest levels becomes a datum in the study of the next highest level, and this process, carried far enough, gives a much fuller understanding of the functioning of all the levels of an organisation.

2.3 THE MODEL APPLIED TO A SHC

Fig.4 shows the major situational variables (as in Khandwalla's general model) which arises in the SHC case.

In Fig.5, we have incorporated the situational variables already developed (as in Fig.4) into the overall model showing the remaining variables, i.e., the strategic, the structural, the behavioural and the performance variables. Fig.5 has been drawn in such a form that only variables that lie below the central level indicated bv the "strategic variables" rectangle, are independent variables, i.e. can be changed by the SHC's Board. It can also be seen that practically all the variables have a direct or indirect influence on performance.

Since the situational variables are more or less self-explanatory and

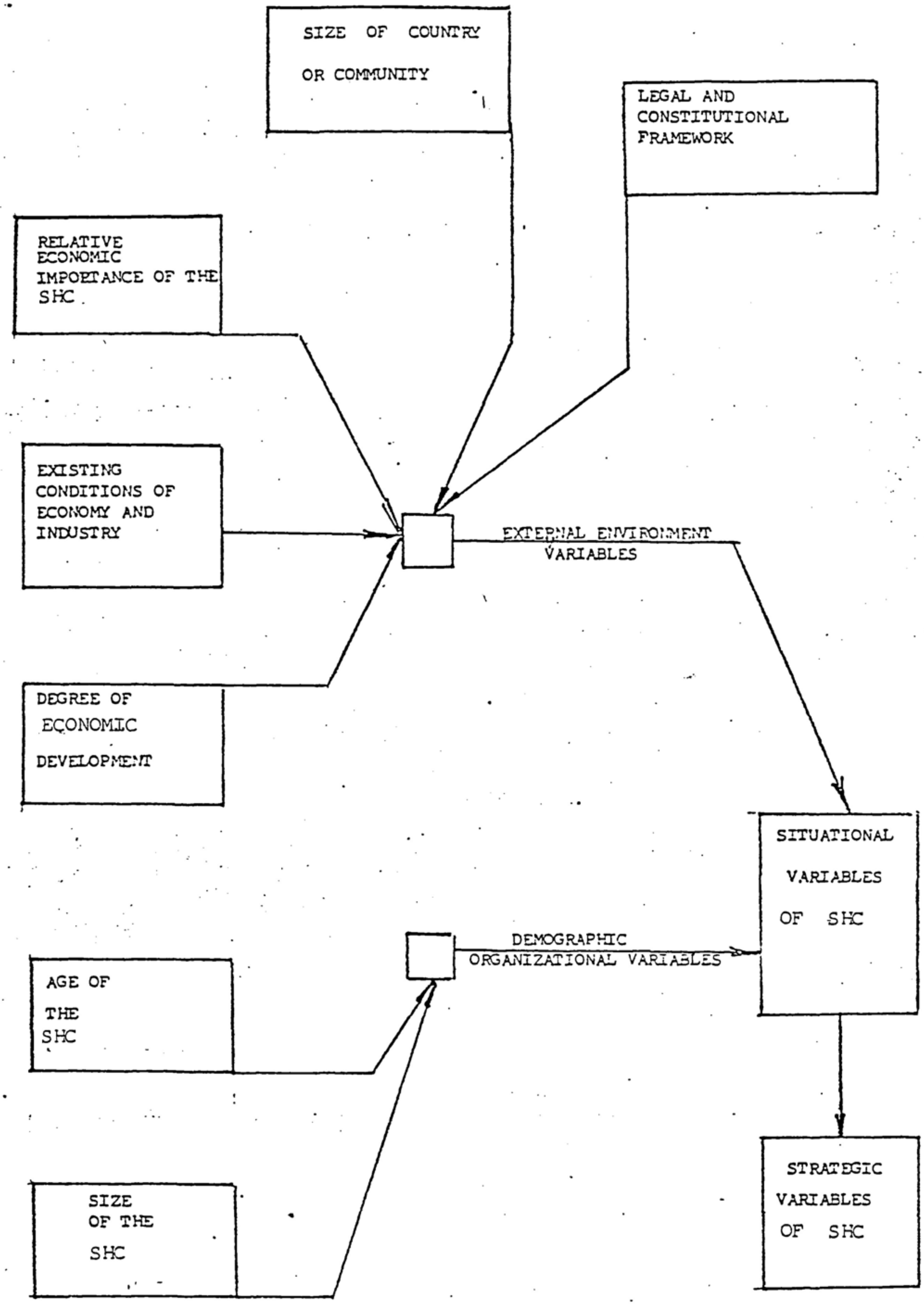


FIG.4. SITUATIONAL VARIABLES IN A SHC

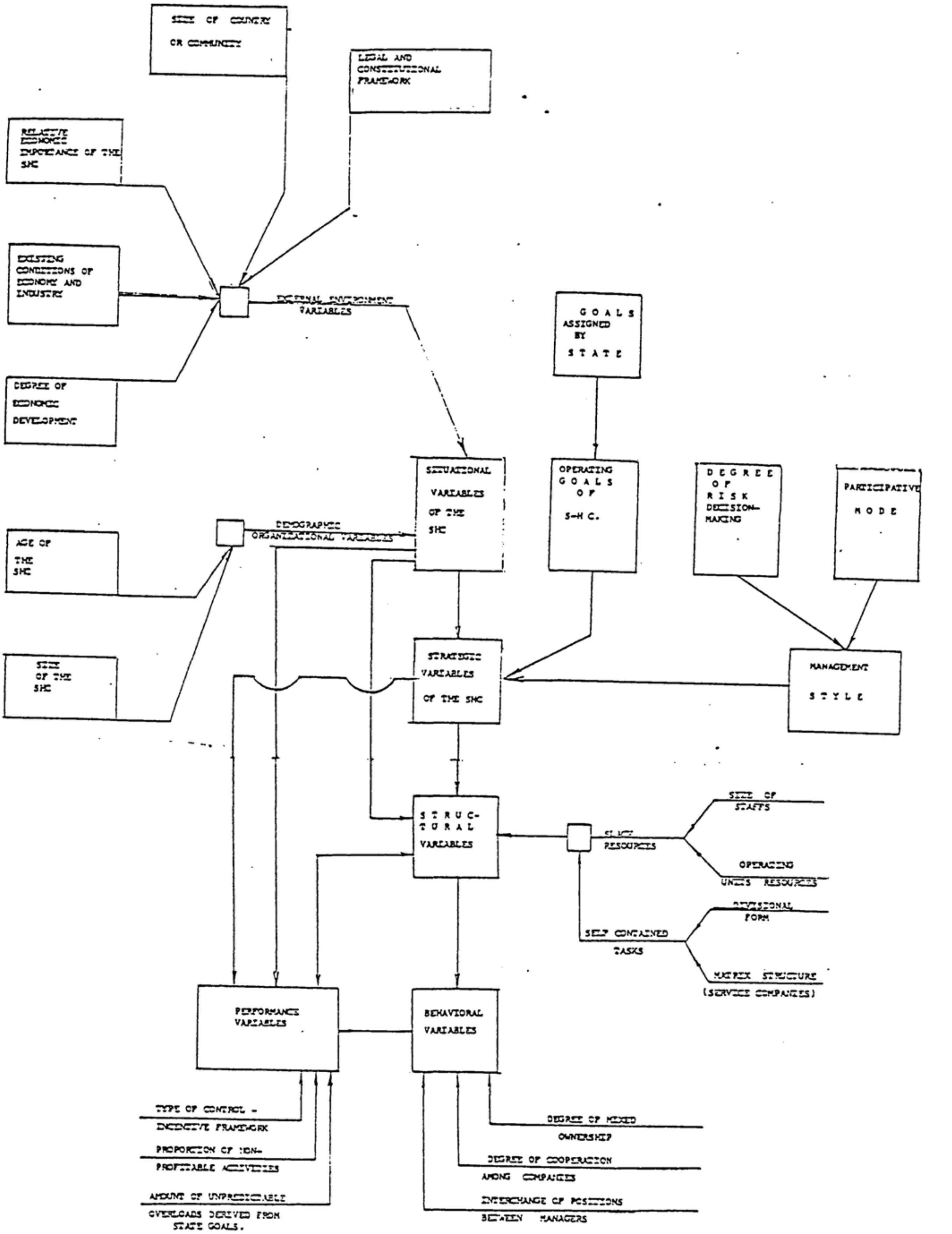


FIG.5. A STATE HOLDING MODEL BASED ON KHANDWALLA'S STRUCTURE

we have discussed already the strategic variables in paragraphs 1.7 and 1.8, we will concentrate on the analysis of the structural variables.

We have utilized Galbraith's method to develop those variables, and they will be explained following his analysis.

2.4 GALBRAITH'S DESIGN METHOD

Galbraith [9] starts his analysis by asserting that the basis of his design framework is the proposition that "the greater the uncertainty of the task, the greater the amount of information that has to be processed by decision-makers during its execution, in order to achieve a given level of performance".

Uncertainty is defined as the difference between the amount of information required to perform the task and the amount of information already possessed by the organisation. The amount of information needed to perform a task is a function of:

1. The diversity of the outputs provided, as measured by the number of different products, services or clients.
2. The number of different input resources utilized as measured by the number of different technical specialities in a project, the number of different production centres in the organisation, etc., and
3. The level of goal difficulty or performance as measured by some efficiency criterion such as percentage of factory utilization.

The greater the diversity of outputs, number of resources, and level of performance, the greater the number of factors and interactions between factors that must be considered simultaneously when making decisions. These concepts of uncertainty and information are the basis of contingency theory, because they are the key variables on which the design of an organisation is contingent.

Galbraith establishes that to reduce the uncertainty some decisions have to be made in order to specify rules, programmes and procedures in large and complex organisations.

In the SHC's case, these decisions and definitions are generally taken by Government or parliament, when the organisations are set up.

In this case also some sort of hierarchy is established simultaneously with the company's foundation - generally in the form of a Board or a collective body whose Chairman is the top manager of the organisation. This Board usually takes some initial decisions to set up the rest of the main hierarchical framework.

As Galbraith explains, the next task is to set the strategic goals of the organisation, a problem that has already been discussed in this study. In general the process of goal setting is accomplished by the Statutory body, in a formal way. The Minister or the Head of Department concerned with the SHC gives a more concrete and operational form to these purposes. In Galbraith's opinion the ability of an organisation to coordinate its activities successfully by goal setting, hierarchical structure and rules depends on the combination of the frequency of exceptions to these latter and the capacity of the hierarchy to handle them. As task uncertainty increases, the number of exceptions increases until the hierarchy is overloaded, at which point the organisation must employ new design strategies.

It can act in either of two ways: reduce the amount of information that is processed, or increase its capacity to handle information. It may also choose to develop in both of these ways. The two methods for reducing the need for information and the two methods for increasing processing capacity are shown schematically in a figure below:

1.- RULES AND PROGRAMS
2.- HIERARCHICAL REFERRAL
3.- GOAL SETTING

4.-CREATION OF SLACK RESOURCES

5.-CREATION OF SELF -CONTAINED TASKS

6.-INVESTMENT IN VERTICAL INFORMATION SYSTEMS

7.-CREATION OF LATERAL RELATIONS

reduce the need for information processing

increase the capacity to process information

FIG.6. GALBRAITH'S ALTERNATIVES

The effect of all these actions is to reduce the number of exceptional cases that has to be referred upward into the organisation through hierarchical channels.

2.5 CREATION OF SLACK RESOURCES

An organisation can reduce the number of exceptions that occur simply by reducing the required level of performance. This means that within an organisation it is possible to have more resources than just those elements that are strictly necessary to optimize every producing unit.

Resources can be man - hours, quantitative or qualitative allowances, times, etc. If the situation is such that more resources could in fact be consumed, then these additional resources are called slack resources.

Slack resources are an additional cost to the organisation, to the customers, or to the state. However, the longer the scheduled time available for meeting a certain target, the lower the likelihood of this target's being missed. The fewer the exceptions to operating rules, the less the overload on the hierarchy. Thus, the creation of slack resources, through reduced performance levels, reduces the amount of information that must be processed during task execution and prevents the overloading of hierarchical channels. Whether the organisation chooses this strategy depends on the relative costs of the other strategies for handling the overload.

This slack resources strategy is a very important feature for use in SHC structure. As was explained, the amount of uncertainty in the IRI model can come from two main sources: One is common to any commercial company that depends on a market to sell its products or services. Market fluctuations introduce a degree of uncertainty in performance. Thus, the structure has to have a system of adapting by itself to overcome changes in the environment. SHCs have a second and unique source of uncertainty: State decisions about the incorporation of new companies in the holding structure, decisions which change short-term or long-term goals, or decisions to invest some fixed amount or percentage of the equity capital in a certain region or in a certain branch of industry.

Sometimes the SHC can reject a proposition coming from Government, or at least can dispute with the Minister or the Head of the department concerned. But sometimes such impositions are compulsory and the opinions of the group, or the functionaries directly linked with the organisation have no weight.

As a result of the former considerations it is uncertain how many directives for or other compulsory actions the SHC will receive. From the group point of view to have a structure prepared to receive such an overload is the only effective response to this uncertainty.

To take over a new company with financial, personnel, manufacturing and organisational problems, involves either having the capacity to solve the problems quickly or to incur the risk of handicapping the group structure with the losses of the "lame duck" company over a long period.

If the country is rich enough in managerial and other resources, perhaps this type of service can be provided quickly and all that the SHC would need might then be a small team capable of taking the necessary decisions and the financial resources to keep the new company working until the rescue measures are implemented. Apart from financial resources, slack resources would be required in this case only among the headquarters decision-making personnel. Finance could be replaced by some borrowing capacity from the banking system or from central government institutions. However, if the country does not have enough managerial or other necessary resources, or if adequate resources exist but they cannot be employed easily and quickly, then the SHC has to maintain these kinds of resources within its structure.

The actual problems are then: What types of resources should be maintained and, where in the organisation can these resources be 'stored'?

The first problem is not a structural problem and will be discussed later.

The second question is indeed a structural matter and a brief analysis will be attempted in this chapter.

One alternative is to accumulate resources in the parent company organisation. This solution leads to a large headquarters staff and may correspond to the so-called unitarian or functional type of corporation, or to a divisionalised form of organisation with an over-sized support staff. In either case, if the SHC is a large corporation, the concentration of staff in one unit will cause structural problems.

Two other possibilities remain: (1) to concentrate resources in the staffs of subholding systems, or (2) to concentrate resources in companies specifically designed for this purpose.

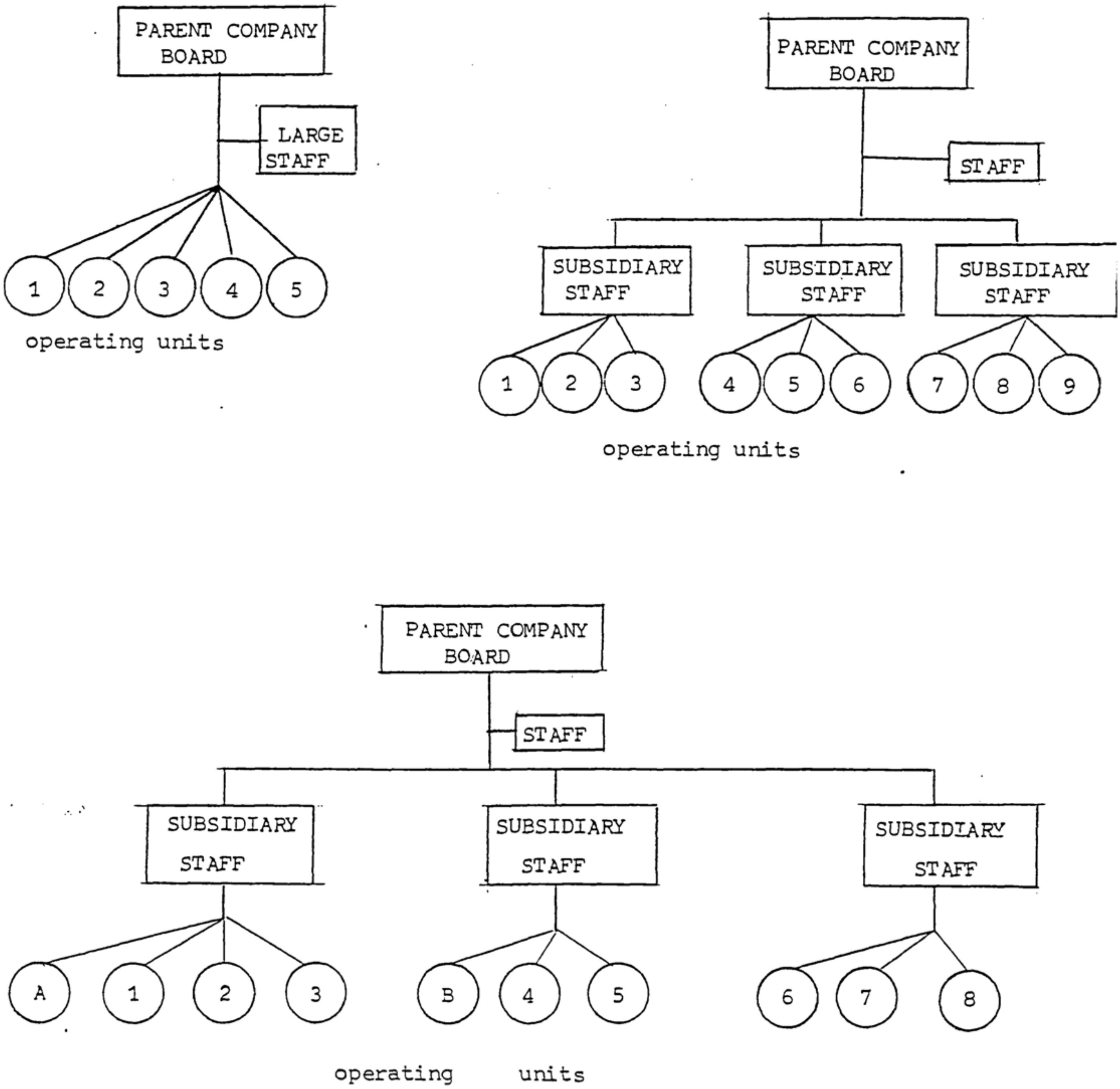
Solution (1) pre-supposes a divisional organisation in which the SHC has given the operational units a certain structure, arranging them according to certain criteria (regional, complementary outputs, markets, integration of production, etc.). Resources are no longer concentrated in one centre of the company, but de-centralized in each sub-holding staff.

In some respects this is a better solution but it involves certain difficulties when an attempt is made to put the system into practice. One problem is related to the great variety of resources that could be needed and the necessity of coordination among them. Assuming that only three different types of resources were required, e.g. management services, engineering man-hours, and some special machine-hours, it would be very difficult to device a system where, at staff level, the incidence in time of the demands for resources could be co-ordinated in ways which avoid overload but use the resources intensively. The other problem is derived from the difficulty of obtaining high efficiency and performance, in an organisation that is not set up as an enterprise; that is to say, where its outputs cannot be sold at market prices. In general, the costs of a staff unit have to be allocated as overheads among the companies concerned, and the greater the scale of these services, the greater the dissatisfaction among the operating units derived from costs that they do not control themselves.

On the other hand, the nature of staff work does not allow to provide services outside the holding company, and if the operating units do not need or do not ask for the services, the staff activity becomes idle. These considerations seem to suggest that the amount of resources situated at staff level in the sub-parent companies, has to be reduced; however some resources can be placed there without major problems.

The solution (2) is to put the resources into operating units having the form of normal productive organisations. These are compelled to obey certain performance rules and efficiency criteria, accepted both by the parent company and by the companies using the services. Two structural alternatives exist for this scheme: to choose or to set up one particular enterprise to provide a special service to the others, or to extend a part of an enterprise beyond normal requirements in such a way that by using the excess capacity the service can be provided to the other companies.

From the structural point of view this brief description of the slack resources problem is adequate for understanding the alternative design solutions that can be found in practice. Fig.7 represents the structural alternatives already explained.



Companies A and B have slack resources.

FIG 7 SLACK RESOURCE ALTERNATIVES

2.6 CREATION OF SELF-CONTAINED TASKS

The second method for reducing the amount of information processed is implicit in the previous explanation, because it consists in changing from the "functional task" design (the so-called "unitarian form") to one in which each group has all the resources it needs to perform its task. What is attempted with this type of structural design is to have a divisional form of organisation in which each division or part of the group would contain the input resources necessary for its goals. The strategy of self-containment seems very reasonable when applied in a corporation or in a part of a large corporation where diversification is not too wide. In that case, each operating unit would have its own production facilities (machines, product engineers, process engineers, assembly operations, etc.). However, when this strategy is designed to be suitable for a large highly diversified corporation, with a conglomerate structure, the problems are far more complex.

In order to explain the possibilities of this kind of structure for SHCs it is necessary to consider the mechanisms through which self-contained units reduce the amount of information that needs to be processed.

First it reduces the amount of output diversity faced by a single collection of resources. For example, a professional organisation (a project engineering company) with multiple skill specialities that provides services to three different groups must schedule the use of these specialities across three sets of demands for their services, and must determine priorities when conflicts occur. If the organisation changes to three separate groups, one for each client category and each with its own full complement of specialities, the schedule-conflicts across client groups disappear, and there is no need to process information to determine priorities.

Relating this advantage to SHC's structure suggests that self-contained units are more suitable if there already exists a divisional organisation in which groups have been thought of in advance, in such a way that self-contained units can be set up with some degree of specialization. If groups are organised without the appropriate criteria, for instance using vertical integration criteria useful for transport or tax reasons, then the advantage of self-contained units could become very dubious.

The second source of information reduction occurs through a reduced division of labour. The functional or resource specialized structure pools the demand for skills across all output categories. In the above example of a project engineering group, each client (perhaps individual firms of the conglomerate) generates approximately one-third of the demand for each skill. Since the division of labour is determined by the extent of the market, the division of labour must decrease as the demand decreases. In the professional organisation each client group may have generated a need for one-third of a computer programmer, or of a planning engineer, etc. The functional organisation would have hired one programmer or one engineer and shared him across the groups (or subsidiaries). In the self-contained structure, there is insufficient demand in each group for the programmer or the engineer, and so the professional organisation must do its own programming or engineering work. Specialization is reduced but there is no problem of scheduling the programmer's or the engineer's time across the three possible uses for it. In this sense, reduction of specialization (the self-contained strategy) seems to be unsuitable for the SHC structure. Nevertheless, if it is possible to design a system which combines specialization with sharing of demand among many companies in the group, the advantage of functional form could be achieved together with the advantage of specialization. This suggests that a matrix form (which will be treated later in this study) could be adapted to the SHC structure.

In any case, the two strategies already described, i.e. slack resources and self-contained units, reduce overloads on the hierarchy by reducing the number of exceptions that occur. The reduction occurs by reducing the level of performances, diversity of output, or division of labour.

Due to the particular characteristics of a large SHC, these strategies could lead to some very special forms of internal service units, which can be considered the central matter of this study (see Chapter 3).

The other two strategies identified by Galbraith take the required level of information as given, and create processes and mechanisms to acquire and process this information, during task execution.

2.7 VERTICAL INFORMATION SYSTEMS

The organisation can invest in mechanisms which allow it to process information acquired during task performance without overloading the hierarchical communication channels.

The following logic underlies this mechanism:
After the organisation has created its plan, or set of targets for production, budget and schedule, unanticipated events occur which generate exceptions requiring adjustments to the original plan. At some point, when the number of exceptions becomes substantial, it is

preferable to generate a new plan, rather than make incremental changes in the old one with each exception. The main issue is then how frequently plans should be revised - yearly, quarterly or monthly? The greater the uncertainty, the greater the frequency of replanning. But the greater the frequency of replanning, the greater the resources, such as clerks, computer time, input-output devices, etc. that are required to process information about relevant factors. Providing more information more often may simply overload the decision maker.

Investment may be required to increase the capacity of the decision maker by employing computers, various man-machine combinations, assistants, etc. The cost of this strategy is the cost of the information processing resources. The aim of this investment strategy is to collect information at the points of origin and direct it to appropriate places in the hierarchy. This strategy increases the information processing at planning time while reducing the number of exceptions which have overloaded the operational hierarchy. In a SHC structure this strategy is not only recommended, but seems absolutely indispensable, given the high degree of autonomy of the subsidiaries. The existence of a general plan, the collection of information at operating unit levels and the selection and re-collection of information at sub-parent level provides a control system for the whole group structure, and seems to be the main device for achieving its goals and avoiding "anarchic" behaviour among its constituent firms.

In SHCs, as in any large and diversified corporation, there is a strong tendency to make plans that deal only with quantitative aspects. However, in strategic problems qualitative factors are very important and sometimes dominate decisions. Plans necessarily assume some conceptual model of the organisation and in general in SHCs there are both financial and non-financial models underlying the main plans. But some auxiliary plans and models are also designed to evaluate special projects, such as new ventures and acquisitions.

The formulation of financial plans and models is not the only type of planning needed in a state-holding company. Information about labour force, raw materials, investments, etc has to be used in a similar way to try to coordinate the efforts and performance of the autonomous operating units, and at the same time, to reduce the amount of data at each level, until no more than the main indispensable information reaches the top staff.

However, the more diversified the group is, the more the financial flows are the only common flows that link every part of the system with the rest of the structure. Money has proved to be the unique variable that connects operating units, sub holdings and the main parent company. Financial plans and financial data are the main source of information in large corporations not only in the vertical information system, as Galbraith points out, but also as a very important feature that connects the group to the external environment (the markets).

2.8 CREATION OF LATERAL RELATIONS

The last design strategy described by Galbraith is to employ lateral decision processes which cut across lines of authority. This strategy moves the level of decision making down to where the information originates rather than bringing the information up to the points of decision. This decentralizes decisions, but without creating self-contained groups. Several mechanisms can be employed, depending upon the level of uncertainty facing the organisation. The simplest form of lateral relation is direct contact between two people who share a problem. If this system is adapted to a SHC, it entails direct contact between two companies of the group. Direct contact avoids the upward referral to another part of the system, and removes overloads from the hierarchy.

In some cases there is a large volume of contact between two subsystems or two companies of the group. Under these circumstances a new role, a liaison role, may be created to handle the intercompany contacts. As tasks of higher uncertainty are encountered, problems are detected which require the joint efforts of various units of the group. Rather than refer the problem upwards, the top managers of these areas form a task force or team to resolve the issue jointly.

In this manner "inter-unit group problem-solving" becomes a mechanism to decentralise decisions and reduce hierarchical overload.

As more and more important decisions are made at lower levels of the group, through inter unit mechanisms, problems of leadership arise. The general response is the creation of a new role, an integration role.

The function of this role is to represent the general manager in the inter-unit decisions for a particular set of companies. In the SHC context these roles are accomplished by representatives of the present company staff who transmit and represent the higher level point of view to the operating units. However, the role can be accomplished by the sub holding parent company as a whole, if the group structure has been designed appropriately. After the role is created the issue arises of how much and what kind of influence the role needs in order to achieve adequate integration for the given task, without impeding individual companies' autonomy. Mechanisms ranging from supporting information and budget control all the way to dual reporting relations and "matrix design" can be employed. These integrational forms can adopt very specific structures when they are implemented in the SHC context, but as was mentioned before, the general tendency is to create autonomous and specialised units, i.e. setting up complete firms. In that way the lateral contacts are institutionalised, and can be subject to common rules of control and performance.

2.9 CHOICE OF STRATEGY

Galbraith points out that an organisation can choose to follow a single strategy or some combination of several strategies if it chooses. It is important to note that Galbraith's four strategies are hypothesized to be an exhaustive set of alternatives. Whether the organisation is faced with greater uncertainty due to technological change, higher performance standards, increased competition, diversified product range to reduce dependence, or compulsory expansion because of Government decisions, the amount of information processing is increased. The organisation, concludes Galbraith, must thus adopt at least one of the four strategies when faced with greater uncertainty. If it does not consciously choose one of the four, then the first, reduced performance standards, will happen automatically.

When the three state-holding companies are compared later on, this important conclusion will be discussed in a more concrete context and its worth clearly revealed.

The task information requirements and the capacity of the organisation to process information are always matched. If the organisation does not consciously match them, reduced performance through budget overruns or schedule overruns will occur in order to bring about equality. Thus the organisation structure should be planned and designed simultaneously with the planning of the strategy and resource allocations.

But if the strategy involves introducing new products, new industry branches, entering new markets, etc. then some provision for increased information must be made.

This seems to be particularly true in the SHC case. As Galbraith ends his summary of the subject: "Not to decide is to decide, and it is decided upon slack resources as the only strategy for removing hierarchical overload".

This study tries to demonstrate that the "slack resources" strategy is not simply the least undesirable solution, but the only practical solution for state-holding groups. It concludes further, that due to the particular features of the model, else "slack resources" need not entail a reduced level of performance if (and only if) appropriate structural rules are followed in the whole model.

Since the holding structure we have discussed permits the coordination of companies with a permanent and autonomous status, it can be anticipated that permanent companies could be set up, being independent and self contained units, but specializing in support activities, such as could improve the performance of the group as a whole. This mechanism will be discussed more fully in the following chapter.

2.10 DIVISION OF LABOUR AND SPECIALIZATION OF FUNCTIONS

The primary function of the division of labour and specialization in corporation is to permit a variety of activities to be executed efficiently. The secondary function of these activities is to interconnect the diverse activities of the organisation, particularly through programs that link activities together.

Analyzing the SHC case it must be observed that "specialization" has a particularly restricted meaning for the companies which constitute the group. In any modern enterprise there is a large number of activities and different types of work, that are indispensable for the functioning of the firm. A company where only one kind of work was done could not operate. The more simple is the work done, the more difficult it is to organise a whole company based on that kind of work. If specialization of functions and division of labour are to have any meaning within a conglomerate type of organisation, then they must mean that the output of a company within the conglomerate (or rather an operating unit) has to be concentrated in a narrow field of production or services. This concept is exactly the opposite of diversification of functions, or of production. In a conglomerate it is the group which is diversified.

The members of the group - the operating companies - can be structured mainly according to technological or other factors, but without any serious consideration of diversification as a means of protecting one individual company against market fluctuations. Some complementary activities to the main activity can be carried out in a company as a way of improving the overall capacity in staff, machinery, warehouses, transport equipment, etc. However, these complementary activities are subordinated to the main activity, which is the subsidiary's specialization. The important point then, is that in a SHC each firm has a well defined functional specialization and that this specialization permits the company to associate with other companies of the group, thereby creating a sub-group of companies, that can in turn be structurally associated with other sub-groups, and so on. That feature of holding companies which combines specialization of each enterprise with the grouping together of similar or related functional companies, creates bigger sub-systems, and is the characteristic that permits the integration and co-ordination of the whole group.

2.11 HIERARCHY OF AUTHORITY

As was mentioned in Chapter I the concept of hierarchy does not apply easily to SHCs because it is more suitable to individuals than to companies. The concept of delegation of authority is more appropriate.

Hierarchy - meaning that one who is in a lower position has to obey orders from above - is not a particularly helpful concept in the study of holding companies. However, there is a feature of organisational theory related to the concept of hierarchy that is useful. This is the pair of concepts "tall" and "flat" relating to the number of management levels in an organisation. These concepts are easily understood when applied within a company as can be seen in the diagrams below:

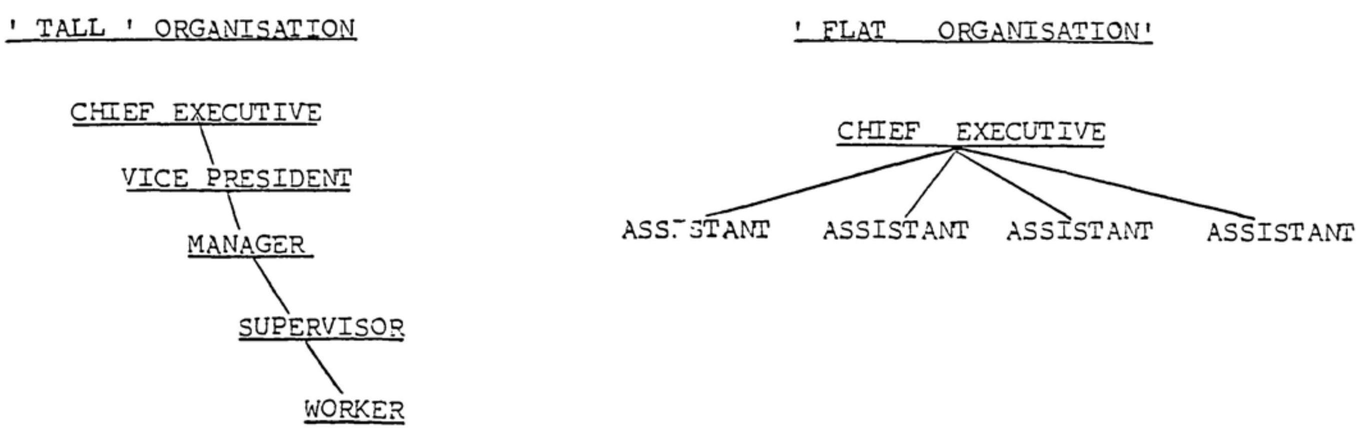


FIG.8. TYPES OF HIERARCHY

Clearly, if the number of organisational members is hold constant, the larger the number of management levels (i.e. the larger the vertical span of control) the lower is the average horizontal span of control, and vice versa. In a sense, hierarchy within an individual company is an integrative device and is important for coordinating the diverse work of subordinates.

An important question is whether this concept has any definite meaning when applied to a group of companies that constitute a holding company.

It appears from diagrams of structural relationships between companies, to be similar to the concepts of "flat" and "tall" organisations:

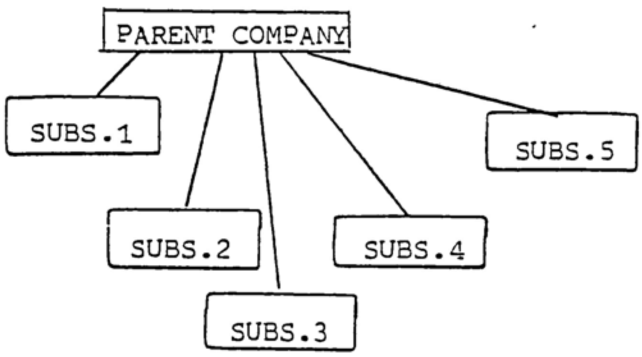


FIG.9.
FLAT ORGANISATION

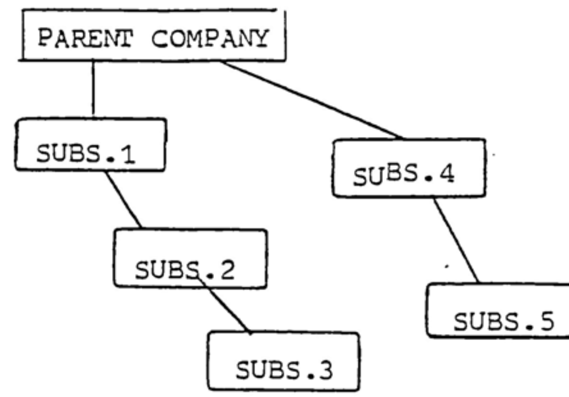


FIG.9a.
TALL ORGANISATION

The meaning of Fig.9 "flat diagram", is that every subsidiary is directly linked with the parent company. That is to say, the parent company owns a capital share in each subsidiary, and of course, designates Board members to every company of the group. This idea has nothing to do with hierarchy as ability to give orders, because the parent company can be a minority shareholder, and may have to discuss its ideas with other partners. However, it may appoint its representatives in subsidiaries directly and, also, may argue directly in favour of its ideas in the Boards.

In Fig.9a is shown a "tall" organisation". The parent company is the direct owner of only two subsidiaries, these in turn are the owners of other companies, and so on.

The importance of this infrastructure does not arise from the percentage of ownership that the parent company needs to keep the subsidiaries under control. In either system the parent company may be either a majority or a minority shareholder.

The importance lies in the fact that it is also possible to delegate authority among companies by means of the designation of Board members.

These two tactical approaches for structuring holding groups have some importance in the state organisations analyzed in this study. The main tendency seems to be the development of "flat" or "radial" organisations in the initial stages, and the slow transformation of these into "tall structures" as they reach more mature stages.

2.12 THE BEHAVIOURAL VARIABLES

It can be seen from Khandwalla's model that "structural variables" have a dominant effect on behavioural variables. Once the situational and strategic variables have determined certain elements of the organisational structure it seems that the behavioural variables are already determined.

Nevertheless, when one attempts to apply the model, things do not look so simple. Most of the problems arise from the fact that in SHCs the structure has been defined in advance. In one sense, this confirms the relationship established in the model. But on the other hand, it might mean that there are no alternatives for designing new behaviours within the group. In fact this is not true; there are alternatives, but only very few.

The result of this is that most of the design strategies available to organisations in general are not available to SHCs. It is not possible to modify the organisation's environment and demographic properties, neither is it possible to modify the organisation's top level goals, structure, technology and tasks. The only design tools available to the group headquarters is the management style, which can be considered, by itself, as a very important behavioural variable.

In general it is accepted that the main goals in individual and group behaviour are "motivation", "cooperation" and "innovation".

Since it is not the purpose of this study to examine general behaviour techniques, it will be assumed that these terms have a clear and known meaning. In this way it is possible to discuss immediately the problems faced by the policy makers in a SHC group, when they manipulate the behavioural variables from the top of the organisation.

Difficulties in assessing the behavioural variables arise from three sources: first, because some of the operating units have mixed ownership (no information has been found in the literature about this "mixed behaviour"); second, due to the pyramid structure of the group, a variety of relationships are produced with the public and with the government, throughout the different levels of the organisation; and lastly, the author's personal experience suggests that individuals tend to change their attitudes when they belong to the public or state sector.

The addition of these complications to a behavioural approach, which is already complex in itself, works against any analytical effort applied to the subject. However, some considerations will be given in this study, mainly as an attempt to introduce and to present the problems, but with no intention of a thorough discussion.

The SHC has two main characteristics, already mentioned many times in this study: the first is a structure that has many features in common with large private corporations; and the second is a certain pattern of ownership in which public funds play a fundamental role. In many modern industrialised countries where the state has adopted a holding structure that is similar to the large private sector corporation structure, it represents an implicit recognition that this kind of structure has some organisational advantages. When it is considered that in the so-called "socialist countries" (or centrally-planned economies) there is a tendency to organise an industrial sector around a similar holding company structure, then it is natural to arrive at the conclusion that this kind of structure has certain superior features not linked, at the present time, with any particular form of social development [12].

What seems to be the fundamental factors in this coincidence of organisational forms are:

(a) Behaviour of people working for wages and rewards, mainly pecuniary in nature.

(b) The role of the State in modern countries, and

(c) Some organisational characteristics that link the actual industrial technology, the allocation of social resources and the satisfaction of human needs.

This last factor implies a concept of performance and efficiency in a modern country's economy, that is shown in Khandwalla's model as a mutual dependence between performance and behavioural variables.

In other words, behind the organisational structure under discussion there is a double and simultaneous condition: the need for competition between individuals and between organisations and the need for co-operation between individuals and between organisations.

The large private divisionalized corporations are an organisational attempt to combine both conditions, within the limited framework of a company. The SHC is an attempt to combine both conditions in a wider framework, which includes the public interest as represented through the state institutions. Since the behaviour of people working for wages is one of the supporting pillars of the organisational structure, it is fundamental to analyse it, pointing out the difference between a private and a SHC with respect to this variable.

It is worth recording that in the three SHCs under consideration, every effort is made to reduce the differences between them and the private corporations. As will be seen, only top managers and the Boards are directly conscious of Government goals and they try to diffuse these goals throughout the lower levels of the group. What remains in the lower levels are objectives very similar to private corporations's goals, that is to say, annual profits, rates of turnover, growth of production, etc.

Nevertheless, important differences of behaviour remain among employees. It is a fact of life that every employee in a company which belongs to a state group is aware of his belonging to a sector of the public sector. Hence, what remains as a top management alternative is either to encourage or to discourage this feeling. If the decision is to encourage it, then this can be done by means of some common policies, put into practice throughout the whole group. If the decision is not to encourage this collective feeling the best way seems to be to apply different patterns of policies in the different companies. In fact, both kinds of attitudes can be seen in the SHCs but the top management decisions are not independent, as they rely stronly upon the social environment. If the general climate in the country favours collectivization, then top management efforts are easily reinforced and can obtain successful results using common policies for the whole group.

The main problem is to decide what these common policies should be, because the more policies are imposed on the operating units from the top, the more these lose their autonomy and so the responsibility of the lower management is diluted. For this reason, only three very general policies can be suggested, as follows:

First, the participative mode of management which in its more developed form may acquire the label of "industrial democracy". One concrete form of this policy is to nominate employees, elected by the employees themselves, as members of the Boards. In the framework of a SHC, this means the operating companies' Boards, the sub-holding Boards, and the main parent Board.

It can be readily seen that the group structure is suitable for this kind of participation, and there is in fact a strong tendency to start these schemes of participation in the state sector, and particularly where SHCs are set up. Governments which are favourable to the initiation of state enterprise are also likely to be favourable to participative styles of management.

The common policy may consist to encourage the easy interchange of positions between managers at every level, either in horizontal or vertical directions within the structure.

However, what would seem not to be sensible (in fact as far as this study has been able to discover, it has not been applied anywhere) would be to stimulate the interchange of personnel at levels lower than managers.

A policy could easily be designed which would consist of giving to any employee of the group the status of "group employee" and to use every member of the group as a member of a giant pool of human resources. However, this policy, which could be considered as the highest expression of organisational integration, may lead to failure. There are several arguments against its use:

(a) It is impossible in a conglomerate structure to have the same wage distribution among different companies. To transfer an employee from one unit to another would mean to change his wage every time that he was moved (this could be done very easily when it was an increase of wage, but not when it was the opposite) or if he kept his salary, then differences in wages would arise continually, for the same job within a company.

(b) Not only wages are different among companies, but also many other forms of remunerations, pecuniary awards, holidays, welfare allowances, etc. Every time that it was proposed that an employee be transferred to another company, he would like to retain every partial advantage of his former company. In this way, the transfer of employees would lead to a continous spread of economic demands that could make the state group uncompetitive very quickly, and

(c) To make the transference of personnel from one company to another possible, would encourage the turnover of personnel - a situation that is not compatible with modern technology, which requires stable and skilful personnel in most positions. By contrast, the transference of management within the group, is not only acceptable, but also advisable.

Managers can obtain a better understanding of the group's functioning when they move from one unit to another because their job is not, in general, linked with any particular kind of technology. Neither is there such a close connection between a particular job or ability and their remuneration. In fact, the SHCs studied show a substantial mobility of management personnel from company to company and from parent company staff to top positions in subsidiaries. Sometimes members of Boards are nominated as managers of the same company (or another related company) that they know through their Board membership.

Finally it may be possible to encourage a general policy of co-operation between companies of the state group.

Cooperation within each company of the group is a form of behaviour that has to be achieved by each company's management, and it cannot be considered as a variable of the whole group. But cooperation between companies within the group, or within a sub-holding of the group, is a very important variable that can be encouraged by the top management. Cooperation among companies can adopt a wide variety of forms. Sometimes it can consist of a service that is performed in exchange for some monetary transfer, or in exchange for another service. But this kind of cooperation does not imply any important internal policy in common, because it can also be achieved between companies that do not belong to the group.

Cooperation acquires its main significance when two or more companies within the group behave in a way that cannot be measured in monetary terms. Some examples can be given:

(a) Companies can give preference as suppliers to companies within the group. In that way they attempt to improve their performance through assuring a certain constant level of demand. If the SHC is large and highly diversified, then such a goal is easily achieved through this type of cooperation. For instance a figure of 10 or 20% of turnover within the group as inter company trade, could be suitable for a large group.

(b) A common stock of raw materials can be organised by means of a planned inventory policy. The most common event is that one company lends to another company certain materials that are scarce, and receives a promise that it will receive the material back by a certain date. Sometimes a raw material that is obtained more cheaply when bought in a big batch can be bought by one company and then shared among other companies within the group. In that case each company has to pay its own proportion of the bill, or has to compensate with a future purchase.

A pooled stock can be organised, using a common warehouse, or the warehouse of one of the companies.

(c) Skilled personnel, technical staff and also management personnel can be lent for short periods of time. This kind of cooperation can be seen as a matrix form of organisation, with the difference that it is not institutionalized (not compulsory) within the group; it is left again to the initiative of each company.

A network of cooperation arrangements put into practice throughout a state group leads immediately to a more complex and institutionalized structure, i.e. the organisation of new companies, based on partnerships between two or more companies, that have realised that they can pool a common service or other resource. The idea is to establish a company whose goal is to specialise in a particular activity or activities that are sold to the parent companies or to other subsidiaries, on commercial terms, but assuring better efficiency, because of its narrow field of activity (high labour specialization).

As was mentioned above, this kind of company will be treated later. For the moment it is worth recording that to organise a company in partnership with other companies, that is to pool a service, is a form of cooperation whose benefits cannot be strictly measured in monetary terms. Firstly this is because a dependence relationship is established, and so a certain amount of autonomy is lost by each company participating in the scheme. On the other hand, if the relationships are set up on commercial terms and a profit is earned by the service company, then the profits have to be distributed (or capitalized in proportion to the equity capital share of each partner. Hence, when services are provided in different proportions from the capital shares, a transfer of profits from one or more companies to another has to occur.

The exact meaning of the latter consideration is that to organise service companies among firms that do not belong to a group is rather difficult. What cannot be discussed in the context of this study - mainly because of reduced sample of SHCs available to be studied - is whether there is any difference between the behaviour of private holding companies, and state holding companies, with respect to this particular form of cooperation.

2.13 PERFORMANCE VARIABLES

Performance is the most complex variable in an organisation because it is the point of convergence of all other variables. Furthermore, its complexity arises from the natural desire to have a quantitative measure of organisational performance, while most of the situational, structural, strategic and behavioural variables - that have already been discussed are not immediately susceptible to quantification. In general, performance can be considered as a dependent variable influenced by the other characteristics of the organisation, but also - as Khandwalla's model and common sense indicate - performance can clearly initiate changes in the strategic and structural variables.

The first problem faced in this respect is to have a clear definition of performance as an organisational concept in order to develop from it a clear concept of performance suitable for public enterprise and then to try to adapt the latter concept to SHCs.

The problem arises in that "organisational performance" is as ambigous a term as "organisational goals". If this last term were not also ambigous it would be easy to define performance by reference to organisational goals. In general, this is what private corporations attempt to do when they measure performance in relation to achievement of goals, and certain concepts have been derived from such measurements. The best known of these concepts are: profitability, growth, employee morale, solvency, public goodwill, etc. In Khandwalla's study of Canadian firms, it was found that the concepts most often used were actual profitability, growth rate and earnings stability. The same procedure is used in some public organisations, where their statutory bodies and/or guidelines establish certain quantitative goals and then evaluate performance as the degree to which these figures are achieved [20].

This might seem to be the only, or at least the most sensible, solution to calculate SHC performance; however, this arbitrary imposition of a performance concept is not reliable as a scientific way of measuring the overall performance of an organisation.

In a private firm, organisational performance has to be assessed in such a way as to reflect the concerns of different groups of people, because if any of these is not weighted properly the perceived overall performance may start decreasing. In general, the groups concerned with a private firm are: the firm's employees, consumers, distributors, suppliers, stockholders, Government and society or the community at large. However, the points of view of these groups can often be different and it is the task of top management to take into account the various expectations and to attempt to optimize the weighted assessments of the groups concerned.

If we assume that in public enterprises the state is the only owner (which is not in fact the case for SHCs) and that it represents the common interests of stockholders, government and society, then the problem of performance seems to be the problem of assessing the effect of the public enterprise's performance upon society, consumers, employees and suppliers, and to measure these effects [16]. In order to do that, two main and distinct courses have been followed in the U.K. [24].

First, a concept of "profit" and its variants (return on investment, return on capital employed, etc.) has been derived whose uses in the nationalised industries broadly correspond to their primary meaning in the financial context of the private sector.

Second, an attempt at performance measurement has been made starting from the individual factor inputs: labour, fuel (or energy), specific capital assets, etc. By relating these to physical output, or to value added, a wide range of measures can be constructed, as for example, thermal efficiency, total factor production, etc. These factors can then be used in internal comparisons across divisions or similar units in a corporation, and also in international comparisons.

Both of these performance assessment techniques have been applied to the U.K.'s conventional public enterprises, i.e., those with total public ownership, a wide or even national monopoly of their industries, and a considerable degree of independence from direct government control, together with funding directly from the public treasury. In addition, until the appearance of the NEB, a very low share of public enterprises existed in the fields of industry, finance and trade, utilities being the prevailing form. These enterprises tend to be run along commercial lines, being required to accrue enough sales revenues to cover all, or nearly all, their total costs (including a return on capital). At the same time, it is true that in Britain there has been a substantial flow of public resources or subsidies to these enterprises, widely considered as a burden on British economic performance. If it is pointed out that even today some complex opportunity costs (of capital, partially inmobile resources, and public funds) must be estimated arbitrarily and that there remain unresolved accounting issues (of depreciation, capital write-offs, inventories, etc.) then it must be accepted that the actual picture of performance in public enterprises is not at all clear [29].

In an attempt to improve this situation a continuing effort has been made to separate "commercial" from "social" aspects of operation in public firms. "Commercial" operations involve primarily the producing and selling of outputs under normal market conditions. The "social" aspects have involved such things as keeping unprofitable coal mines in operation in order to mitigate the social impacts of closure, and altering the price structure and wage levels in order to produce benefits elsewhere in the economy.

In the example given it should, for instance, be possible to calculate separately the finances of keeping some mines in operation for certain reasons external to the enterprise. In this way, two concepts of performance are implied: the enterprise's individual performance, and its performance in relation to the economy as a whole; and the evaluation, in economic terms, of these two concepts, and the decisions taken in consequence of these are external to the public enterprise concerned in the problem. However, if the calculation is performed, the enterprise performance can be evaluated in itself, and a subsidy from the state institutions can be requested. In that sense, it is irrelevant if the subsidy is in fact paid to the enterprise or not. The important point in this context is that the performance of the enterprise could be evaluated according to its commercial operations, and that its social effects may be separated from the enterprise performance concept.

The real problem arises when the "social" effects are not as clear as in the example of the coal mines. For instance, the public enterprises might be requested to undertake a countercyclical investment policy, or a Regional Development plan, or to maintain a wage restraint measure or to achieve sovereignity in a field of activity in order to protect the country against foreign control, etc. because the Government wishes to apply a certain macro-economic policy. It is easy to understand that these policies may be "correct" ones, but they may at the same time be inconsistent with a policy of operating nationalized enterprises on "commercial principles" [30].

In order to deal with this type of problem the concept of externality has been developed [27].

Granick [12] has pointed out that the existence of nationalised enterprises in capitalist economies finds a broad efficiency justification in the fact that they provide a useful means for internalizing what would otherwise be externalities. But if the nationalised enterprises are operated on strictly "commercial principles", internalising externalities solely through a policy of state subsidy for those activities which would otherwise not be carried out then, Granick argues, the above justification does not apply, because such a method of internalization could be applied just as appropriately to enterprises in the private sector. Thus, the justification is appropriate only if internalization is carried out by means other than use of the pricing system. This can be the case for SHCs which are supposed to use the pricing system, but which in attempting to internalize externalities also employ other means.

Again, following Granick, an externality can be understood as any action which affects the firm in specified probabilistic ways. An externality is considered negative if it reduces the utility function of society as a whole (a good example is the pollution or destruction of collective resources). An externality is positive, if it improves the utility function of the society as a whole, such as a river project, an educational institution, etc. Granick gives the following definition of externality in mathematical terms:

Let $X_{1\,a}$ be an externality, where:

U firm 1 = $f_1(X_{1\,a}, X_{1\,b})$

U society excluding firm 1 = $f_2(X_{1\,a}, X_c)$

U represents the utility function, and $X_{1\,a}$, $X_{1\,b}$, X_c represent actions which affect outputs and costs in specified probabilistic ways. $X_{1\,a}$ represents an action by firm 1, which may adversely (negatively) affect the rest of society (excluding firm 1). The external social cost of $X_{1\,a}$ can be expressed as the difference in the value to (or in the utility of) society (excluding firm 1) between the static situation which results if action $X_{1\,d}$ were taken instead of action $X_{1\,d}$ were taken instead of action $X_{1\,a}$, where action $X_{1\,d}$ maximizes the social welfare function.

$$\text{External effect of } X_{1d} = U \text{ society excluding firm } 1(X_{1\,d}, X_{1\,b}, X_c)$$
$$-U \text{ society excluding firm } 1(X_{1\,a}, X_{1\,b}, X_c)$$

One interesting aspect of this concept is that it is applicable to the treatment of large private corporations, where the counterpart of the "firm" is the subunit (operating unit of division), and the counter part of "society" is the company as a whole (it could be the SHC structure as a whole).

The objective function of a divisionalized company, is defined as that of the company's top headquarters management (e.g. of its Board Chairman). Using the concepts and approaches considered earlier it seems that now a concept of performance can be developed, which is suitable for the SHC case.

As argued above, in private corporations the predominant performance criteria were those linked with goals that the top management decided, usually in a rather arbitrary and subjective way. In SHCs, goals are set by Government and hence it is not the responsibility of the SHC if they are arbitrary in relation to the group, since they can be considered as objective criteria. In some cases Governments set goals which are heavily influenced by the ease with which they can be assessed, believing that efficiency is best promoted by expressing management's objective function in some simple and quantifiable form. On other occasions governments set performance criteria themselves as a goal; that is to say, instead of setting an objective and deriving performance goals from this, a performance requirement is established which has implicit goal assumptions underlying it.

If one considers the two main courses of performance evaluation followed in U.K., public enterprises, it can be seen that only the first one, derived from "profit" concepts, is suitable to SHCs, because the second - namely figures worked out from physical output - seems to have relatively little value when applied to an entire conglomerate structure. They can be useful for comparing one firm in the SHC with another firm not belonging to the group, or to compare two similar firms within the group, but not to make comparisons between two SHCs or between conglomerate whether state-owned or private.

If a decision is taken to use a "profit" derived performance criterion, then it is necessary to distinguish clearly the "commerical", form the "non-commercial" operations. This can be done, either through complete isolation - in accounting and financial terms - from the non-commercial operations, or by requesting from Government a subsidy, equivalent to the decrease in the utility function of the group, caused by this kind of operation.

If an action falls outside the profitability constraints, either it cannot be compulsory for the group or it can be treated as an externality; that is to say, the action must be evaluated as an external factor and once quantified in financial terms, could be expressed as a subsidy to be requested from the Government. In general, as already suggested, a request to take over a company on the verge of closure or a request to continue operations - as in the case of coal mines - both with the intention of improving the utility function of the whole economy are those most commonly arising. In both cases the request must be evaluated as an externality which reduces the utility function of the group, and it must be treated as a separate figure, which must not affect the measure of overall performance. In this way, most of the performance criteria used by large private corporations can be considered suitable for use by SHCs, with the additional limitation that, due to the demands of public accountability, rate of return and profitability seem to be the most common criteria in the SHCs discussed in this study.

However, it is worth noting that the behaviour of a public enterprise - of which SHCs are only a special case - should always be examined in terms of their particular national context: generalizations are frequently inadequate. This is particularly important in relation to the IRI complex in Italy, which has managed at best to breakeven or to earn only very modest profits, (certainly below any rates of return sufficient to cover the opportunity costs of its capital). However, it has been widely considered as a model SHC, with a fairly good general performance, i.e. implying that it has been a useful instrument of the economic policy of government [14].

2.14 CONCLUSIONS

In reviewing this extensive discussion of Khandwalla's model and the successive attempts to apply is relationships to the SHC structure, it is apparent that few real alternative design systems remain.

In summary we can say:

1. The ownership relations are established from the definition of the state group.
2. The conglomerate character of the group, concerning the broad diversification of its production and markets, differentiate SHCs from any other nationalised corporations.
3. Strategic goals are set up as variables external to the group and
4. The multiple constraints to which the SHC is subjected derive from:
   (a) Its public accountability at different levels and
   (b) The necessity of having quantitative performance criteria simultaneously with the fact that the SHC has to introduce certain externalities into its commercial operations, that can be measured in relation to the economy as a whole, but which are difficult or impossible to evaluate in micro-economic terms.

From the previous discussion it seems that only three main issues are clear enough to be resolved at this stage of the study.

First, the situational variables have a predominant role in determining the state-holding structure. Situational variables may be decomposed in multiple parameters, each one of them being difficult to evaluate in any comparative or absolute analysis.

Second, the variations allowed within the already defined structure (a holding company with pyramidic shape) are relatively few.

Any proposed variation in form has to have high flexibility. The necessity of specialisation in companies to obtain better technological, market or labour efficiency, reinforces a natural tendency to use the divisional form of organisation. Simultaneously, the need for slack resources, indicates the necessity of pooling resources among different divisions. The most suitable form seems then to be a sort of matrix structure in which the intersecting points are autonomous companies.

Third, these companies (what we have called "service companies") represent an important way of accumulating resources, but divisional staffs are no less important for dealing with managerial services. The main integration problem seems to be how to distribute resources among staffs, service companies and operating units.

Due to the small sample of SHCs the only method that seems to be suitable to progress in this study is to make a comparison among specific state groups, and attempt to follow the historical trends - if any exist - in their organisational development.

This will be done in Chapters 4, 5 and 6.

CHAPTER III

SERVICE COMPANIES

3.1 DEFINITION AND OBJECTIVES

We will call service companies or service enterprises certain operating units that are set up usually to operate within a large group of companies, having firms belonging to that group as principal clients.

Their primary role appears in multidivisional forms of organisational (M-forms as defined by O. E. Williamson) [43] and in SHCs, which we have considered as a special case of multidivisional corporations.

We have taken some of the concepts used in this chapter from "Divisional Performance" by Solomons [36]. However, it must be recorded that the concept of division used by him is: a segment of a business that exercises responsibility for both producing (or purchasing) and marketing a product or a group of products [36, p.4].

In that sense the word "division" has too wide a meaning for the purposes of the present study of SHCs because in our case the division is a unit of a parent company.

The existence of professional service companies - with an independent status - is common in developed countries as is the existence of professional service enterprises that are subsidiaries of large corporations. But, it should be noted that professional service companies - enterprises that essentially sell professional knowledge - are only a special case of service companies [35].

In general terms, service companies are set up in order to achieve at least one of the following goals:

(a) To embody specialised skills or functions in more effective ways by concentrating the human and material resources that are necessary to carry out the required activity. The underlying assumption is that if the same resources were spread among many companies of the group, none would achieve as good a performance as the specialised service company can achieve.

It has to be borne in mind that a SHC often includes operating units of very different sizes and it is essential to provide effective specialist support to all companies if the group as a whole is to achieve high performance.

(b) To accumulate resources in order to overcome the overload that may arise within the structure of the group from events whose occurrence is uncertain. This goal can be called the slack resources strategy mentioned earlier in this study. The central concept here is the use of the service companies as self-contained centres for a-cumulating a variety of resources, whilst giving to these centres an entrepreneurial structure. In this way they may be treated as any other profit centre, or as any other subsidiary of the group. Service companies are then subjected to rules closely similar to the norms applied to the rest of the holding company.

(c) To create an internal market within the group (which can be called an "Interdivisional", or "Intracompany" market) whose primary purpose is to achieve a higher performance of the group through assuring certain minimum levels of activity in most of the firms of the group. This goal becomes more important in a state group subject to unpredictable decisions from Government, and is a way of reducing negative externalities. It can also be seen as a way to counterbalance the weakness of the state sector in its relationships with the labour movement and with the private sector. A deeper discussion of these problems will be seen in the last part of this chapter ("Service Companies versus Private Companies").

If these three objectives are consciously adopted the setting up of service companies appears to be a logical development. In practice, however, the state-holding companies studied show different structural patterns. The IRI, as will be seen, has practically no service companies as self-contained units, but has strong parent companies which concentrate within themselves support services for the whole division of the group. The IRI structure is so large and diversified that most of the specialised services can be found in one or another of its enterprises as staff activities where they can be used by the rest of the group. The Statsföretag group has some service companies with a tendency to concentrate these companies in one part of the group. That is to say, practically all main service companies are linked directly to only one parent company.

The NEB set up service companies which were primarily concerned with the export of specific products, involving the training of personnel, and the coordination of computing software services in Europe and in America.

Slack resources have not yet proved to be an important motive for setting up "service companies" in modern industrialised countries (whether slack resources can be regarded as a major reason for the setting up of service companies in developing countries might valuably be the subject of another research study) [41],[25],[24].

3.2 FIELDS OF ACTIVITY

The main overall goal of this kind of unit is to aid the performance of the group as a whole (or to achieve the so-called "corporate good") providing inputs to the operating companies more effectively than would otherwise be the case: relations between divisions should be so regulated that no division, by seeking its own profit, can reduce that of the corporation. This is not the same as saying that no division may seek a profit at the expense of another, but whenever one division does increase its profit, at the expense of another, the amount it adds to its own profit must exceed the loss it inflicts on the other [36, p.11].

In this sense, every input - whether service or commodity - can be considered a "service" provided to another company, although certain "services" may well consist of ordinary productive activities or simply in the provision of commodities.

Thus, the expression "service" is not intended to classify these companies as belonging to the service sector in economic terms, though this may be the most usual meaning.

A rough classification should include at least seven kinds of service companies:

1. Management service companies, including computing facilities.
2. Engineering companies: including project engineering, specialised contracting and building companies.
3. Maintenance and security companies.
4. Trade companies: Export and Import services.
5. Suppliers of such intermediate commodities and services as:
   (a) Raw materials

(b) Intermediate manufactured parts

(c) Transport and Distribution facilities

(d) Advertising

6. Financial Services (Banks).

7. Technical and training centre, Research and development laboratories (including quality control units).

Some of these activities appear in the SHCs that we have studied, but patterns followed by them are uneven as was mentioned above in the particular cases of IRI, NEB and Statsföretag. Certain service activities are organised in autonomous operating units, which can properly be called "service enterprises". Other activities are combined in one miscellaneous and large service company which has a special status, in the sense that it is linked with the parent company staff at the top level of the group. In certain cases, there may be no autonomous service unit, but one part of a large parent company concentrates within itself support activities for a whole division or subholding group.

What is more relevant at this stage of the study is that a wide variety of supporting activities appears in the holding systems studied, and that they can all be seen as "service" activities.

Management services are, perhaps the best known type of support activity in modern corporations and there are already different opinions about the best way of organising them within a group. Eilon argues: "there are clearly many advantages to be gained from having a central management services group (as opposed to having smaller units dispersed among the operating divisions). Not least amongst these are the opportunity to build up technical expertise and the ability to provide career development for existing and new personnel" [6].

The argument is certainly valid when only management services are considered. However, if the "services" are extended to include those mentioned above: engineering companies, computing services, building contractors, maintenance of equipment, supply of raw materials, etc. it obviously becomes difficult to organise this whole range of heterogenerous activities in a single service unit. In this case the setting up of a new service company which specialises in a certain field or fields, becomes a necessity. However, this is likely to give rise to certain problems, which will be briefly discussed in the following paragraphs. The alternative, of using "outside" service companies, will be discussed later.

3.3 THE PROBLEM OF LOCATION OF THE SERVICE UNITS

Usually the first problem to be faced is related to the company structure and its capacity to control an independent unit. Sometimes the U-form is also suitable for this purpose, and organising a new management service company turns out to be the first step in a structural corporate transformation. The M-form corporation is often well prepared to control new operating units. However, to set up a complete autonomous unit is not always an easy task if the M-corporation is not already a holding-company, because it is the holding-company form which provides a legal framework for organising new companies, and the M-form which provides a control system for units that may have a wide diversity in their relations with the main production items of the company.

Once the decision to organise a new company is taken, there are two alternative locations where the link to control and coordinate its activities can be established; one is the top staff level, that is to say, a direct dependency relationship with the General Manager of the company (this situation seems to be suitable for some management services such as consultancy, audit and basic research).

The second location is in a division where a parent company, with a certain degree of specialisation, serves as intermediary between the operating company and the headquarters. A project engineering company, a computing service, an applied research company, are examples of firms that may be well situated in a division and be operated as any other subsidiary company.

The most logical procedure will be to set up a service company within a division where its activities are most often required, or where similar activities are carried on. On the other hand, there is often a tendency to place operating departments that have to deal with confidential or sensitive information as high in the structure as possible [36, Chapter I].

3.4 THE SIZE PROBLEM

In general the size problem is best approached by a feasibility study, which should determine the break-even point of the new firm, and the amount of resources (manpower, machinery, warehouses, sites, finance, etc.) required to obtain the best performances of the corporation as a whole. As was mentioned above in SHCs the service units can be useful in developing a slack resources strategy. In this case, the feasibility study would have to consider a double breakdown approach: one for the new firm alone, and another for the group as a whole, including the new company.

In most cases the service activity will require a minimum size, determined by the necessity to have a minimum amount of resources that are indispensable, for technological reasons, for providing the service.

The feasibility study has to determine whether internal demand is sufficient to allow a firm of at least minimum size to break-even. The size of company should be that which provides maximum net benefit to the organisation as a whole.

In Fig.10, below are shown the alternatives faced by the group; making traditional assumptions of increasing marginal cost and diminishing marginal benefit.

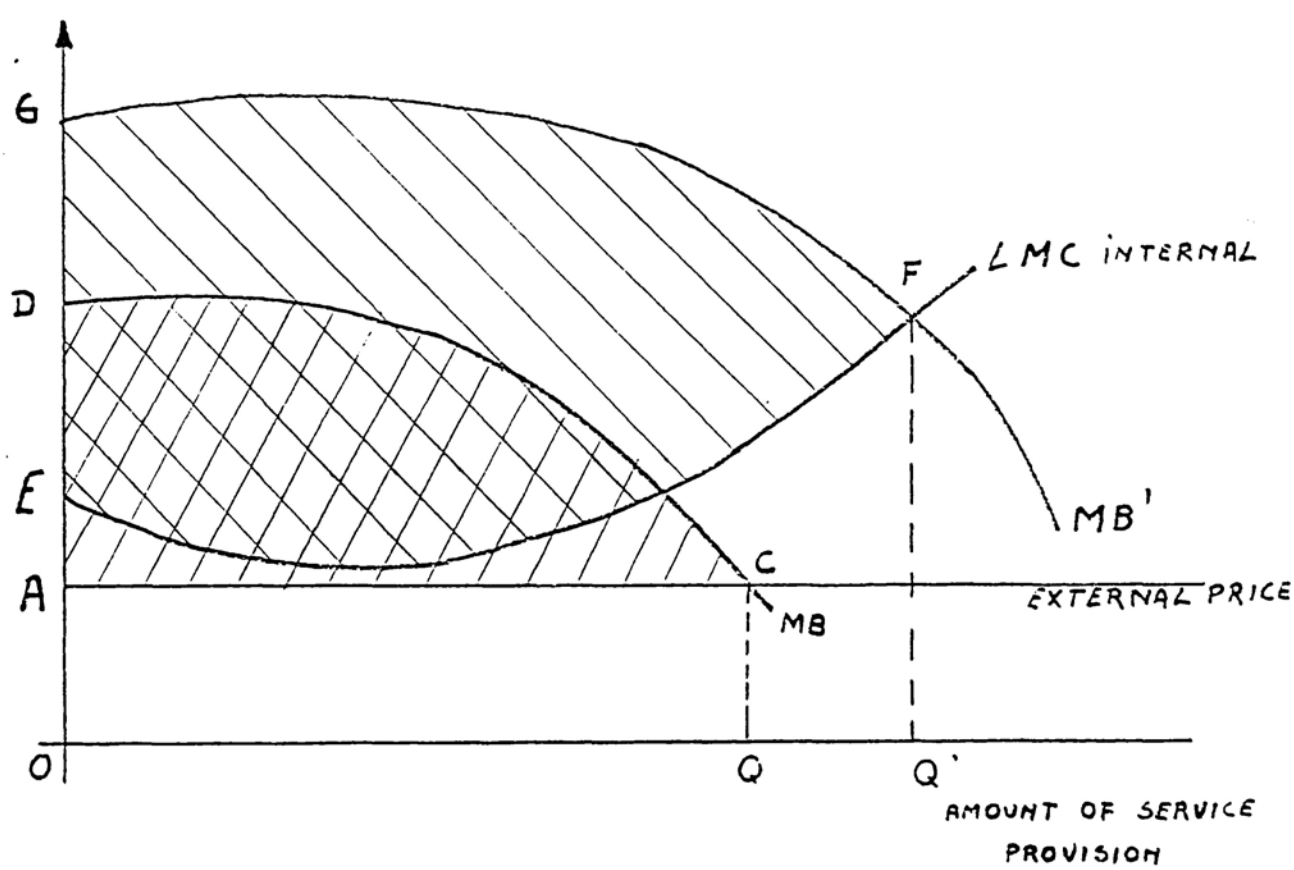


FIG.10. SIZE OF A SERVICE COMPANY

EF is the long term marginal cost of internal supply of services.

AC is the external price of the service (assumed to be constant).

MB shows the marginal benefit of external supply.

MB' shows the marginal benefit of internal supply.

The difference between these levels of benefit, MB and MB', corresponds to the strategic organisational benefit of internal supply which was discussed earlier.

OQ is the amount of service which allows the maximum excess of benefit over cost (net benefit).

OQ' is the amount of service which allows maximum benefit net of cost with internal supply.

Area ACD shows the area of net benefit from external supply.

Area EFG shows the net benefit from internal supply.

If area EFG is greater than area ACD, it will be more beneficial to provide the service internally with OQ' units of the service.

If area ACD is greater, then it will be more profitable to buy the service from outside with a maximum of OQ units.

However, the problem may well be more complex if the break-even is not reached and the activity of the new company has to be evaluated as a positive externality for the group.

3.5 CHARGING FOR THE SERVICES

This problem can be seen as a particular case of the more general problem of transfer prices within an organisation. A transfer price is the price charged for a good or service between two points within an organisation. In our case, these two points are two different companies within a SHC. Transfer pricing is, of course, the subject of an extensive literature. Some of it far more complex than would be justified in the present context.

Solomon [36] identifies five different possible pricing systems: the market price, the sales-minus, the full cost, the marginal cost and the shadow price methods.

It would seem, however, that certain of the methods are not suitable to the SHC case. The market price, understood as the price for the service and/or the goods produced by the service company, in the actual market (domestic or international) is a clear concept when two independent companies are involved. However, it implies the existence of a market price which is independent of the companies within the state group involved in the agreement. Since such an independent market price sometimes does not exist, either because the service is too specialised or because the state group represents a major share of the market, it is worth specifying an alternative system for use in these cases.

The difference between a "division" as a profit centre and a company as a centre lies in the fact that it can be assumed that alternative costs and prices within a division would not affect the overall performance of the company in that they do not alter the profit of the division as a whole but merely its distribution within it. But this is not acceptable in a state group where even companies in the same division (or subholding company) could have different owners, in the sense that they often have different proportions of private capital shares (and/or different private owners). It then follows that every company has to be considered as a different profit centre, although on certain exceptional occasions it may be accepted that a part of the group (either a division or the group as a whole) is considered as a temporary profit centre and different price criteria become suitable.

Hence, on most occasions sales-minus, full cost and marginal cost systems are unsuitable for the companies if they lead to higher prices than those prevailing in the market. (Sales-minus could be an acceptable criterion in the case of certain export service companies that charge a fixed percentage of the sale price as their cost).

On the other hand it follows that if the prices charged by suppliers are lower than the market prices, then the buyer companies are less concerned about the system by which prices are calculated within the group.

The only alternative that remains open to the buyer companies - in the case where they consider that the market prices are too high, and that they might thereby be accepting a large transfer of profit to other profit centre - is to organise within their structure the production or the provision of the particular "service" needed.

So-called "shadow prices", which result from the construction of a mathematical model of the company as a whole, dictate the operation of each division, and/or company so as to optimize the corporate good. "Shadow prices" represent a theoretical solution that tends in practice to be very complex to apply in the case of a large corporation; and well-nigh impossible to calculate for a state-holding company where the owners of the constitutent units are not the same. Then the corporate good, in the short term, may be in contradiction with the interest of profit centres and conflict may be inevitable. It is for this reason that the intervention of the headquarters - the only centre that is identified with the corporate good - must be employed in the long-term decisions, that is to say, in the strategic planning.

If we accept that the market price method is the most suitable for state-holding companies, we have also to accept that its practical use faces many problems that must be examined in a general approach. In an attempt to achieve this purpose certain "shadow prices" of simple structure will be suggested in the following paragraphs.

The system most often used is the setting up of a new service firm in which the equity capital is shared among the companies within the group which are seeking a secure supplier of the input in question (service or commodity). If the demands of the firms concerned can be foreseen it is advisable to divide the capital into shares proportional to their average annual demand for the input. In this way, if a profit or loss is produced, its effects are also shared in the same proportions by the consumer firms. By this means, conflict between partners over the transfer price system can be avoided. In general, the new company is linked hierarchically to the major share capital partner, which in this case, will turn out to be the largest customer.

However, the shares of the demand are often variable and as a consequence they may not continue to coincide with the proportions of the capital. If a small shareholder of the service company becomes a big consumer of the input, then it has to accept a transfer of profit (if this were the case) from the consumer firm to the service company, and from this to the majority owner. Of course, the opposite situation happens if, instead of a profit, the service company produces a loss. Then the loss is "transferred" to the major shareholder.

Because these transfers of profits or losses are unavoidable if there are variations of demand, it is desirable to develop a system of balance between companies within the group.

One system consists in the distribution of service companies between the different divisions of the corporations (or SHC) in such a way that a balance of their turnovers may be achieved over a certain period of activity.

This system implies at least the following assumptions:

First, an even distribution of the investments required by the service companies set up in the different divisions (or sub-holding companies).

Second, that the spot market price of the commodity or service that is bought or sold is agreed as a permanent basis for transactions.

Third, that any transaction occuring between two divisions, can be written as a current account credit or debit - in monetary terms - and so can be balanced with any transaction of services between the same two divisions that represents a similar amount in monetary terms.

Fourth, that triangular balances can also be accepted; that is to say that if one division has a credit balance with another division, but needs a "service" that is set up in a third division, it may use it by transferring its credit from the original debtor division to the latter.

The system described above implies the creation of an internal market for services within the group, in which, if it is evenly balanced, it can be assumed that financial balance would be reached over a certain period. If this were not the case, a form of monetary balance or compensation could be agreed, but a strong tendency would need to be developed to use credits up as soon as possible.

When "services" are exclusively linked with the normal operations of firms, it is difficult to imagine a forced utilization of resources that are not linked with the actual market demand. However, if the pooled services also include those that are linked with the expansion plans of the firms, (that is to say, their need to carry out feasibility studies, market surveys, research and development studies, project engineering, etc.) then it is easier and more sensible to try to achieve a balance over a longer period of time, which may include the expansion of the companies.

In any case, if this system were encouraged by headquarters it would give strong support to the creation of an internal market and also to cooperation between the companies.

Another system is based on the assumption that it is possible to find one or more compound "service monetary units", in which the existing capacities of the service firms within the group are represented. The price of these units may be evaluated using the market prices of the different services.

In this way, the firm that uses a "service" has to pay in "service units" and has the right to use them in the same proportion that they exist as existing capacities within the group. The firms that actually make use of the service in the existing proportion get the best use of their resources; the firms that use the services in an uneven way, have only a short time to utilize the rest of the services paid with the units, and if they do not utilize them they waste some of their resources. In this way, all of the firms of the group pay for the existing service capacities and some (those that do not utilize the services in the "existing proportion") also pay for their ability to have slack resources at their disposal, independent of whether they are utilized or not.

This latter system of a "compound service monetary unit" has been explained in a restricted case, i.e. trying to balance the need for services with the real utilization of the service capacities within the group. However, if the state group is considered as a closed market in which the transfer of services and/or commodities within the group has to be in equilibrium, and the surplus is calculated as the amount of services and/or commodities that are sold to the external market, a more complex approach would have to be developed.

3.6 GROUP SERVICE COMPANIES VERSUS PRIVATE COMPANIES

In order to discuss the use of service companies rather than external private companies we have to specify what are the differences between a service company and any other company of the state group.

In the first instance we can say that while an ordinary company in itself has a goal - coordinated with the general goals of the group - (for instance to produce a high rate of return, to develop a particular new technology, etc.), a serious company subordinates its goals to other companies' goals, and is not primarily market-orientated.

The meaning of this last statement must be understood in the sense that a service company does not continually seek customers outside the group; but only exceptionally when it has idle capacity should it try to improve its performance by increasing the number of its external clients. In this sense it is simply a profit centre with special constraints. In the exceptional case of an export service company, it is true that it has to look for new customers for the products of the other group companies. Even in this case it is not its main goal to look for new customers outside the group wishing to sell their products through it.

The fact that a service company is not considered a profit centre in itself, does not imply that profits will not be produced in that operating unit. In the particular case of SHCs where in one or more of the constituent firms the majority shareholders may be in the private sector, it is a fundamental requirement that profits should be achieved in a satisfactory proportion by all the partners involved. What the state group companies demand from the private partners in service companies is an efficient financial performance in addition to being their preferred customers. What the group can offer them is a more secure demand and the general support that any company that belongs to the state group may receive through exchange of staff and the support of other service companies. As we have seen, the market price seems to be the best basis from which to calculate a "satisfactory" rate of profit for a support activity. Having in mind price criterion let us now consider why it may be that the internal 'service company' strategy may be superior to that of buying in service requirements from outside the group.

We may distinguish three categories of arguments in favour of the setting up of service companies within the group, which nevertheless do not exclude the possibility of buying services from private sector companies.

The first category consits of profit-linked considerations similar to those that apply to any large corporation.

The second category is related to the strategic decisions of the state group intended to combat the hostile ambiente that commonly faces the state-holding company in a mixed economy.

Last but not least a third category, relating to the need for integration, is intended to improve the overall performance and to offset the centrifugal tendencies that often appear in divisionalised state groups.

The profit-linked arguments are composed of the general advantages that any large corporation can achieve, when, by internalising an activity, it achieves a higher profit yield by obtaining the profit that is otherwise obtained by companies not belonging to the group. Such a process is limited by two principal sources: one is the ability of large corporations to achieve at least the same efficiency as that with which the internalised activity was produced in the market. If this were not the case, a competitive attitude by suppliers outside the group could transform the eventual profit into an actual loss in the group. Such cases should be able to be successfully foreseen by a feasibility study and this needs no further discussion here.

The other limitation may arise from the size of the corporation and its capacity to incorporate a new activity (in the form of a new company) without being overcome by structural problems arising from this. This reason is particularly important in corporations whose structure is on the brink of being overwhelmed by problems related to lack of control, delays in communications, bureaucracy, etc. Size is a limitation on the M-form structure as well as on the U-form. These kinds of problems are closely related to the problem faced by companies which, having merged, become unprofitable due to structural problems.

To a private group, as opposed to a state group, the balance between the profit maximization goal and eventual structural difficulties is a more or less free decision: if the company does not want to become more complex, the establishment of a new service company be postponed or simply abandoned.

The underlying assumption in this case is that the market price of the service under consideration reflects the long-run marginal cost of supplying the service (assuming there are no monopoly/oligopoly price constraints), i.e. a competitive market is in operation.

This first set of "profit" reasons for internalising a service, are common to all large corporations, including state groups.

The second category of reasons relates almost exclusively to SHCs and will be discussed in some detail.

SHC are organisations closely linked with mixed-economy societies, particularly in cases where the public sector is involved in manufacturing activities and has even set up mixed enterprises. Theoretically, in a mixed economy, the private and the public sector collaborate to help each other. In practice, there is normally intense competition between the two sectors (the policy reasons behind this rivalry being irrelevant here).

Since the majority of manufacturing enterprises in most countries are private companies, the SHC group is encircled by a rather hostile environment that watches carefully whether it is expanding, whether it is making profits or losses, whether it is gaining any advantages from the Government, whether it is invading profitable fields of activity, etc.

Surely it depends on how far the public sector involvement is politically accepted, i.e. the degree of consensus that such involvement is "right" and effective. In the UK the consensus is not strong. As will be seen, in Sweden and Italy it is, and probably the degree of maturity of the state enterprise is an important factor behind this attitude.

The socio-political explanations of this phenomenon are not relevant to our study; however, from a managerial point of view, if a large and diversified corporation has hostile surroundings, it has a strong reason to develop a self-sufficient strategy, leading to self-contained organisations. If we translate this into our state-group structure we arrive at the necessity of setting up firms that are able to supply most of the main support inputs of the group from within the group itself. Since the state group is a holding company characterized by the mixed ownership of its operating companies, and since autonomous firms in day-to-day operations are a managerial feature of the group, it follows that service units, in partnership with the private sector will be a preferred strategy for overcoming the hostility of the environment.

Three main effects of this hostility will be mentioned in some detail. One is related to services that have strategic importance to the state group; that is, a certain input of one or more of the group companies could have large repercussions on the whole group's performance - it might be a technological improvement or the opportunity to enter a new market, or access to an information data system, or simply the supply of a scarce material.

In those cases private suppliers of strategic services are not avoided but the best approach seems to have a supplier within the group.

Two recent cases in the UK can be mentioned as examples; the production of titanium alloys needed by Rolls Royce, and the provision of micro-chips for the electronics and computer division of the NEB. Both strategic supplies have given origin to the setting up of new companies within the NEB.

A similar approach to this problem is taken by some large private corporations which usually try to have two or more suppliers of every important input. Often they help one of the suppliers to develop by means of a partnership, or simply by a loan of money linked with a contract of exclusivity, or as preferred customers - although they do not often integrate backwards.

The second concrete effect is that if a resource required by the SHC is seen to be in short supply, the rate of profit on that resource could be far higher than it could be in the case of a private owned client. This may happen because the state group company is often considered as an occasional customer, where profits have to be maximized in each and every deal, (this due to an expected change of government policy, or any other uncertainty linked with the public sector).

The third effect of the hostile environment is the relative weakness of small and medium size firms that belong to the state group, in their relationships with suppliers in the private sector. While there are means by which small companies can be organised to overcome this situation, it is difficult to find a way that does not interfere with managerial autonomy. Therefore, to provide service companies within the group which can supply inputs to moderate size firms is perhaps the best way of improving their performance without intervening in their business.

In summary we can say that the hostility of the surroundings, independent of the degree of development of the country's economy, provides a strong argument in favour of having a network of service companies within the group.

The third set of arguments is related to the need to maintain a co-operative attitude between all companies of the state group. As was mentioned before, the operating units usually have partially different owners and conflicts of interest can often be present.

One source of conflict comes from the divisionalised structure. As we have seen, in large corporations the formation of "divisions" or sub-groups of companies that have certain common features, has become a necessity. In the same way, a divisional parent company has to play the role of "leader" enterprise within the sub-group. As a consequence of this, a tendency may be developed to isolate one sub-group of companies from the others creating, in this way, barriers against inter-divisional cooperation. In a large and complex organisation it is not sensible to try to use authoritarian modes of management, nor to establish a strict hierarchical structure, because the results are too often disappointing: each step that reduces the operating autonomy of firms harms both its performance, and the overall performance of the group. However, at the other extreme, the lack of interdivisional cooperation may also produce a reduction in overall performance.

The only system that appears to be a reasonable approach towards solving this dilemma is to set up companies that are intended to sell common inputs through different divisions; that is to say, setting up a sort of matrix structure where permanent nodes - the so-called service companies - play the role of slack resources (including staff resources) which are at the disposal of any company of the group. For this it is irrelevant to what division the individual companies are most closely linked, either by ownership or by market links, or by virtue of their common technology.

The existence of these special companies that sell inputs throughout the structure of the state group, and whose equity capital (and eventually their profits) can be shared by any company within the group, has a strong effect in creating a cooperative climate within the structure. In a certain sense, a network of resources involving all the group firms can be achieved, that is, a network in which the individual firm's problems can be shared and resolved. This is not, however, through direct relations between them (because this may over-strain the structure), but using intermediary specialised companies that have slack resources at their disposal.

If these "services" are sold at market prices, and are produced with at least the same efficiency as the similar services outside the group, the effect on the overall performance of the group will be positive. In this way the group will obtain not only the internalisation of profits, but also an improved performance through the synergistic effect of internal cooperation, as well as a probable increase of efficiency through the pooling of resources.

This last idea - the pooling of resources - leads us to the second source of potential conflict within the group. Most of the SHCs studied have grown through acquisitions and/or mergers - a fact that often produces simultaneously an "overdecentralization" and an excess of resources spread through many firms. The overdecentralization arises when firms that were more or less self-contained (because they did not belong to any group) are acquired by the state group. It is not an easy task to convince top staff that some of their own resources are uneconomic and that the firm, once incorporated in the group, can rely on the supply of inputs bought from other companies. After the trauma that always occurs after a merger or acquisition, (both in labour relations and in the whole management of the enterprise), it becomes indispensable to offer to the newly acquired company a clear view of what the group is asking it to give up from its own structure and with what any segment of the firm that is to be split off is to be replaced.

If the solutions consist in the transfer of human or physical resources from the newly acquired firm to another firm of the group, which specialises in a particular service, then the possibilities of conflict are considerably lower.

Several companies in this sense are used as buffers to avoid "overdecentralization" since they can easily lead resources from one point to another point of the organisation, through pooling them within the total structure.

It is true that if the expansion through mergers and acquisitions continues, the whole system could become oversized in service resources through using this method. An important part of the service turnover may then have to be sold outside the group. However, this alternative will have a better financial result than keeping the excess resources spread over a number of unprofitable segments in many firms.

A more radical solution can be proposed: to sell the oversized service company to the private sector. But if the state sector accepts its role as a minority shareholder and the service company can continue as a mixed enterprise whose main customers are from within the group, what are the reasons for a complete takeover by the private sector?

From the above discussion it follows that only ideological reasons may justify a compulsory selling of "service companies" belonging to a state group that is in a process of expansion. But the same ideological reasons should be valid for every company of the state group, and this kinds of reasons are beyond the scope of this study.

3.7 CONCLUSIONS

In summary, it can be concluded that service companies have an important role to play in the functioning of all large modern corporations, and particularly in the case of state-holding companies.

The setting up of service companies gives rise to problems that are linked with the divisionalized structure of the state-holding groups, and also with their mixed ownership between private and public sectors.

The relation between the performance of state groups and their use, in some degree, of service companies is a subject that deserves research. The same applies to the relationship between the system of internal transfer price and group performance.

Since these subjects are beyond the limits of this study it is sufficient to record here the importance of these problems, and to emphasise the necessity of including their evaluation in any model of state group structure.

The existence of "service companies" within the state group does not mean that all the inputs of the group - supported by feasibility studies - have to be produced within the system. However, there seem to be good reasons to decide on the setting up of service companies when their outputs can be seen as strategic for the whole group; that is to say, outputs linked with the growth of the corporation and/or outputs that are scarce or may become scarce, and whose availability will affect group performance.

CHAPTER IV

THE NATIONAL ENTERPRISE BOARD

4.1 DESCRIPTION OF THE PARENT COMPANY

The NEB was set up in November 1975 as a statutory public corporation under the Industry Act 1975. During the years 1976-79 the organisation had a stable pattern of management. The information and description of the NEB given in this study corresponds to those years. In 1980 during the completion of this research important changes affecting the NEB's structure were made; these happened too late to be taken into account. The role of the corporation has been under close scrutiny by the government but its survival in some form seems highly probable.

Information concerning the internal organisation of NEB is sparse. Much of what follows here has been drawn from the annual reports of the Board or in the Written Evidence to the Committee to Review the Functioning of Financial Institutions on the 22 November 1977 [16].

The charts showed in Figs.11 and 12 were constructed by drawing together information from various sources, some published, some personal including an interview with the former Chairman of the NEB, Sir Leslie Murphy. So far as is known no such charts have hitherto been available.

Fig.11 shows the structure of the parent company and how the functions and hierarchy were organised.

The Chairman was in direct charge of the British Leyland (BL) and Rolls Royce (RR) units. He also controlled the three main central departments, i.e. Planning, Finance and Information, and the Secretariat.

The Deputy Chairman was in charge of the four Divisions and the two Regional Offices.

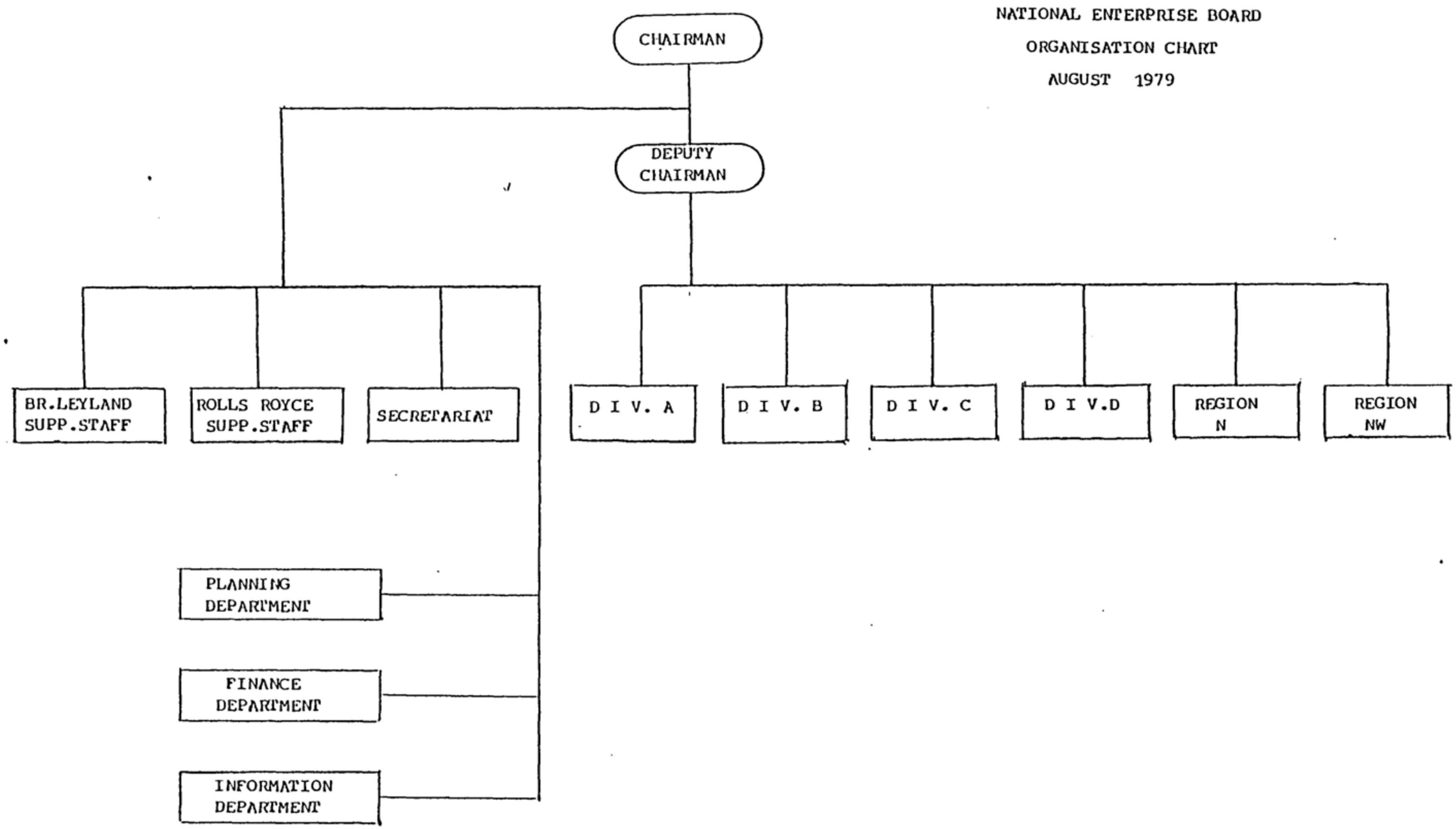


FIG.11. NATIONAL ENTERPRISE BOARD - PARENT COMPANY

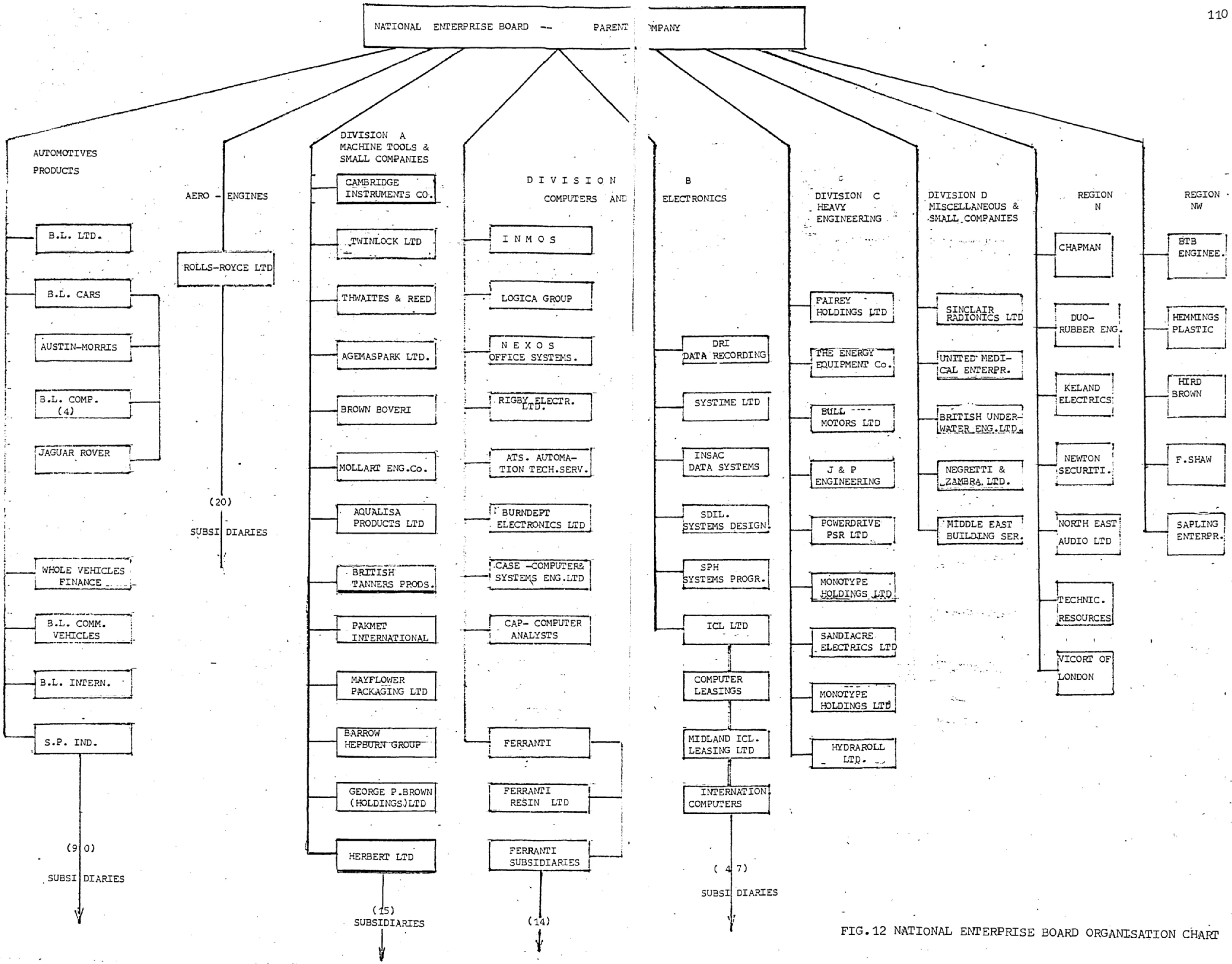


FIG.12 NATIONAL ENTERPRISE BOARD ORGANISATION CHART

The Divisions, as will be explained later, were responsible for the group's companies (other than British Leyland and Rolls Royce).

4.2 ORGANISATION CHART OF THE GROUP

In Fig. 12 is shown the divisional structure and linkages among the group companies and the parent company. The four divisions were simply called A, B, C and D.

Division B was the only division which showed a distinct homogeneity of activities, related as it was to computers and electronics (in fact it is possible to distinguish four areas within the division: semiconductors, programming, computer peripherals and office equipment).

In Division A, because of the presence of Herbert Ltd and its subsidiaries, there existed a degree of specialization in the machine tool sector. However, many companies concerned with other industrial sectors were also to be found in that same Division.

The completion of Division C was, if any, heavy engineering.

Division D had no industrial specialization as such, and at the end of 1979 was mainly in charge of small company affairs.

However, in each division there was a mixture of small, medium and large size companies. There was a tendency to place small companies in the computer field under Division B, but the small investments that were wholly in a particular geographical region were dealt with by the regional director, whatever their field of activity.

4.3 DIVISIONAL STRUCTURE

This brief description of the organisation shows that the divisions were only an internal distribution of functions. No intention to set up divisions as subsystems or self contained units (in the sense of the multidivisional type of corporation) was discernible nor was any such intention put forward in our talks with members of the NEB staff. On the contrary, the functions of the divisional level staff were clearly reduced to appraisal of new investments, monitoring of existing investments and advisory activities. They could have particular sectoral responsibilities, allocated by the Deputy Chairman, but these were in the nature of data gathering and analysis rather than operating responsibilities. In most cases allocation of new companies to any particular division reflected more closely the Chairman's judgement of the capabilities and capacities of the personnel concerned rather than apparent industrial logic. The allocation would therefore depend on the perceived managerial needs of the new company, the skills of the divisional managements (especially its Head) and existing work loads. When a company had a problem it went to talk directly to a particular person of the divisional staff, there not being any structure with a specified responsibility for dealing with the subsidiary company problems.

4.4 NEW INVESTMENTS

Concerning new investments, the divisional role was also limited and may be described as follows. The planning department usually studied those industrial sectors or companies in which the NEB had a potential strategic interest.

Where the analysis was favourable an approach to the selected company would, in various forms, be made. The form of the approach would depend on the degree of the intended participation in the company.

In other cases the company itself might take the initiative with an approach to the NEB. The processes of appraisal and evaluation would then, of course, be more specific to that company.

Afterwards one person of a division was designated to negotiate with the firm. Sometimes - though this was not always true - if the investment was approved the negotiator became Director of the company or remained in charge of the company's affairs within the NEB, thus assuring a continuing responsibility for his own recommendations.

4.5 CONTROL OF SUBSIDIARIES

The subsidiaries were requested to prepare an annual plan and a five year plan. Both plans were studied by the division concerned and submitted to the Planning Department which was in charge of the formulation of the Corporate Plan for the NEB as a whole. This had then to be presented to the Secretary of State for Industry. None of these Corporate Plans was published. Their content was therefore not available to this research.

As was stated in the Annual Report, 1977 (page 10): "the NEB has a firm policy of not interfering in matters of day-to-day management. A system of regular reporting will be agreed with the company. NEB's main concern is to see the company expand as quickly and profitably as possible, within the capability of its management resources" [28].

This quotation gives a good summary of what has been the main managerial pattern during the four years.

4.6 GROUP PERFORMANCE

There is no doubt that pragmatism and the vicissitudes of government policy have been the main determinant factors behind this philosophy of management. To obtain the acceptance of the private sector has been the fundamental target of the Board.

However, a closer analysis may reveal that there has been also a kind of struggle between the different concepts of what a SHC should be in the UK. The Board has achieved acceptable results in growth, rate of return, degree of acceptance by the financial institutions and public at large. On the other hand the NEB structure has proved to be fragile and there is little evidence as yet that it will produce any long term and significant impact on the British economy.

The ease with which the structure has been pruned of vital companies by a new government, shows the low degree of integration of the structure. As yet, the activities of the NEB have been more akin to those of a merchant bank than those of an active holding company still less a multidivisional enterprise - at least with respect to those investments it has made other than by government direction. Whilst this may be a valid function for a state-financed body, and one which undoubtedly has been ascribed to the NEB, it is only a part of the role which is generally assumed for the SHC model. This would encompass, e.g., the functions of the former Industrial Reorganisation Corporation as well as of a state bank.

There is no reason why a state industrial group should achieve a better result than a private corporation, if its structure is a simple aggregate of individual firms where collaboration is not encouraged from the headquarters. Large private corporations have learned from experience that widespread diversification must be combined with effective integrating structures which exploits synergy and which provides for an overall perspective of the various activities. For these purposes, a rational divisional structure has been a commonly adopted solution.

4.7 THE GROUP GUIDELINES

In the NEB's case the purposes as set up in the Industry Act 1975 (Section 2) [18] were, until the modification of August 1980:

1. To develop or assist the economy of the UK (or any part of the UK).
2. To promote industrial efficiency and international competitiveness, and
3. To provide, maintain or safeguard productive employment.

In its first report, the Chairman stated: "The NEB is an entirely new concept - a state-owned body operating in the competitive sectors of the economy and forming a bridge between state ownership and private entrepreneutial activity. It will take several years to prove whether or not this experiment can be successful". (1977, Annual Report, page 7) [28].

It can be observed that these purposes and this characterization of the NEB place it very close to the IRI model described in Chapter I.

4.8 THE FINANCIAL ROLE

Almost simultaneously at the request of the Committee to Review the Functioning of Financial Institutions, in November 1977 [16] the NEB produced the following statement, concerning its activities and functions:

"The main function of the NEB is the provision of finance for industrial investment, particularly for the expansion and modernisation of productive facilities in manufacturing industry. Finance is normally provided in the form of equity, but loans at commerical rates of interest may also be provided.

As a complementary function, the NEB is a holding company for shareholdings in industrial companies which it has acquired either through its industrial financing activities or through the transfer of such share holdings to it by the government".

In this statement signs of the struggle between the two different interpretations of the NEB that was pointed out earlier can be discerned.

One gives to the financial role the highest importance, and understands the holding structure as a simple means of holding shares of companies. This role is very close to that of a merchant bank. It leads directly to the actual structure that the NEB has developed during the four year period we have examined.

The other interpretation assumes that the holding structure is the main organisational target because it implies a corporate structure for the state industrial sector, and would more obviously allow the group to achieve its stated interventionist purposes.

The question is whether or not these two roles are compatible. It is arguable that they are not.

The function of providing finance to a given industrial sector may militate against the achievement of some of the SHC's more strategic industrial purposes.

Firstly, the provision of finance is predominantly a 'reactive' function, i.e. the initiative comes from the would-be-user of funds. In such cases only a very large volume of applicants from widely diverse fields would allow the SHC to meet its industrial objectives by the highly selective granting and withholding of funds.

Secondly, and more positively, different skills are required for the 'merchant banking' function from those of the interventionist functions. Particularly in the earlier stages of the SHC's development, a serious management overload may arise from the attempt to fulfil both functions with limited managerial resources.

The analysis of borrowers' applications, the opening of regional offices, and the implementation of a control system of the loans are necessary stages, once the service is offered to the public.

In fact, up to November 1977 about 300 companies came to the NEB asking for financial help, and only 10% actually received it [16]. It is worth bearing in mind the Guidelines set out by the Secretary of State for Industry in December 1976 (see Annual Report 1976, pages 45-56) [28] which pointed out the following framework to the financial activities: "The NEB may make loans, provide guarantees, engage in joint ventures or make any other form of financial commitment within a limit of £25 million for each project. Beyond that sum they shall act only with the approval of the Secretary of State, and in all cases where a proposed commitment exceeds £10 million or raises new or significant policy issues the NEB shall give the Secretary of State reasonable notice of their intentions. After giving notice in accordance with this paragraph the NEB shall wait for a reasonable time before acting to give the Secretary of State the opportunity to intervene to prevent or qualify the exercise of these powers by the NEB".

Certain initiatives adopted in years 1978 and 1979 suggest that this credit service to small companies had become embarrassing to the headquarters. Newton Securities Ltd was founded as a joint venture with the Midland Bank to make loans to small companies, and Sapling Enterprise Ltd was established in partnership with management consultants "to provide guidance and advice to selected smaller companies".

It may be observed that these new companies were intended to give credit and support to small firms. However, the NEB has been predominantly concerned with credit problems of the medium size companies (with a market capitalization below £15 million).

A policy of giving credits, from the headquarters, to medium size companies continued to be applied until the end of 1979.

Therefore, human and financial resources have been diverted to accomplish the credit function and this pattern in a relatively new and small organisation inevitably weakened its development in other areas.

4.9 STRUCTURAL PROBLEMS

A policy of investment based on lending money directly from the parent company will certainly lead to a radial structure, i.e. one in which each subsidiary or associated company maintains a direct connection with the headquarters.

This kind of radial structure does not favour the organisation of the group into divisions of real substance or logic, the creation of sub-parent or sub-holding groups, or the umbrella role that should be assigned to certain companies in order to decentralize the parent company's functions. As a matter of fact, in Fig.12, it is shown that the only sub-holding groups (British Leyland, Rolls Royce, Herbert Ltd, Ferranti and ICL) were already set up before the foundation of the NEB.

A brief review of the NEB's development during the years 1976-79 will show that:

> In 1976 the NEB received from the government six main investments, the so-called "transferee companies", i.e.:
>
> > British Leyland (BL)
> >
> > Herbert Ltd
> >
> > Rolls Royce (RR)
> >
> > Ferranti Ltd
> >
> > The Cambridge Instrument Company Ltd
> >
> > ICL Ltd

The aggregate activities of the NEB have been dominated by those transferred holdings. BL and RR were of such magnitude that they never could be integrated within the structure. On the other hand BL and RR together contributed in 1978 around 92% of NEB turnover. Furthermore, in the same year, the transferee companies took up 98 per cent of total loans made. Of expenditure already made between 1976-78 in the form of shareholdings or in loans to companies, only just over £50 million were devoted to non transferee companies [31].

In spite of these figures the growth of the group has been quite impressive, although little of it has been 'organic'.

4.10 GROUP DEVELOPMENT PATTERNS

At the end of its first year the NEB had investments in 13 companies (including the 6 previously listed). In 1977, 20 new companies were incorporated into the group, but none was due to government request. Of these new investments, four corresponded to totally new firms organised by the group from 'scratch'. At the end of 1978 the NEB had interests in 46 companies (13 more than in the year before). At the end of 1979 the investments were distributed over 70 companies, but 10 of these involved no equity capital; the investments consisted in loan stocks.

It is worth noting that some of the new companies set up in 1978 and 1979 were organised as partnerships between subsidiaries of the NEB. This has been the case of NEXOS, Muirhead Office Systems Ltd (MOSL) and Systems Programming Holdings (SPH) in relation with the wholly owned INSAC.

This feature may be seen as a new trend towards the organisation of sub-groups and an attempt to improve the collaboration of firms in new projects. However, the main tendency was still largely one of a radial structure, and it can well take, in the opinion of the former Chairman, ten or more years to find a suitable form of organisation.

We may argue that a more integrative pattern will be found only if the credit activities are reduced to a minimum, the emphasis is given to new projects and the initiative for these new projects is left in the hands of divisional headquarters. The growth of the group and the requirements of performance will then determine the structure and not, as at present, where structure and growth are largely determined by arbitrary demands from industry and the past government i.e. by improvisation to meet imposed commitments.

The NEB gets its funds from the National Loans Fund. The average interest rate has been around 12% and the maturity dates extend to 1997. (1979 Annual Report, page 43) [28].

Since these borrowing terms are very favourable, particularly in periods of rapid inflation, there may be a temptation to meet the SHC's stipulated financial objectives by lending for shorter periods. predominantly for low risk projects. This would seem to offer a less ardous and less hazardous way of achieving a target return than a process of putting out risk capital on the basis of a considered and researched investment strategy.

These kinds of distortions often develop in public organisations, and it seems better not to mix activities that could generate tendencies opposed to the general purposes of the organisation.

We can observe that, as was pointed out in the introduction, no recovery has been undertaken by the NEB during the four years just reviewed. On some occasions, this kind of recovery action was requested and the Board rejected the request, obviously trying to protect its future performance.

4.11 GROUP QUANTITATIVE ASSESSMENT

The figures below show certain quantitative assessments of the NEB performance:

TABLE I

% Rate of Return on Capital Employed 1976-79

	1976	1977	1978	1979
NEB and its subsidiaries excluding BL and RR	7.3	11.4	11.3	4.3

TABLE II

Turnover (£ Millions)

	1976	1977	1978	1979
NEB and its subsidiaries excluding BL and RR	58.4	195.2	321.9	212.9

TABLE III

Personnel

	1976	1977	1978	1979
London and Regional Offices Staff	47	62	89	92*
NEB and its subsidiaries excluding BL and RR	59,000	57,000	56,000	13,150

* last figure published, corresponds to April 1979.

TABLE IV

Number of Companies*

	1976	1977	1978	1979
NEB's portfolia including BL and RR	13	33	46	70

* figures at the end of year.

TABLE V

Administrative Expenses (£ Millions)

	1976	1977	1978	1979
London and Regional Offices	1.49	1.69	2.42	3.01

All the figures given above have been taken from the Annual Reports. In Tables I and II, British Leyland (BL) and Rolls Royce (RR) have been taken out because their aggregate activities and results would have otherwise dominated the figures. In fact these companies were never well integrated into the group.

Rolls Royce was withdrawn from the NEB by the government in November 1979, and a similar action is under consideration for British Leyland.

In Table I the NEB's rate of return has been calculated on the financial capital employed, defined as: "the aggregate of public dividend capital, reserves, loans from HMG, other loans, deferred taxation, minority interests, overdrafts and short term borrowing less bank balances and overdrafts". (see Annual Report & Accounts 1977, page 37) [28].

In Table II, the 1979 turnover figure shows a reduction mainly because Ferranti Ltd ceased to be a subsidiary company and its results were consolidated as an associated company. Including Ferranti's sales, the total turnover would have been around £394 million.

In Table III the figures of total personnel are only an approximation. The annual reports show the group's aggregate personnel including British Leyland and Rolls Royce. In the Table, figures for the latter have been substracted. The 1979 figure is given in the Annual Report and shows a large reduction in personnel. Part of this may be due to

Ferranti's withdrawal (16,464 employees) but the difference is still significant and unexplained.

4.12 RECENT DEVELOPMENTS

The NEB according to the most recent report at the time of writing (published on 11 April 1980) has maintained its responsibility for three major investments related to high technology initiatives, i.e.

(a) INMOS, for standard memories and microprocessors

(b) NEXOS, for office equipment and systems, and

(c) INSAC, for the overseas exploitation of UK software skills.

It has also developed a major investment in underwater engineering (British Underwater Engineering Ltd, BUE).

However, during the last months its shareholdings in ICL has been sold, as have those in Fairey Holdings Ltd and in Ferranti Ltd.

4.13 CONCLUSIONS ON THE NEB

1. The NEB does not correspond to the model of SHC that we have described in Chapter 1. Neither has it been the intention of its management to set up that kind of organisation. Their priority has been to adapt the NEB structure to cope with short term objectives, most of which have their origin in government directives and political pressures. As a consequence, the structure lacks a coherent multidivisional pattern and a central support system.

2. During the years 1976-79 there were no important rescue operations. No further "lame ducks" were added to the portfolio after 1976. New acquisitions were all made on the Board's own decision and judgement. When some requests for recovery actions were presented to the Board, they were turned down and the government did not persist in the matter. It is not possible to predict what would be the result if rescue operations were to be undertaken by the NEB.

   In practice, the NEB record with its "lame ducks" is mixed:

   British Leyland and Rolls Royce were withdrawn from the NEB.

   Herbert Ltd was in the process of dissolution, at the time of writing.

   Cambridge Instruments Company Ltd was transferred (75%) to the private sector after heavy losses.

   Ferranti and ICL recovered and were sold by government decision.

   The new investments have a similar mixed record:

   Fairey Holdings, after a successful recovery, was sold.

   Thwaites & Reed, British Tanners, Power Dynamics, Sinclair Radionics and Pakmet International suffered large losses and were sold or sent into receivership.

   What is evident from the records is that in these four years the NEB applied just two types of measure:

   (a) To input new funds and,

   (b) To change the management.

   No structural device has been set up to deal with loss-maker companies.

3. Few projects were generated from the headquarters, and as is observed by Foster [8], most of them were discovered by chance

or by the initiative of some external agency. No systematic search for new projects was reported, neither did any specialised organisation for this purpose appear within the structure.
The NEB's performance in this matter appears even weaker if it is compared with what was achieved by the Industrial Reorganization Corporation between years 1966 and 1971, when IRC undertook a total of 70 projects [26].

4. The target of a rate of return within the range of 15-20% by 1981 has not yet been achieved. Whether it was impossible to achieve this level in the then current circumstances is open to debate. As was pointed out by the new Chairman in his report on 11 April 1980:
"the present form of financial duty laid down by government (comparing the NEB to the average of manufacturing industry) can only make sense if the NEB maintains profitable investments as a means of supporting its new projects during their start-up and loss-making years". (Annual Report 1979, page 5) [28].

5. Collaboration was not encouraged or imposed from the parent company. It was left to the initiative of subsidiaries, but it seems that no results were achieved in this field.
No figure appears in the reports about intracompany trade, or the production of intermediate commodities as a way of integration, nor are joint ventures reported.

6. The organisation of INSAC and NEXOS as partnerships between subsidiary and associated companies of the NEB in trying to improve the marketing of their products overseas, was an important initiative towards the integration of the system. This may herald a new trend in the organisation.

CHAPTER V

THE STATSFÖRETAG GROUP IN SWEDEN

5.1 FORMATION AND STRUCTURE

The Statsföretag Group (National Business Enterprise) was found by statute at the beginning of 1970 with Statsföretag AB as the parent company of 22 directly-owned subsidiaries.

The information about the Swedish State Group has been mainly taken from the annual reports 1976, 1977, 1978 and 1979, from the Product Directory 1978, and from the Policy for the Statsföretag Group (1975). Private communications with the persons related to the group were also used.

At the end of 1979 the group comprised of 36 subsidiaries, most of them wholly owned by the state, with a wide range of activities and of levels of technology such as mining, steelmaking, organic chemicals, forestry products, electronics and machines tools.

Since its foundation, the group and the companies, have been through successive reorganisations. These changes seem to reflect mainly the following:

a) The 22 original companies tranferred into the group had already had long histories of independent operation. There was little background of cooperation and marked contrasts in management style and product orientation.

b) Thirteen of those companies were making a loss, and among the rest, only two were performing with acceptable profitability. From 1975 until 1979 the group suffered a long financial crisis. This was chiefly a consequence of the world economic recession that affected most of its heavy basic industries.

c) New guidelines were set up in the middle of the period with new targets and a complex system of compensation intended to

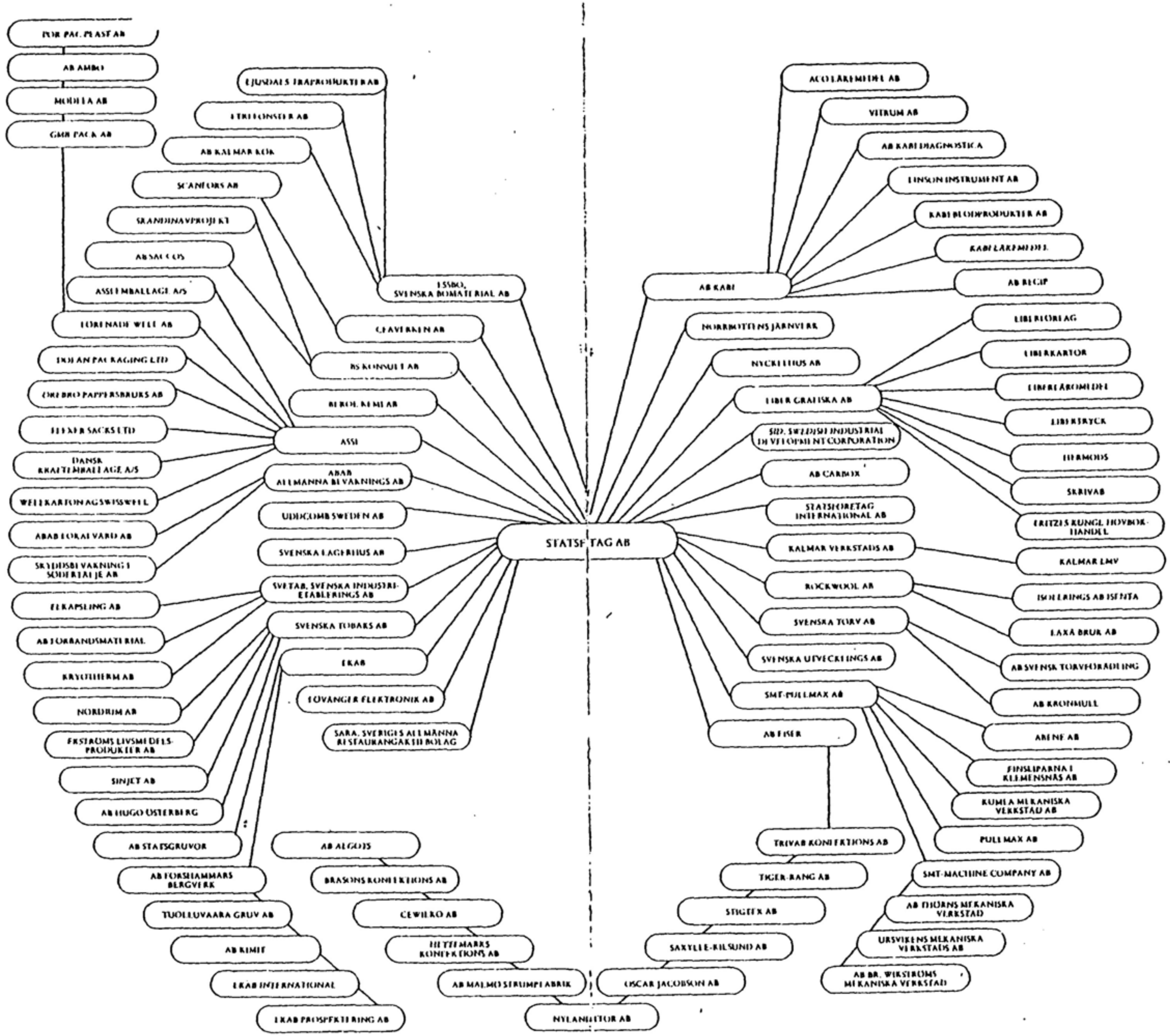


FIG.13. STATSGORETAG ORGANISATION CHART

balance unprofitable activities adopted as a consequence of directives from government.

This structural mobility and capacity for adaptation has become a characteristic pattern of the organisation.

5.2 DESCRIPTION OF THE GROUP

We have chosen the organisation chart published in 1978 [40] as the basis for a description of the group.

In Fig.13 is shown the relationship of property between the parent company, the twenty-six subsidiaries, and seventy operating units or affiliated companies at that time. The structure seeks to decentralize the group; each company has its own Board and President which runs the business; companies that belong to a similar or connected activity are placed under the umbrella of one sub parent company. For instance, The Kabi Group (see Fig.13, first subsidiary on top right), has as sub parent company AB Kabi, and this group comprises one of the largest pharmaceutical organisations in Sweden. The following operating units are included in the group: Kabi Blood Products, Kabi Pharmaceuticals Division, AB Recip, ACO Läkemedel AB, Vitrium AB, AB Kabi Diagnostica and Linson Instrument AB.

In 1978 it was decided to form a new subsidiary company within the Kabi group, viz Swe Drug Consulting AB. The company supply expertise to the group, for example in the planning of manufacturing programmes, forecasting, organising and installing manufacturing facilities, management services for operating these factories and training.

The evolution of the Kabi Group provides a typical example of the structural process which has taken place in the whole SHC.

"When the Kabi Group was formed in 1972 the companies had nothing in common except their owner, the State. Three companies with different product ranges, ways of operating traditions and aims, were to be merged into one unit. During the years since then we have attached great importance to this merging process. A decentralized organisational philosophy has been formulated, integrated administrative systems have been built up, central units for some staff and service functions have been found". [38, Annual Report 1978, page 46].

The other groups shown in the organisation chart have a similar structural and evolutionary pattern to that attributed above to the Kabi group.

The other important groups within the Statsföretag were shown with separate figures of capital expenditure in the annual reports:

1) ASSI, forest industry products.
2) Berol Kemi, organic chemicals.
3) Eiser, textile industries.
4) Kalmar, railway and transport equipment.
5) Liber, graphic industries
6) LKAB, ore mining
7) Rockwool, energy conservation.
8) Sara, hotel, restaurant and food service companies.
9) SMT-Pullmax, machine tools
10) Swedish Tobacco Company, tobacco and consumer goods.

There are also some other important subsidiaries and groups, which will be analysed later. However, it should be borne in mind that the eleven main groups (including the Kabi Group) represented 90% of total Statsföretag sales in 1979.

5.3 RECENT DEVELOPMENTS AND TRENDS

During 1979 and after Fig.13 was drawn up, six new subsidiary companies were incorporated into the group.

The list below gives their names and principal activities:

1) Kockums Chemical AB: Time-temperature sensitive products.
2) Kockums Automation: Control in sawmilling and cargo distribution.
3) Kockums Industri: Machinery for the forestry and timber converting industries.
4) Regioninvest i Norr AB: Industrial Development in the north of Sweden.
5) Serva Promotion AB: Specialised sales company.
6) Statsforetag Contracting AB: Marketing of installations and systems using group's know-how.

The three Kockums companies were incorporated in 1979 following the decision by government to takeover the KIAB group affected by the shipbuilding crisis (the latter activity was not incorporated). The reconstruction of the KIAB group has been undertaken by Statsföretag in accordance with an agreement with the state, by which compensation is paid to the group for expenses incurred in its rescue role.

Regioninvest i Norr AB was set up and conducted solely with direct government funding.

Serva Promotion AB was acquired from a private company mainly to assist in the marketing of manufactures from areas receiving regional employment aid.

Finally Statsföretag Contracting AB was set up in order to provide services and goods in connection with projects that involve heavy capital expenditure by the prospective customer of any company of the Statsföretag Group.

We may conclude then that the new subsidiaries are the results of either rescue operations or of government industrial policy or lastly, of the necessity to set up service companies for the rest of the group. We will return to this point later on.

All the subsidiaries we have already described are wholly owned by the parent company. There are three associated groups in which Statsföretag owns between 45% and 50% of the equity. But the other shareholders are state corporations or companies under the control of the group itself. There is no explanation in the Group Annual Reports of the absence of joint ventures and partnership with the private sector. Only one company - Uddcomb AB, manufacturer of heavy reactor components for nuclear power stations - is reported with a 25% shareholding by an American corporation.

This lack of mixed ownership might be due to factors external to the Group. In its terms of reference it is clearly established that the parent company is to exercise its functions towards the subsidiary companies in collaboration with any prospective minority part-owners that may arise [39].

The group classifies its activities into eight main business fields. The ways in which the relative importance of these fields have changed during the period 1970-79, are shown in the table below:

TABLE VI

Sales by Field of Business as % of Net Total

	Activity	1970 %	1976 %	1979 %
I	Iron and Steel	41	30	18
II	Mechanical Engineering	13	16	9
III	Forest Products & Building Materials	16	22	31
IV	Chemicals	4	10	12
V	Consumer Goods	21	15	16
VI	Services	3	5	6
VII	Development & Venture Capital	1	1	1
VIII	Other Companies	1	1	7

The tendency has been clear: a sharp reduction in Iron and Steel activities and a huge increase in Forest Products and Building Materials, and Chemicals.

Although on a smaller scale, "Services" has maintained its share of turnover.

The rise in "Other Companies" in 1979, is due to the inclusion of Eiser - the textile group, into this category.

5.4 THE GROUP PERFORMANCE

The following tables give a guide to the Statsföretag's performance in recent years:

TABLE VII

% Rate of Return on Total Assets*

1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
6.8	4.4	4.9	6.6	12.3	5.0	0.3	-2.8	-1.7	1.0

*Defined as the consolidated result after financial income and costs plus interest cost as a percentage of average total assets in the balance sheet (approximately financial return).

TABLE VIII

Net Sales SKr Million

1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
3,592	3,947	4,441	5,606	8,063	7,923	9,747	9,187	10,105	12,177

TABLE IX

Average Number of Employees

1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
34,093	34,285	35,022	36,999	41,299	45,957	47,710	42,281	43,690	46,458

TABLE X

Number of Employees in Parent Company

1975	1976	1977	1978	1979
50	56	63	65	63

TABLE XI

Number of Subsidiaries

1975	1976	1977	1978	1979
26	31	32	30	36

TABLE XII

Expenses in Parent Company
(SKn Million)

	1975	1976	1977	1978	1979
Labour Costs (1)	6.9	10.4	13.8	17.0	17.6
Total Administration and Development Costs (including (1))	15.7	21.8	28.1	33.9	52.4

These figures show the deep financial problems that the group has faced from 1975 until 1978 and the small recovery in 1979. It can be observed that the group has managed to increase the net sales continuously, with the sole exception of 1975.

The total number of employees has been maintained with the exception of 1977 when a reduction of 11% occurred due mainly to the state interventions in the shipbuilding, steel and textile industries.

The personnel and the labour costs in the parent company have been kept in reasonable figures. The total costs of the parent company have grown sharply, because some development costs were included in the last three years.

5.5 GUIDELINES OF THE GROUP

The purposes of the group evolved from its foundation until 1975 when was published the "Policy for the Statsföretag Group" [5] which lays down the tasks of the parent company, the responsibility of subsidiary companies, the relationship among them, and with the government.

The general goals of the group according to [39] are:

a) In the long term: to attain expansion in the area stipulated by the government, within the demands of profitability.

b) In the short term: to increase the efficiency, competitiveness and profitability of the state company sector, by means of rationalisation and coordination.

c) To provide work satisfaction and greater participation by employees in company decision-making processes.

d) Additionally the group has the duty to submit tenders, at the request of the government, for such special tasks as the state might demand to be undertaken by the group.

This last obligation of the group, which was incorporated in the original statute, has been called "the quotation principle", and it deserves further explanation. It means that the group is obliged to submit a quotation for the costs - over and above the purely commercial aspects - of accepting tasks that the state might request to the group to be performed.

In fact, during the last years this kind of activity has expanded, thereby obliging the group to set up a clear distinction between normal commercial activities, and the special program activities. The latter include rescue operations, regional development and local employment creation; these activities involve the investment and administration of public funds and for this purpose the group has devised a special accounting system. This we will return to later.

The parent company is responsible for the aggregate financial results of the overall group; the state is able to demand dividends from the group and it expects, after a transitional period, to obtain at least the same yield on invested capital as is generally achieved by companies of this kind in Sweden [39].

It may be observed that this responsibility is very similar to that attributed to the NEB (see Chapter IV). The difference is that the public funds were given to the NEB as loans with a fixed rate of interest. The rate of return target was not linked with the payment of interest or repayment of loans. In the Statsföretag case the state funds are considered as investments that do not yield interest, but the state expects a dividend upon these investments and the dividends are set up as targets and as a standard for measuring the performance of the group.

Due to this duality of activities, commercial and non-commercial, the parent company has been obliged to restrict the autonomy of subsidiaries, and has reserved to itself to:

a) set up objectives for the activities of the subsidiary companies
b) be responsible for the overall planning of the group as a whole
c) collaborate in the procurement of capital for the companies in the group, and
d) collaborate in the recruitment and training of personnel for management functions.

The main emphasis in the activity of the parent company is the strategic planning of the group and its structural development. This implies the right of coordinating the financial policy within the group and the profit allocation between dividends and reinvestments.

5.6 INFORMATION AND CONTROL

Every company of the group is requested to have a strategic plan for the next three to five years, requiring continuous attention to long-term planning [39].

If a company wishes to expand activities into an entirely new field it must obtain the approval of the Board of Statsföretag AB. The same requirement arises when there is to be any important expansion within existing fields of production.

The parent company must also be consulted in the taking up of any major long-term loan or for any large personnel changes.

The parent company nominates the members of the Boards of the subsidiary companies, and requires from them the following information:

a) Summary of long-term plans

b) Summary of the annual budget

c) Annual balance sheet

d) An interim statement of accounts twice a year (or every month in certain companies).

5.7 COLLABORATION

In the policy statement [39], collaboration between the companies is stressed as a condition of the progress of the group. It is emphasised that collaboration must take place continuously so that by their joint efforts the competitiveness of the group will be strengthened.

In the annual reports, there is no description of the forms that collaboration has taken in the past. Nevertheless, the figures of intra-group sales are reported each year and are shown below:

TABLE XIII

Intra-Group Sales
(SKn Million)

1975	1976	1977	1978	1979
218.3	188.3	189.5	52.5	160.6

Though these figures are not of great significance in relation to the total sales of the group, they show that trade between subsidiaries does exist and the fact that the figures are published as a separate item, shows certain encouragement from the headquarters.

5.8 SPECIAL ACTIVITIES

As was pointed out earlier, the group has divided its activities into two types: (a) normal business activities and (b) special program activities. By the latter is meant activities where the state is responsible for meeting the costs of achieving the industrial policy goals stated in parliamentary or governmental decisions.

Some of these special activities may consist in rescue operations, in which, the group is requested to takeover a company that is in danger of bankruptcy. In those cases, and since open information about the state group is especially important, all the economic circumstances are registered following a basic principle, i.e. the financial position and the results of the group should not be affected by events prior to the date of the acquisition or that can be foreseen at the time of acquisition. Thus, all the negative items that may be worked out according to the principle are demanded from government as a contribution to the rescue operation.

The other special activities, regional programs, employment promotion, marketing activities, etc. are evaluated in a similar way and together with the rescue operation quotations they set up the total contributions from the state to the group.

On the other hand, five of the subsidiaries are classified as developing companies and most of their budgets come directly from the state.

We have already referred to the new subsidiary called Regioninvest i Norr AB the function of which is to promote industrial development in the Norrbotten region.

Svetab AB is an investment and venture company that participates in the establishment of new firms, concentrating on small and medium-sized enterprises. It also works on a consultancy basis actively supporting the company's management.

The Swedish National Development Company (SO) operates as a central development unit for the whole group and also constitutes a resource of expertise taking a long term perspective in products, methods and systems which are in the national interest.

The Swedish Industrial Development Corporation (SID) acts as a liaison organisation in North America trying to promote the introduction of Swedish products and systems in the USA and Canada.

The Swedish State Company International Ltd develops marketing activities outside Western Europe and North America.

5.9 SERVICE COMPANIES

Three subsidiaries are classified as "service companies", but the term "service" is mainly to be understood as belonging to the service sector. No information is available about what proportion of the turnover of these three companies is obtained as intra group trade.

In fact, ABAB-ALLmanna Bevaknings AB is a security services organisation with clients in both the public and private sectors.

Liber Gregiska AB is the graphic subsidiary which includes publishing, printing, training and educational activities.

The third subsidiary is BSK BS Konsult AB, a consultant firm to the construction sector. The company conducts surveys, programming and project work for buildings and facilities. An affiliated company is in charge of project in provision and administration, and another deals with overseas work.

None of these three companies seems to be especially involved in intra group trade, and there is no information available concerning their participation in rescue operations.

The actual service companies set up as supporting activities to the rest of the group were referred to in paragraphs 2 and 3 of this chapter i.e. Swe Buig Consulting AB, Servapromotion AB, Statsföretag Contracting AB. They are all new companies. Svetab AB established in 1975 can also be considered a true service supporting firm, because it helps new or existing companies primarily within the group, on a consultancy basis.

Loans made by the group to the private sector are not recorded at all in the annual reports.

5.10 CONCLUSIONS

1. The Statsföretag group has a complex and non-homogenous organisation. A changing structure has been its pattern: incorporating new and old companies into the group, merging firms within the group, and re-organising subsidiaries in charge of various operating units, have been the characteristic modes during the ten years under review.
   A prolonged financial crisis has affected the group, particularly certain basic activities with large turnover, i.e. in the mining, steel production and shipbuilding sectors, from 1975 to 1979. When allowance is made for the effects of these circumstances it can be considered that the group has performed remarkably well.

2. The group has been in charge of numerous and important rescue operations, as well as more continuing non profitable activities. The group has not sought to avoid these kinds of operations nor has it shown any resistance to their imposition. On the other hand, a complex accounting system has been developed in order to regulate the provision of funds from government. A clear distinction exists between funds that are given as investments, expecting a dividend, and compensation funds to finance "the special program activities".
   Compared with the NEB, the Statsföretag group seems to be closer to the SHC model, playing an important role in the industrial development of the country.

3. No financial role, such as the provision of funds to companies outside the group, appears in the Policy statement of the group, none of these activities appeared in the annual reports.

4. No specific system to handle rescue operations can be discerned. The small size of the parent company headquarters does not seem sufficient to face the problems which arise from large rescue involvements. The parent company has delegated these operations to the subsidiaries or sub parent companies. Also the generation of new projects is decentralized and mainly developed at the level of the operating units.
It would appear that two direct consequences of this decentralized management pattern, have been the proliferation of the subsidiaries and the indistinct definition of divisions within the structure. However, insufficient information has been available to assess the development of the group at the subsidiary and operating unit levels.
In that respect, a relevant feature has been the appearance at the subsidiary level of service companies that maintain certain resources in order to support other companies within the group. Also remarkable has been the degree of collaboration between the companies and its encouragement from the parent company.

CHAPTER VI

THE IRI GROUP

6.1 BRIEF DESCRIPTION AND HISTORY

Since the Italian SHC is the best known of the European state groups, and Holland [14] has provided a comprehensive description of it, we will discuss here only those features that are relevant to our comparative study. In addition, the IRI structure is so large and complex that a full description would go beyond the purposes of this thesis. Apart from Holland's [14] main sources of information used have been the IRI's Annual Reports of 1976 and 1977 and the Directory of the IRI's group in 1977.

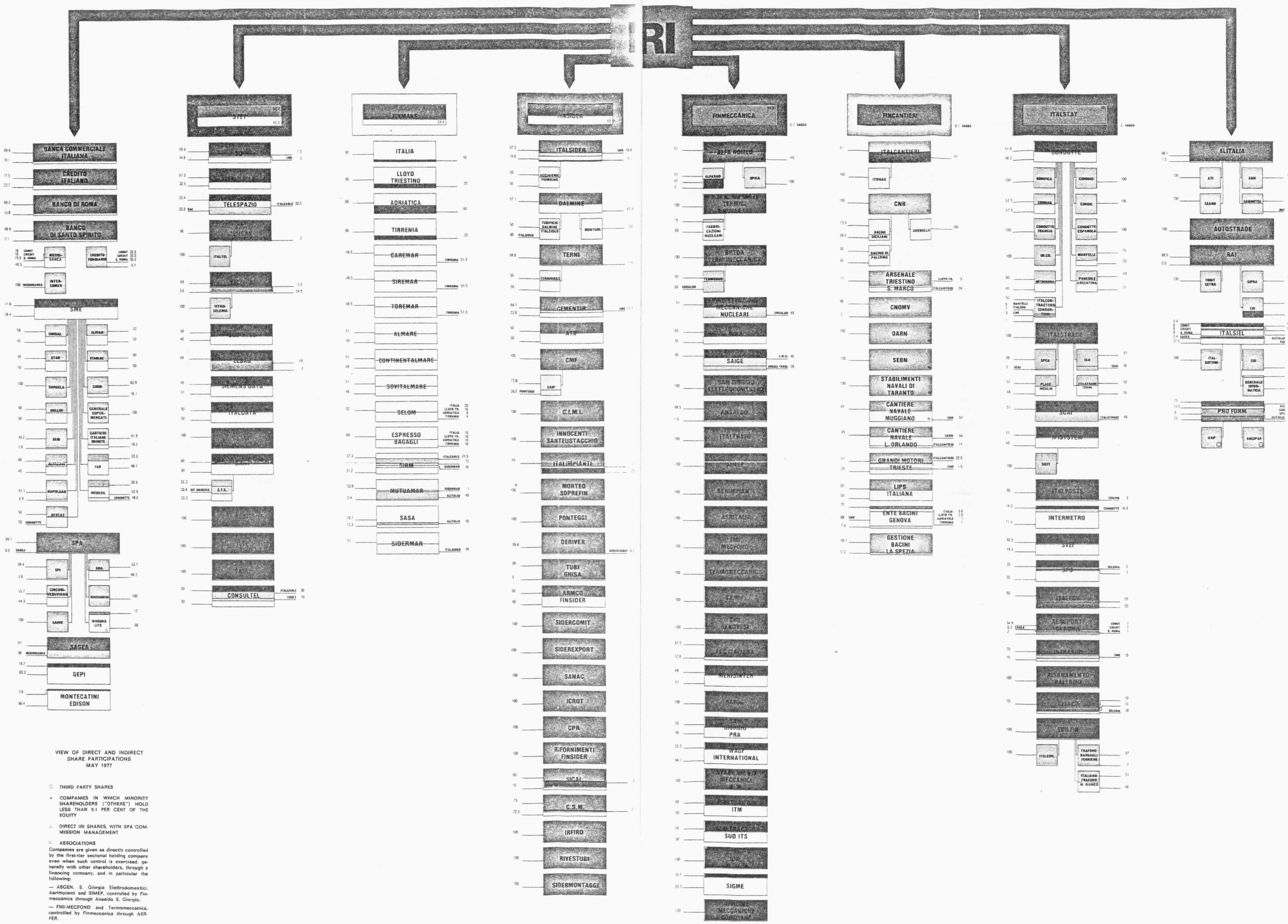
As was stated earlier, The Institute for Industrial Reconstruction (Istituto per la Ricostruzione Industriale - IRI) was created in January 1933 as an emergency operation during the depression.

Three important banks went bankrupt (Banca Commerciale Italiana, Credito Italiano and Banca di Roma) and the Italian State looked for a formula to disengage the banks from their medium and long-term investments in industry. In 1937 the IRI was declared a permanent body, an 'ENTI', and began to enlarge its field of activity operating through financial holding companies which link and control a wide range of industrial and service enterprises.

In 1948 the IRI was given a new structure which has retained its basic features to the present day.

Fig.14 shows the group structure in 1977. Its chief characteristics will be drawn out from that diagram.

The companies are grouped under a number of IRI-controlled 'finanziarie' or sub-holding parent companies, mainly by field of activity.



VIEW OF DIRECT AND INDIRECT SHARE PARTICIPATIONS
MAY 1977

□ THIRD PARTY SHARES

* COMPANIES IN WHICH MINORITY SHAREHOLDERS ("OTHERS") HOLD LESS THAN 0.1 PER CENT OF THE EQUITY

△ DIRECT IRI SHARES, WITH SPA COMMISSION MANAGEMENT

○ ASSOCIATIONS

Companies are given as directly controlled by the first-tier sectorial holding company even when such control is exercised, generally with other shareholders, through a financing company, and in particular the following:

— ASGEN, S. Giorgio Elettrodomestici, Aerimpianti and SIMEP, controlled by Finmeccanica through Ansaldo S. Giorgio.

— FMI-MECFOND and Termomeccanica, controlled by Finmeccanica through AERFER.

FIG 14

The principal "finanziarie" with their corresponding sectors are as follows:

			Sectors
1.	Finsider	-	Iron and Steel
2.	Finmeccanica	-	Engineering
3.	Fincantieri	-	Shipbuilding
4.	Stet	-	Electronics and Telecommunications
5.	Finmare	-	Shipping
6.	Italstat	-	Infrastructures and Construction
7.	SME	-	Miscellaneous
8.	SPA	-	Development of Southern Regions

On the top left-hand side of Fig.14 is shown the banking sector, without "finanziarie" as a sub parent company, i.e. the IRI controls the four main banks by direct link.

The banking sector is part of the IRI as a consequence of the origin of the group. But the banks do not play any important direct role in the administration of the group, and are normally excluded from any performance evaluation.

On the right-hand side of Fig.14 there are four important companies specialising in services: the RAI, Radiotelevisione Italiana; Alitalia - Linee Aeree Italiane; Autostrade (Motorways) and Pro-forme-Investi e Iniziative per la Formazione Professionale (professional training).

The parent company is set up by law and is defined as a financial public corporation (i.e. ENTI, "ente autonomo di gestione").

All the holding companies within the group are organised as public companies with shares. They have self-administered bodies and operate according to commercial criteria.

In the IRI the decentralization concept has reached its most highly developed form in that the parent company delegates to its subsidiaries all operating functions. Only investment policy by way of a central capital budget and long and medium-term goals are imposed on the subsidiaries.

Due to its special structural features, this form of decentralizing is transmitted from one level to another lower level, from the parent company to its subsidiaries, from each subsidiary (which in turn is the parent company of other firms) to its associated firms, and so on. As the IRI permits partnership with the private sector at the lowest levels, and there is a strong tendency to use non-shareholding professional managers then decentralization produces a very high level of autonomy among companies. In fact, the structure is such that the group's control and state's partial ownership over the operating unit become weaker and weaker, until a point is reached where there is no practical difference between a firm belonging to the holding-company and any other private enterprise.

In Fig.14 the figures adjacent to the companies names, show the participation in percentages, by the private or public capital, in the equity of each firm. In many of the companies the partnership is not with small private shareholders, but rather with other large firms, controlling a particular company to serve their common interests.

The group comprises - in Italy and abroad - around 600 companies, without taking into account 45 banks and financial firms. These figures were compiled by adding all the independent companies that appear in the 1977 Directory of the IRI group [19]. However, the figure that more often appears in the studies of the IRI [2] shows around 350 state holding firms in Italy. The consolidated balance sheet of the group in 1976 comprised 467 industrial enterprises and 92 banking companies. The non-consolidated companies, in which the IRI is not a majority shareholder and which it does not control, number around 90.

Finally, in 206 companies in which the IRI is a majority shareholder or otherwise has a controlling interest, there are those shareholders that do not belong to the group (so-called 'third parties').

6.2 THE IRI's GUIDELINES

The purposes of the IRI were not established in the 1948 Bill which approved it as a statutory body. In Article 1 it is said: "It pertains to the council of Ministers to determine the general course of the Institute's activity in the public interest". [19, page XIII]. Since 1967 this function belongs to the Economic Planning Inter-ministerial Committee (CIPE) by direction of the State Participations Minister. Over the years, the IRI has been given new targets and guidelines, but no authoritative and up-to-date text has been produced concerning the actual purposes of the state group.

Allen [2] points out that it is generally accepted that the major roles of the 'finanziere' groups are:

a) Leading the rest of the economy by example (new production techniques, management and labour training, etc.).
b) To inject competition into parts of the Italian economy.
c) To promote and intervene in activities where private firms have been unable or unwilling to intervene (steel industry, telephone

sector, etc.).

d) To apply a counter-cyclical policy, and, not the least,

e) It must combine commerce with social considerations, i.e. regional development, limiting damage from bankruptcies, etc.

Due to the imprecision and complexity of these objectives, it is difficult to produce an assessment of the efficiency and performance of the group which gives due weight to each. It has to be remembered furthermore that after 1957 the IRI and other state agencies were compelled by law to locate in the South of Italy, the region called Mezzogiorno, 40% of their overall Italian investments and 60% of their investments in new industrial enterprises. These figures were raised to 60% and 80% in 1971 [2].

On the other hand, it should be noted that the IRI is only a part of the Italian state holding system; there are five other "ENTI" apart from the IRI. The ENI (within the field of hydrocarbons) is the second largest after the IRI, and the only one of comparable size. The objectives listed above are then the common purposes of all the six ENTI, and not of IRI alone. Although sharing responsibilities with the other ENTI, by the end of the 1970's IRI was easily Italy's biggest company and among the twenty largest corporations in the world [2].

6.3 IRI's PERFORMANCE

It is said that the goal of IRI is success, not profit, and that IRI has no policy of its own. Its objectives are those of the state [14].

Perhaps due to this there is no profitability assessment in IRI's balance sheets, at least not in the common form of a rate of return on total investment. In contrast, there is plenty of information about several other performance variables of the group i.e. turnover, personnel, growth, investment, etc.

It should be emphasized that the form in which the IRI obtains its finance is different from the other two SHCs we reviewed in previous chapters, and there is an important interdependency between the finance and the economic results of the group.

The group has five main sources of finance:

a) bonds

b) medium and long-term loans

c) short-term loans

d) self-finance and

e) state finance

The finanzieri and the companies do not enjoy direct access to state finance, but are able to raise funds by floating equity [2]. The items (a), (b) and (c) together represented 89.6% of the total in 1976 and 79.9% in 1977 [19, IRI Annual Report 1977, page 57].

The small proportion of self-finance and state finance, has led to an increased indebtedness in the capital market, which can be seen in Table XIV below:

TABLE XIV

Ratio of Equity to Total Capital Employed in %

	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977*
IRI Comps. on Consolidated Basis	27.6	27.4	23.9	21.2	17.7	17.2	16.5	18.5	-	12.0

(see Annual Report 1976, page 112, abridged version in English)

*1977 figure taken from IRI Relazioni e Bilancie 1977, page 105 [19].

TABLE XV

Total Sources of Finance (Million US Dollars)

	1970	1971	1972	1973	1974	1975	1976
Total Finance	1,678	2,329	2,893	3,724	3,854	5,022	3,985

(see Appendix - Annual Report 1976, abridged version in English [19].

The total sums shown in Table XV comprise: self-financing, state contributions to IRI's Endowment Fund (Equity from the State), equity, medium and long-term debts, short-term borrowing and other transactions.

In 1976-77, short-term borrowing amounted to 54% of all the funds employed, whereas it represented only 31% during the preceding eight years (1968-75).

On the other hand state contributions, which were 14.2% of total funds during the period 1968-75, diminished to 7.1% in 1976-77.

These figures demonstrate the progressive dependency of the group in its borrowing capacity in the capital market. As a high proportion of the investments and takeovers are by request of the government, the group is burdening its finance with the payment of interest, which in turn increase the indebtedness. The Board of Administration estimated that the burden of this sub capitalization in 1977 had grown to between 400 and 500 billion liras (between 4.7 and 5.9 billion dollars), a figure that roughly corresponds to the group losses in the same year (see IRI Relazione e Bilancia, 1977, page 106) [19].

The breadth and 'macro-economic' character of IRI's objectives (and perhaps also its growing reliance on debt capital) may explain the form in which its financial results are presented. This makes use of the 'value added' concept and shows the proportions of value added attributable to various inputs including borrowed funds.

In both the original version of the Annual Reports, in Italian, as well as in the abridged version in English, is used the expression "Return on total capital invested" ("Redditi del capitale complessivamenti investito").

TABLE XVI*

Value Added of IRI

	1968	1975	1976	1977
Value Added (Billion Current Lire)	1350	5140	6340	7200
Components in % :				
1) Wages, Salaries and Social Charges	59.5	69.8	65.9	65.3
2) Amortization	16.6	13.9	13.9	15.5
3) Direct Taxes and Rates	4.4	2.7	2.4	2.6
4) Return on Total Capital Invested :	19.1	13.6	17.8	16.6
Net Interest Paid	(16.1)	(22.8)	(25.4)	(27.7)
Net Return on Equity	(3.0)	(-9.2)	(-7.6)	(-11.1)

Table XVI shows value added divided into the shares of labour, amortization, and taxes and rates. The rest is called "Return on total capital invested", but is actually the proportion of the value added remaining after the subtraction of the former shares, without any reference to the actual capital.

*Taken from IRI Relazione e Belancio 1977 page 103 - Figures for 1975 were taken from Annual Report 1976 (abridged version) page 10 - Figures of 1977 were provisional. They include the whole value added of the companies with at least 50% of group participation [19].

It should be observed that what Table XVI shows is not the rate of return, but the share of the gross profit (before interest) as a proportion of the value added. In order to calculate the actual rate of return on total capital invested we need the net profit, as the gross profit less interest paid, divided by the total investment. The latter could be expressed - as total financial capital - as the average of the amounts at the beginning and end of year of the equity capital plus the borrowed capital. These figures would then be comparable with the rate of return calculated in the NEB and Stato Statsörestag figures. However, as was noted earlier, these figures are not shown in the IRI Annual Reports, and little emphasis is placed on profitability assessment. The so-called "return on capital" is then split in Table XVI between the part paid to the borrowed capital (net interest paid to the capital market) and the remainder of value added is called "return on equity". The latter is negative in year 1975, 1976 and 1977, obviously very much affected by the interest paid.

In 1978, IRI was asked by government to incorporate a number of heavily loss-making subsidiaries of EGAM (Enti Autonomo Aziende Minerarie) the state mineral agency, which was being dismantled. These subsidiaries, IRI argued, accounted for most of the increase in losses from 1977 (when they were 845 billion liras, i.e. US$ 986 million) to 1978 when they increased to 1,067 billion liras, i.e. US$ 1,200 million. (See Financial Times, 31.5.79).

Between 1968 and 1977 the value added grew more than five-fold as a result of the growing activity made possible by investment in the companies concerned and from the acquisition of a number of companies. No information is available about the number of takeovers in those years, but it is stated in the 1976 report that in the period 1966-70, the companies taken over had 11,000 employees, and those taken over between 1971-75 had 50,000 employees.

In spite of the fact that the state contribution to IRI's endowment fund has been considerable between years 1970 and 1975 no mention of its applications is made in the reports, therefore, it becomes even more difficult to access the performance of the group in objective terms.

The following tables show figures relating to the group's growth.

TABLE XVII

Total Turnover (Million US Dollars)

1970	1972	1974	1976
5,474	8,038	12,584	14,643

TABLE XVIII

Total Fixed Investment (Million US Dollars)

1970	1972	1974	1976
1,394	2,640	2,848	2,956

TABLE XIX

Total Employees (Thousands)

1970	1972	1974	1976
355	451	512	527

TABLE XX

Employees in Parent Company and Sectoral Holdings (Thousands)

1970	1972	1974	1976
1.2	1.3	1.5	1.5

These figures show how remarkably well the group has managed to sustain its development and expansion during the years of Italy's recession (1970-1973). The IRI has been used as a counter-cyclical economic tool, and this may help to explain its financial problems [2]. It may be legitimate to argue that if these "special programme tasks" were to be accomplished by giving the group "special funds" (as we have seen in the Swedish practice), the financial results would have been significantly better.

6.4 CONCLUSIONS ON THE IRI

1. As was expected, the IRI group has a clear multidivisional form. Its divisions have a neat sectoral orientation with a sub parent company at the head of the sector. When a group of companies have similar characteristics within a division they are placed under the umbrella of a sub-sub parent company. The purpose of this is to combine decentralization with ultimate control of the sector. The organisation of a division, in groups and sub groups, can be appreciated from Fig. 15, which corresponds to Finmeccanica. In that division the companies Alfa-Romeo, AMN-Impianti Termici e Nucleari Spa and Ansaldo are at the head of their respective sub groups.

2. This complex structure has been achieved after successive re-structurings of the group over at least thiry years. Companies that did not fit well within the divisional structure were passed to other ENTIs. On the other hand IRI took over three heavy electrical equipment companies from EFIM between 1970 and 1973 [2] and in 1978 it acquired several subsidiaries of EGAM,

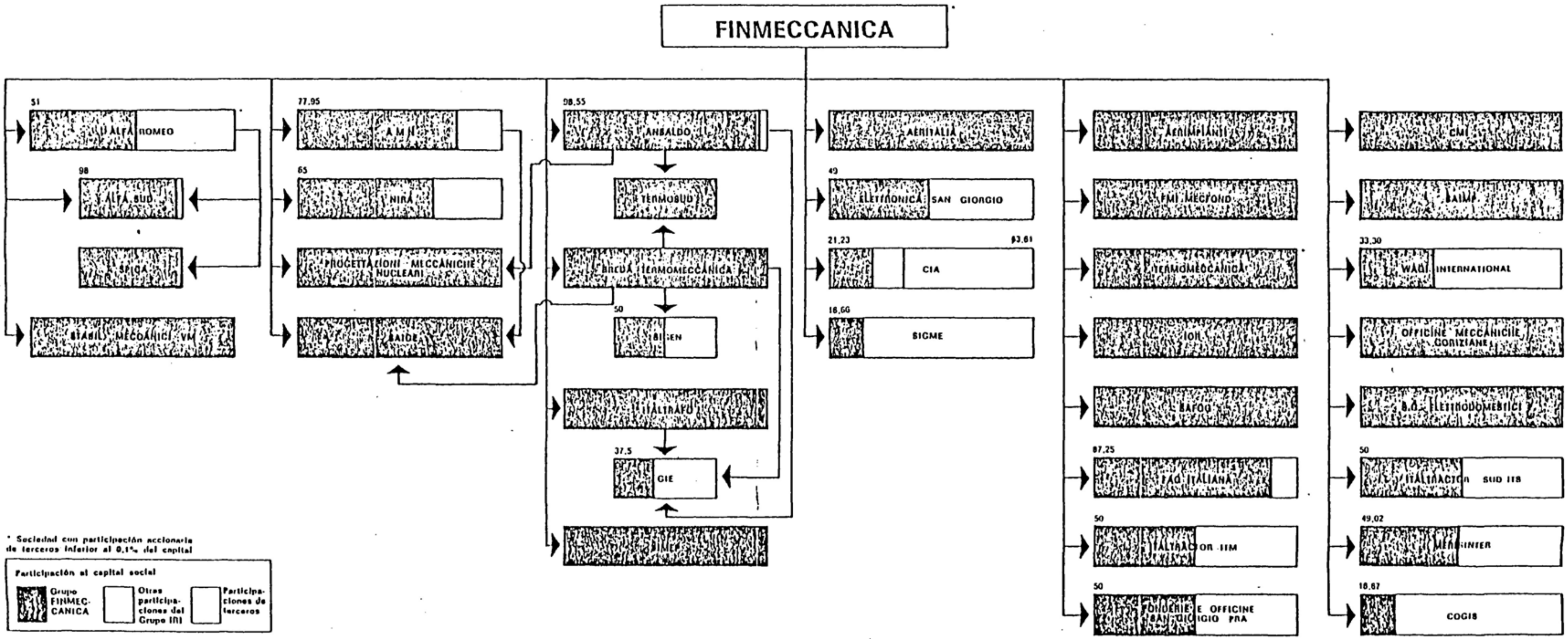

FINMECCANICA
51
ALFA ROMEO
98
ALFA SUD
SPICA
STABIL. MECCANICI VM
77,95
A M N
65
NIRA
PROGETTAZIONI MECCANICHE NUCLEARI
SAIDE
98,55
ANSALDO
TERMOSUD
BREDA TERMOMECCANICA
50
ITALTRAFO
37,5
GIE
AERITALIA
49
ELETTRONICA SAN GIORGIO
21,23
CIA
16,66
SIGME
AERIMPIANTI
FMI MECFOND
TERMOMECCANICA
IOR
87,25
FAG ITALIANA
50
50
FONDERIE E OFFICINE
CMI
33,30
WAGI INTERNATIONAL
OFFICINE MECCANICHE GORIZIANE
50
49,02
16,67
COGIS
* Sociedad con participación accionaria de terceros inferior al 0,1% del capital
Participación al capital social
Grupo FINMECCANICA
Otras participaciones del Grupo IRI
Participaciones de terceros

FIG.15.

related to mining.
However, the basic structure and characteristics of the group that were identified in Holland's study [14] have remained without significant changes. In 1979 the new IRI chairman was reported to be planning a major internal reorganisation of the state conglomerate (Financial Times, 31 May 1979). However, that reorganisation has so far not been announced.

3. No special recovery system is set up within the IRI structure, nor is the concept of "service company" used within the meaning defined in Chapter III.
The structure seems to be so large that it can provide resources from many different places as required to the companies under recovery. However, the main reason may be the lack of profitability targets. Many of the interventions that were described earlier involve taking actions that, in the short-term may act against narrowly commercial objectives. In the Annual Reports there appear explanations of reported losses; but no attempt seems to be made to separate the commercial from the non commercial activities and to establish a quantitative criterion of profitability. The IRI approach in this matter is absolutely different from the criteria adopted by the two other SHCs we have reviewed.
With respect to "service companies", two enterprises may be seen as coming closest to the concept we have used. They are: Proform - Investi e Iniziative per la Formazione Professionale S.p.a. and Societa Italiana Sistemi Informativi Elcettronici Italsiel p.A.
Proforma is the parent company of two subsidiaries or operating units, i.e. ANCIFAP, Associazione Nazionale Centri IRI Formazione

Addestramento Professionale and IFAP, Istituto per la Formazione e L'aggiornamento Professionale. The main task of these companies is vocational and management training. They coordinate and integrate the training activities of the whole group and also establish and run training centres for skilled workers, technicians and managerial staff.

Proform and its subsidiaries supplement but do not replace the internal training schemes of the IRI's companies. Furthermore, they provide to the group, central training resources that none of the individual companies could afford to develop independently. Italsiel specialises in design installation of information systems; it also rationalises existing systems and helps in the reorganisation of companies. Management services, in general, are centrally provided within the divisions from the parent companies' staffs.

Research and Development activities of the group are quite considerable, although they are not concentrated in specialised companies. The investment in R & D is performed mainly in the largest companies of the group individually.

4. Collaboration among the group's companies is not encouraged by any specific rules from the parent company. Figures of intra-company trade are not included in the Annual Reports, but because the divisions are often vertically integrated this trade must be considerable.

Collaboration does exist but is mainly supported by means of a strategic plan which tries to link and combine the efforts of the enterprises.

The other integrative device which is intended to improve collaboration is the common ownership of companies that may be related to a group of firms. For instance, in Fig.15, Breda Termomeccanica and Ansaldo are partners in Termosud.

This common ownership achieves its greatest development in Proforma and Italsiel, the two service companies we have just mentioned, i.e.

Proform	=	IRI 25%, Finsider 25%
		Finmeccanica 22.50%, Fincantieri 14.50%
		Finmare: 6%, SAIAT 3%
		SME: 0.50%, SPA 0.50%
		Alitalia: 2%, RAI 1%

An even broader ownership appeared in the care of ITALSIEL; 10 companies of the group own 62.44% of the equity capital, the rest belongs to third parties.

As a final conclusion on IRI we could say that the group structure matches very well the model we have defined. However, it does not display the main integrative features that are proposed in the recovery system to be examined in Chapter VII.

CHAPTER VII

ANALYSIS OF A STRATEGY FOR COMPANY RECOVERIES

7.1 RESEARCH PLAN

The main purpose in this part of the research will be to devise a strategy for a SHC faced with a probable series of enforced acquisitions and divestments.

Our plan will be as follows:

1. We shall analyse the group performance and the structural characteristics linked with it.
2. Subsequently we will develop a theoretical model of a state group, suitable for responding to a flow of takeovers.
3. We will express the model in the form of a computer programme which will be run using assumed, but realistic, data.

7.2 PERFORMANCE AND STRUCTURE

Considering that the SHC will face the necessity of government intervention in a number of ailing companies, we intend to concentrate our efforts on that part of the group's structure that will be in charge of that task.

As was previously explained the rate of return '*r*' will be considered the most suitable measure of the group's performance. Due to the special holding structure of the group, its aggregate performance is a weighted value of the individual company performances, and hence it is clear that there is no way to change the group performance without changing the performances of operating units. The basic objective is therefore to determine how to improve the firm's performance through appropriate design of the group structure.

On the other hand, the changes that can be made at the level of the individual firm unrelated to the group structure, as, for instance, a productivity improvement in an existing plant, will not be considered in our model. Our approach is that the existing companies of the group, which are not directly connected with the recoveries, must not be altered in their performance by the flow of acquisitions or divestments. Their involvement will be indirect, through the supply of intermediate commodities to the firm under recovery. This particular point will be developed later on.

It is our assumption that the government wishes to use the state-group as an instrument of economic policy. The most common request may then be to give support to activities, in either private or state sector, that are in a weak condition. This support usually consists of an instruction to the group to incorporate companies within the holding structure, i.e. a forced takeover - 'forced' on to the SHC by the government. Alternatively the government may request the expansion of the group in a certain branch of industry which is judged to be of strategic importance, or to invest in a certain region where unemployment is high.

However, the government may also ask the group to sell its stakes in certain companies, or to withdraw completely from certain branches of industry. This has been the case of the NEB during the years 1979 and 1980.

The occurrence of such compulsory decisions which are beyond the control of the top management has become the main characteristic of the SHCs distinguishing them from otherwise similar private sector organisations. It gives also an additional dimension to the definition of SHCs: they have to internalize actions requested by government which reflect the perceived needs of the economic situation of the country as a whole whilst maintaining a commercial and profitable operation, assessed according to conventional criteria.

In an attempt to overcome the effect of government demands on the group, two types of actions have been observed in existing SHCs:

1. Passive actions which intend to isolate the effect of obliged takeovers or other forced decisions upon the overall performance evaluation. We can identify two such defensive systems:
   (a) to evaluate any compulsory action demanded by government as a distinct and separate part of the group accounts, at least during the rescue period. In this way, the overall performance figure of normal companies is not affected by the new firm's operation (this was the NEB's practice in relation to British Leyland and Rolls Royce).
   (b) The new company (or in general the compulsory action) is incorporated in the normal accountancy, but is treated as a "project" in which the government is considered as an investor and is charged with all the funds, directly or indirectly necessary, until a normal performance is achieved (Statsföretag's case).
2. Changes in the group structure in order to protect the existing companies and to give support to, and accelerate the recovery of, the new companies.

We accept that the formerly mentioned passive actions are useful as defensive strategies for the state group. Nevertheless, our strategic plan attempts to go beyond those actions and will try to propose forms of organisation for the state group which allow it to provide the new companies with the inputs and/or services required for a successful recovery. Our proposal will imply that the value of all the inputs applied in the rescue operations - both those maintained within the group structure and those bought from outside - are treated by the group as an investment shared by the companies involved in the operation. Once the process of treatment is completed (which may take the form of the dissolution of the firm), the capital invested has to be requested as a total sum from the government.

It may happen that part of or the whole of the sum invested during the recovery period, will not go to improve the performance of the firm under recovery. In this case not all the expenses of the group would be considered as an increase of capital in the firm accountancy, but just as an operational cost. This situation - to the extent that the government agrees to pay for the cost of the recovery - will not affect the group profit and loss results.

The role of the parent company (or headquarters) staff will be considered in this approach as the role of any other operating unit. Very often its costs are charged as overheads to the rest of the firms within the group. This may lead to an arbitrary and possibly unbalanced distribution of expenses between companies.

In the case of recoveries it seems sensible to try to reduce overheads to a minimum and allocate most of the expenses directly from the supplier-companies.

7.3 THE CONCEPT OF 'RECOVERY'

At this stage of the analysis the structural problem may be stated as follows.

If we assume that a new company (as a part of a flow of takeovers and divestments) must be added to the group,

> What will be the cost of its recovery if all the necessary resources are bought from outside the group?

and,

> What will be the cost of the recovery if the necessary resources are continuously maintained within the group?

By the expression "takeover" we mean any actions on the part of the SHC in response to orders by the government. Similarly, the expression "recovery" will mean the process by which the SHC will accomplish the activity requested by the government, in accordance with the general guidelines of the group.

The most current forced involvements are:

1. Being in charge of ailing firms
2. Expanding in new technologies or highly risky projects
3. Expanding into pre-determined regions and
4. Divestment of certain firms.

Some combinations of these activities may of course be requested simultaneously. Although these actions may be of a highly diversified nature, the framework of the guidelines and the quantitative performance requirements will oblige the headquarters to treat each one as a project, and try to obtain a performance that will be compatible with the general goals of the group.

For this reason the concept of 'recovery period', in this study, has been given a particular meaning which is not limited to ailing companies or rescue operations. It implies the period for which the 'recovery' would show a financial loss were it to be deprived of resources input from the state holding group i.e. the minimum period required to give it a capacity for independence free of loss-making.

The parent company will be faced with a permanent evaluation between the cost of providing resources to the new activities, and the cost of recoveries delayed by the scarcity of resources.

In the private sector financial resources are often a limitation which contains many decisions. In the SHC case, we will assume that the financial resources have a well defined cost, but that, to the SHC, they are not scarce. If the government demands certain actions, it usually provides the resources, either by means of the central budget, or as a borrowing capacity.

The SHC role will be then to invest financial resources, within very broad limits, choosing between alternative strategies that could achieve its objectives.

7.4 RATE OF RETURN AND STRUCTURE

Taking the group's rate of return as the main measure of its performance, we have to distinguish two levels for our analysis: the group as a whole, and the individual companies (the subsidiaries and the associated companies). The rate of return of the group may be calculated by adding the profits and losses of each individual company, multiplied by the percentage of the group's participation in its equity capital. The result has to be divided by the total investment, I, of the parent company in the firms under consideration.

Let $F_1, F_2, F_3 \ldots\ldots F_n$ be the firms of the group, and $p_1, p_2, p_3 \ldots\ldots p_n$, the proportions in the equity capital owned by the parent company. If $\pi_1, \pi_2, \pi_3 \ldots\ldots \pi_n$ are the profit or losses of the respective companies, the rate of return of the group will be:

$$r = \frac{\sum_{J=1}^{J=n} \pi_j \, p_j}{I}$$

This is the way in which the state groups studied work out their rate of return. It is evident that, if the state group behaves merely as a conglomerate without encouraging a common policy of collaboration and mutual support among the companies, the value of 'r' will be just the result of an arithmetic operation. On the other hand, there is likely to be some degree of detailed supervision and constraint by the parent of the activities of the constituent companies beyond which overall performance deteriorates. The optimal strategy lies somewhere between those widely separated extremes.

Coming back to the individual companies, the rate of return is simply:

$$r = \frac{\pi_J}{I_J}$$

in which π_J is the profit or loss of a particular company, and I_J, the total investment in that company.

The companies already incorporated within the group are managed independently following guidelines and plans that do not interfere in their operations. However, the companies that are in the process of incorporation into the group, i.e. during the recovery period, must accept the intervention of the parent company, until its performance is considered acceptable. Since the 'recovery period' forms a basic part of our model, it will merit a thorough study later on.

At this point, we will consider the areas in which the group structure might improve the overall performance of the firms that are incorporated within the system and that already enjoy a 'normal' status. It is our intention to follow the analysis proposed by Gold in Explorations in Managerial Economics [10] and in Research, Technological Change and Economic Analysis [11]. Gold's formula [10, page 23] provides a precision tool for analysing the factors that influence the rate of return of a company. This refers mainly to an individual company but we will try to apply its concepts to the state group.

Gold starts by expanding the rate of return as follows:

1. $$\frac{\textit{Profit}}{\textit{Total Investment}} = \left(\frac{\textit{Product Value}}{\textit{Output}} - \frac{\textit{Total Costs}}{\textit{Output}}\right) \times \frac{\textit{Output}}{\textit{Capacity}} \times \frac{\textit{Capacity}}{\textit{Fixed Investment}} \times \frac{\textit{Fixed Investment}}{\textit{Total Investment}}$$

r is then expressed as:

2. $$r = (\textit{average price} - \textit{average cost}) \times \textit{utilization ratio} \times \textit{productivity of fixed investment ratio} \times \textit{internal allocation of capital}$$

Subsequently he introduces the concept of structure of financing, making a distinction between the total investment and the equity investment of the company. So,

3. $$\frac{\textit{Profit}}{\textit{Total Investment}} = \frac{\textit{Profit}}{\textit{Equity Investment}} \times \frac{\textit{Equity Investment}}{\textit{Total Investment}}$$

Afterwards, Gold points out that there are 6 potential areas where rate of return improvements can be achieved and they correspond to the 5 quotients of the Equation (1) plus the expansion made in Equation (3).

The areas can be written in the same order as in (1).

(a) Average level of product prices

(b) Average level of unit costs

(c) Rate of utilisation of capacity

(d) Productivity of fixed capital

(e) Internal allocation of capital

(f) Structure of financing

In the SHC case factors (a) and (d) are mostly linked with the operation of individual firms. Something similar happens to (e) the internal allocation of capital, because the proportion of fixed investment depends mainly on the technology used in the company and also on the balance between cost of wages and cost of capital within the national context. The group structure might have a limited and exceptional influence over these areas. As an example of this we may cite the attempt to avoid competition between companies within the group, by issuing special marketing rules. Factor (f), structure of finance, is important because in general, the rate of return is evaluated as a net value after the payment of interest.

The funds employed by the parent company might come from different sources, as for instance long term borrowing at low interest rates from the central government, re-investment of profits, direct equity investment through the issue of bonds (the latter being the IRI's main source of finance). However, it is necessary to state that the appropriate structure of financing is not susceptible to an analytical approach since it depends largely on government determination and the national context.

Only two broad areas of this approach remain for discussion, i.e.

(a) the average level of unit costs and

(b) the rate of utilisation of capacity

The level of input unit costs depends mainly on 3 parameters related to input proportions: cost proportions, prices of input factors and input quantities per unit of output.

The rate of utilisation of capacity in its turn is determined by the firm's share of the market and variability in the long term but overall level of the market in the short term.

We have to bear in mind that our interest is concentrated on the group policy as a whole. The efforts of the individual companies to improve in the areas mentioned above are assumed and already discounted in this analysis.

The first problem that we face in evaluating the overall performance of a group of companies is to find an adequate set of units in which the variables can be expressed and measured. The rate of return has the advantage of being expressed in monetary units, and in this way may reflect differences in company performance. However, when we attempt to analyse the factors that influence "r", we find concepts and functions that are not commensurable or suitable for a group of companies.

The concept of output that is essential for the calculation of the average level of unit costs and rate of utilisation of capacity, has to be defined for the group, as well as for the individual companies. To define the variable is mainly to find a unit in which it can be expressed. If we were concerned only with one firm, following Gold, the "unit of product" might be defined as a non-existent composite product (a unit of composite product) representing the weighted average of the range of sizes, models and articles produced by the company. This weighted average of products has also to reflect accurately the consumption of factors of production in physical terms, in order to calculate the resources needed to keep the production at a given level.

As we are concerned with a group of companies, the unit of composite product has to be the weighted average of the individual units of composite products. In the case of a SHC with mixed ownership in the constituent companies, an additional limitation appears in the concept of a composite unit of product if it is desired not to alter the allocation of profits between different owners or partners where the output is changing. It may happen that a change in the group output measured in composite units, does not allocate the correct profit to all the partners in the group companies. In that way, what seems to maximise the profit of the group as a whole could not maximise the profits of each of the operating units. This problem could be solved by means of a reallocation of profits, but this implies that the unit of composite product would not properly reflect the interests of all the companies of the group.

On the other hand, every change in the real composition of output, either in an individual plant or in the group will alter the characteristics of the composite product. Thus, the concept of a composite product is not suitable for making comparisons from period to period. It could be used only as a tool of analysis for establishing the possible connections between the group's performance and the group's structure in a short and well defined period of the organisation's life. Furthermore, the concept is meaningless from the stand-point of production as well as sales.

As a summary of this discussion we can say that Gold's formula of the rate of return is useful in finding the areas to which the attention of the group has to be focussed, even if it remains very difficult to find an adequate means of expressing in a quantifiable form the resultant performance of the group as a whole. Even so, we can see why it would be desirable to use the rate of return, expressed as it is in monetary rather than physical units, as a performance measure.

Lastly, Gold's concepts have provided us with a useful tool of analysis: the composite unit of product. Although we could not easily apply this concept to the output of the group, we consider that it is a suitable concept to be used in the input variables that we are going to use in the analysis of the recovery period.

Looking into the areas of potential improvement pointed out by Gold it is clear that the changes may take place either in the physical inputs, or in the physical outputs, or in physical aspects of production flows. The group structure, especially the parent company, may give support to the individual companies in all 3 identified areas. However, if the autonomous status and management of the individual companies is to be respected, this support has to be limited to indicative guidelines and general norms of operation. In contrast, companies that have been taken over or set up only recently must be given strong support in all the areas. The physical aspects of production flows have to be understood in the broadest sense and certainly will include new management, new financial resources, new products as well as new marketing. As we have stated, the financial resources will be assumed to be sufficient for recovery and their amount will therefore not be incorporated into the analysis but the model we attempt to build will consider all the other basic changes pointed out above.

7.5 INPUT AND OUTPUT COMPOSITE UNITS

Let us assume that the output of an individual company can be represented by:

$$Q = f(L,K)$$

where Q is the quantity of output in physical units measured in composite product units, K is the capital stock and/or services derived from the stock, and L is the labour services employed over the period of consideration.

In order to express Q in this way we must assume that all other materials needed by the company are in perfectly elastic supply in the market, i.e. any quantity can be supplied at a constant price. Using this condition we can assume also proportionality between the output and the value added by a company.

Now, we will assume that the output of a company depends on many factors of production or input variables. These factors can be assumed as being particular combinations of the general variables K and L, i.e. specialised resources.

Let x_1, x_2, x_m ..... x_s be the factors of production needed in the output of a group of companies, in which are included the general variables K and L.

Let Q be the output of a group of companies in which F_1, F_2 ... F_i ... F_n are the firms set up within the group.

c_{11}, c_{12} ..... c_{1j} ..... c_{1p} the commodities produced by firm F_1, and c_{ij} any commodity produced by firm F_i.

Let q_{ij} be the quantity of commodity c_{ij} produced in firm F_i in the period of time under consideration, and assuming that there are p

different commodities.

Let k_{ijm} be the proportion of factor of production X_{ijm} required to produce one unit of commodity c_{ij}.

Then $k_{ijm} \times X_{ijm}$ will be the quantity of factor of production Xm required to produce one unit of commodity c_{ij}.

Therefore, the total quantity of inputs required to produce the output of the group, will be:

$$I_p = \sum_{i=1}^{n} \sum_{j=1}^{p} \sum_{m=1}^{s} k_{ijm} \times X_{ijm}$$

The underlying assumption of this formula is that the transformation of the factors of production (inputs) into commodities (outputs) is made with an efficiency of 1 or very close to 1.

If Q is the total output expressed as an aggregate value of the factors of production, then Q will be equivalent to I_p.

Let now Z be the smallest quantity of any commodity c_{ij} produced by the group in the period of time under consideration. Therefore,

$$Z = \min_{1 \leq j \leq m} \left| \sum_{i=1}^{n} c_i q_{ij} \right|$$

and,

$$\frac{I_p}{Z}$$

will be the composite unit of input, i.e. the quantity of inputs needed for each unit of composite product.

Similarly, the unit of composite product (or output) may be expressed as:

$$\frac{Q}{Z}$$

or,

$$\frac{1}{Z} \sum_{i=1}^{n} \sum_{j=1}^{p} q_{ij} \; c_{ij}$$

The unit of composite product will express the smallest measurable quantity of products, where all the commodities are represented in a weighted proportion, and where at least one of them is equal to 1. The total output could be therefore expressed in these units directly. However, a further complication which arises in this approach is that the group can dedicate part of its output to produce services and/or goods that are used for its own growth. This growth may consist of a higher capacity for producing commodities or in an expansion to new fields of activity.

Thus, the composite unit may have one part related to the marketed output and another part related to the group growth. However, it is difficult to achieve a separation between them because some of the inputs may be utilised as supports of existing production as well as inputs for the growth of the group. These constraints led to the conclusion that there is no other variable, apart from r, suitable to represent the performance of a group of companies. For this reason we have concentrated our study on the performance of single companies under recovery.

Subsequently we turned our attention to the expression of "r" developed by marginal analysis [5].

The expression is:

$$r^* = \frac{1}{1+I^*} \left(\frac{1+V^*}{a} \left[p^* - (1-a)\, c^* \right] + V^* - I^* \right)$$

in which:

$r^* = \frac{\delta r}{r}$, relative change of r

$V = Q/I$ and $V^* = \frac{\delta V}{V} = \frac{\delta Q}{IQ}$

p = unit price for the output and $p^* = \frac{\delta p}{p}$

c = unit cost for the output and $c^* = \frac{\delta c}{c}$, and lastly

a = profit margin = $\frac{p-c}{p}$

If I = const. and ignoring second order effects:

$$r^* = \frac{p^*}{a} - \frac{1-a}{a} . c^* + V^*$$

assuming that during the recovery period we do not change the level of prices:

$$\frac{p^*}{a} = 0 \qquad \text{and} \qquad r^* = V^* - \frac{1-a}{a} c^*$$

hence, we chan see that during the recovery of a company, changes in r^* may come either from changes in output and/or from changes in unit costs.

On the other hand if we consider that during a short period of time I = const.

$$r = \frac{\Pi}{I}$$

and therefore $r \sim \Pi$.

This means that during recovery, the profit Π will depend only on changes of output and/or of unit costs. With these analytical tools we will attempt to build the model of a company under recovery and to design the basic structure of a state group adapted to a series of takeovers.

7.6 THE MODEL OF AN AVERAGE TAKEOVER

The model that we intend must be able to perform three functions.

First, to calculate the rate of return of the company taken over at any time during the recovery.

Second, to work out the quantity of each resource needed at any time during the recovery of an individual company.

Third, to calculate the cumulative value of each resource, to be provided by the whole structure, when the state group will be faced with a probable series of takeovers and divestments.

These then are the objectives of this part of our research. In order to achieve these goals we have first to clarify what the recovery will consist of and how it is going to be evaluated in relation to the group's accounting. In practice we must define which are to be the variables considered as resources during the process and what is going to be their influence on the rate of return of the company under recovery. Furthermore, we have to define what will be the probable flow of demands on the group by government.

Firstly, we will describe a model of a takeover in an attempt to identify the basic conditions that affect the level of the rate of return.

The new company, which is going to be incorporated within the group will be still in its initial state achieving some rate of return (positive or negative), some form and level of output with some total investment. Let us call these ro, Qo and Io respectively. As soon as the takeover has been completed, the input of resources from the group into the new company is started. These resources may come directly from the original group output or from outside companies.

The rate of return of the group, in this transitional stage, has already changed because its total investment and output have changed. However, these changes are a matter of interpretation, as will be seen.

The takeover of the company by the group had to be made by means of buying a controlling part of the equity capital at a price. This part, in the case of SHCs may be a majority or a minority share, but in all cases, a controlling share. If this were not the case, it could not be considered a takeover, and therefore the responsibility of the recovery will not be on the group's shoulders.

The price paid for the new company might derive from a market price, but also might be a nominal price (residual value of assets, or of the name of the company and/or the products, etc.). In any case the group has had to use financial resources drawn from its own funds or from its borrowing capacity. In that way, since the takeover took place, the investment has a cost to the group and that cost is, at least, the cost of the capital used during the transitional stage. The difference between this cost and the profit (or losses) of the new company produces a residual income (or outflow)that alters the original rate of return of the group.

However, as was mentioned before, if the government is to be charged with all the recovery costs, in strict accounting terms the group's rate of return has no reason to be changed. Having in mind that the main concern of this study is related to strategic attempts to improve the use of resources given by the state, we have to assume that and act as if the rate of return changes as soon as the takeover took place.

A similar situation occurs with respect to the group output because some part of the resources that were idle within the group, or used in other tasks and companies, have to be diverted and utilised in the recovery.

During this transitional period the flow of new resources into the new company is maintained and the rate of return changes continuously until the recovery is considered complete. The end of the recovery period may be denoted by any of these conditions:

a) The input of new resources has ended and the company continues its operation without any special support from the group (other than the staff or service supports given to the rest of the companies). In that way the group resources could be released.

b) The new company agrees to a permanent input of resources from the service companies of the group and/or from outside the group. This agreement has to be formalised by means of contracts for definite periods. In that way, the flow of resources may become a well determined set of resources that can be matched by the group structure.

c) The new company has decided to replace the flow of resources by a flow of inputs from outside the group. Thus, the group structure will be relieved of the additional demand produced during the recovery.

Following the end of the recovery the group's rate of return may include the weighted value of the new company.

This brief description of the recovery process, from the takeover until the release of the resources, emphasises the necessary definition of the main variables involved in the process just described. This is what we will attempt in the following paragraph.

We will assume that 5 input variables - or resources - are significant for the group's recovery system. They will also be considered as the most suitable to be established in service companies because they are very likely to be inputs common to many companies.

The general formula for the output Q of a company $Q = f(K,L)$ will therefore be expressed as:

$$Q = f(R,E,MS,MK,IC,L,K)$$

in which:

- R represents the Research and Development variable in composite units
- E represents the Project Engineering variable in composite units
- MS represents the Management Service variable in composite units
- MK represents the Marketing variable in composite units, and
- IC represents Intermediate Commodity capacity variable in composite units.

These five input resources of the recovery system are going to be considered as particular combinations of the general input variables K and L, already explained. It is easy to see that the first four resources are clearly linked with expertise capacity, i.e. with capacity to solve problems, to design new systems, to improve the production flow, etc. However, the fifth is of different nature, and, as will be seen in the analysis, represents the capacity of the system for replacing some of the inputs of the new company, either bought from outside suppliers, or self manufactured, by inputs provided advantageously by the group itself.

It can be argued that these five are not the most important factors for a recovery or that there are other factors as important as these five.

However, to add new variables to our analysis would not produce significant changes in the result. Only if a variable of a different nature - or analytical behaviour - could be added would our present analysis become misleading or erroneous.

The provision of financial resources - important indeed not only for a recovery but for any performance at all - is not considered a variable, because as was explained, it is assumed that from the take-over, the group will supply enough resources, to allow ultimately a normal operation of the company. This finance will have a cost and it will be reflected in the rate of return of the firm. On the other hand, the selection of these five resources has taken into account some practical experience. They are sufficiently general that any other resource could well be included within them.

Perhaps the most difficult and complex decision has been to express the five resources in composite units. We need now to consider how this might be done.

First, if we intend to give an analytical treatment to resources of expertise we have to express them in a quantitative form. The man-hour of an expert is certainly a useful unit, but does not represent the whole network of assistants, instruments, installations and capital (in different forms) that are essential to his performance. To subsume the complete network of these costs into a man-hour cost unit is to assume that all the required resources will be available as needed.

The marketing resource, for instance, not only implies the capacity to design a new market approach, but also the real existence of capacity in the means of publicity (TV, papers, etc.). If this capacity does not exist, the recovery will be delayed, in spite of the presence, within the group, of enough experts.

It is worth considering that most of the activities mentioned above have the property of indivisibility, which means that they have to be set up with a minimum size of production capacity. The same problem may arise in respect to growth: it has to be done discretely, i.e. by steps from one feasible capacity to the next feasible capacity.

The Q formula means that in a given company, in any period of time, there is a fixed relationship between the physical output and the 7 variables. It is also assumed that Q, expressed in composite units, maintains a constant proportion between inputs and outputs, during any steady period of the company's life.

We have to point out two constraints on this approach:

a) If we intend to analyse the effect on the group performance of the incorporation of a new company, and vice versa, it seems reasonable to assume that the size of the new firm is sufficiently small to be absorbed by the group structure without requiring any major change in that structure. In practical terms, this analysis is intended to be suitable for a medium size takeover by a state group composed of 30, 50 or more companies. The case of an hypothetical takeover of a large corporation such as British Steel Corporation by a SHC such as the NEB is obviously unsuitable for an analytical approach.

No structure can resist or be prepared in advance for this kind of enlargement. On the other hand, structures of large corporations are very often organised as holding companies and certain service enterprises may already be established in their structures.

b) Another problem closely related to the previous one is the necessary correspondence between the group's existing resources and the needs of the new company. If the takeover were to introduce new variables into the group, the theoretical approach we are trying to evolve might not be applicable. As an example we can cite a takeover in a field of activity absolutely unknown to the group where specialised skills are required. Perhaps, a good example has been the setting up of INMOS by the NEB in the area of microchips.

7.7 EXPECTED COST OF A RECOVERY

The mathematical expressions already shown for r, r^* and Q as a function of the factors of production are not enough to give a solution to our structural problem.

In order to continue our approach let Z_{ij} denote the requirement for resource j which certain recovery i will entail, where

$$i = 1 \; \ldots\ldots \; m \qquad \text{and} \qquad j = 1 \; \ldots\ldots \; n$$

Let R_j denote the total requirement for resource j in a recovery. Then

$$R_j = \sum_{i=1}^{m} Z_{ij}$$

If the recovery i has a probability p_i of being performed, we would have the expected value of:

$$R_j = \sum_{i=1}^{m} p_i \, Z_{ij}$$

Once a unit cost has been established to each class of resources, the calculation of total recovery costs may be done as follows.

Let c_j be the cost/unit of resource j

c be the total cost of the projected recovery

R_j denote the total requirement of the recovery for resource j

Then:

$$c = \sum_{j=1}^{n} c_j \, R_j$$

and the expected value of the total cost will be:

$$c = \sum_{j=1}^{n} c_j \times \text{expected value of } R_j$$

The total of the present values of the costs of all the activities will be given by:

$$c = \sum_{j=1}^{n} \sum_{i=1}^{m} c_j \times e_i^{-dt} \times Z_{ij}$$

and the expected value of c, by:

$$c = \sum_{j=1}^{n} \sum_{i=1}^{m} c_j \, e_i^{-\alpha t} \, Z_{ij} \times p_{ij}$$

where:

α is the rate of interest per period of time

t is the time in periods (years, months, etc.) *

*The project approach and formulas cited are mainly taken from 'Quantitative Management in Research and Development" by Beattie and Reader [3].

In our case, the transitional period of the takeover, which has been called 'the recovery period' may well be divided into two stages: The first one - or shock recovery - in which the most urgent measures are adopted and during which the effort is concentrated in achieving, at least, the break even point ($r = 0$).

We will assume, in this study, that the first stage takes an average of one year (or 12 months). At the end of this period a decision will be taken: either the company remains within the state group and then a new plan will be adopted (second stage of the recovery), or the recovery will be abandoned and new measures will be taken in order to sell the company or to dissolve it.

In the case that the company will remain as a part of the group, then a new plan has to be established, trying to achieve the normal or average rate of return required by the guidelines set by the government. This second stage goes beyond the objectives of this study.

The project approach followed by Beattie and Reader [3] consists of the allocation of a fixed quantity of resources (or activities) whose costs are known, between different projects, whose demands on resources are also known. Therefore the problem is to allocate in time, choosing between projects which have certain expectations of profits, the fixed quantity of resources. Their solution is based on linear programming methods that maximise as the objective function, the present value of the combined rate of return of the different sets of projects.

In our case we have to allocate a certain unknown quantity of resources that will be taken from the total investment capacity of the state group within very wide limits. This allocation will be made between an unknown number of companies, i.e. those that must subsequently become part of the holding company. The number and characteristics (size, type of industry, financial situation, etc.) of these companies could be assumed using a stochastic approach, that should change from country to country. Then we have to know the costs of the resources within and/or outside the group and a certain distribution of the resources requirements between the new companies (the so-called recovery system) and the old companies. Finally, we have to know what will be the change in the performance of any new company as a function of each of the resources that are applied to it.

In an attempt to simplify our model we have taken the following decisions.

First, due to the fact that the recovery period is short (around 12 months) we will consider that is not necessary to work out figures with discounted present values.

Second, we have preferred to avoid stochastic approaches because we have not enough empirical data to provide an adequate representation of reality. Instead of any probabilistic assumptions we have adopted a kind of representative takeover, or average recovery, as the most probable event in which the annual requirements could sensibly be divided. On the other hand, using general data from the British economy, and from existing state holding companies we have calculated a probable total for a year's requests by government.

The critical point in our approach lies in our capacity to assess the effect on the supplier market of a sudden increment in the demand for a certain service. Two main phenomena may occur:

a) the price of the service may increase, and/or

b) a long delay in providing the service will appear as a consequence of the demand.

In both cases the group will suffer increased cost, part of this being due to the excessive price of the service, and part - perhaps the more important part - may come from the delay in providing the necessary input to the ailing company.

7.8 RATE OF RETURN AND RESOURCES

In order to assess the effects of this price-delay combination on the performance of the group, we have to assume a relationship between "r" and the variables selected as the most relevant during the recovery period, i.e. R, E, MS, MK and IC.

However, there is no direct way to link the input of new resources with the change of the rate of return of the company, because "r" is a rate, that is, it measures the profit per unit of total investment, and not the overall effect that a certain quantity of new resources may produce. For this reason we have to assess the effect that a quantity of compound units of resources will have on the profit "Π" of the company under recovery. Only after this step, can a link with the rate of return be worked out.

To start with we will accept as a hypothesis that there will be linear relationships between the profit Π of the new company and each one of the 5 variables. We will also assume that the individual effects of these resources can be added arithmetically, disregarding the second order effects. This proportionality is considered a good approximation during a short period of the company recovery.

So, let "r" be the rate of return of the new company at any time after the takeover.

This "r" will be performed by a profit Π with a total investment of I, then

$$r = \frac{\Pi}{I}$$

We will call j, any resource to be input in the new company, Δ_j will be a quantity of resource j, expressed in compound units, that will be input in the company in time Δ_t.

If each compound unit of resource j yields, within the new company, a profit of k_j, then Δ_j units will yield $k_j \Delta_j$ monetary units of profit. For this reason, we call k_j, a transformation factor, i.e. it shows the capacity of a compound unit of resource "j" to be transformed into output, and eventually into a profit.

Then the total change of Π due to all the input resources during time Δt will be:

$$\Delta\Pi = \Sigma k_j \Delta_j$$

and during a whole year:

$$\underset{0-12}{\Delta\Pi} = \sum_{t=1}^{t=12} \sum_{\text{all } j} k_{jt} \Delta_{jt}$$

in which:

$$\Delta\Pi = \Pi_1 - \Pi_0 = \Delta\Pi R + \Delta\Pi E + \Delta\Pi MS + \Delta\Pi MK + \Delta\Pi IC$$

On the other hand, each compound unit of resource j has a cost of c_j, and the total cost of resources during period Δt, will be:

$$\Sigma c_j \Delta_j$$

If we call r_0 the original rate of return, and r, the new rate of return after Δt and the input of new resources,

$$r_0 = \frac{\Pi_0}{I_0} \quad , \quad \Delta\Pi = \sum_{\text{all } j} k_j \Delta_j$$

$$\Pi_0 = I_0 r_0 \quad \text{and} \quad \Pi_1 = I_0 r_0 + \sum_{\text{all } j} k_j \Delta_j$$

If we assume that the change in I_0 is insignificant then

$$I_1 = I_0 = I \quad \text{and}$$

$$r_1 = \frac{Ir_0 + \Sigma k_j \Delta_j}{I} = r_0 + \frac{\Sigma k_j \Delta_j}{I}$$

However, if we consider that the cost of the new resources are important to the assessment of the company's performance and the calculation of the new "r", then we have two main alternatives for the evaluation:

1) To consider the total cost of the input resources as an increase of the total investment of the company, or
2) To consider the total cost of the input resources as an operating cost which diminishes the total profit of the company

Of course, there is also a mixed alternative in which some costs may go to investment and others to operating cost.

In alternative 1)

$$r_1 = \frac{r_0 I + \Sigma k_j \Delta_j}{I + \Sigma \Delta_j c_j}$$

In alternative 2)

$$r_1 = \frac{r_0 I + \Sigma k_j \Delta_j - \Sigma \Delta_j c_j}{I}$$

If we impose the additional condition that, at least, $r_1 > r_0$, then

In 1)

$$\frac{r_0 \ I + \Sigma \Delta_j k_j}{I + \Sigma \Delta_j c_j} > r_0$$

therefore, $\Sigma \Delta_j k_j > r_0 \Sigma \Delta_j c_j$

In 2)

$$\frac{r_0 I + \Sigma \Delta_j k_j - \Sigma \Delta_j c_j}{I} > r_0$$

therefore, $\Sigma \Delta_j k_j > \Sigma \Delta_j c_j$

If we compare both results we can see that the profit arising from the additional resources has to be in case 1) greater than the cost of the resources multiplied by the original rate of return, and in case 2) greater than the cost of the resources.

In general cases $r_0 < 1$, then:

$$r_0 \sum_{\text{all } j} \Delta_j c_j < \sum_{\text{all } j} \Delta_j k_j > \sum_{\text{all } j} \Delta_j c_j$$

In those cases where $r_0 < 0$ (negative rate of return), then:

$$0 < \Sigma \Delta_j k_j > \Sigma \Delta_j c_j$$

We will also assume that the resource requirements (linked with $\Delta\Pi$) during the first year of the new company's incorporation will follow a certain average pattern characterised by:

a) The starting point of the resource 'j' requirement.

b) The rate of change of the requirement (the slope of the line $\Delta_j = f(t)$ in Fig.16).

c) The time "t" in which a change in the rate of change of the resource requirement may occur.

In Fig.16, the resulting shape of the individual resource lines in the graph $\Delta_j = f(\Delta t)$ are intended to represent the best quantities of the resources that can produce a significant improvement in "r" or in the total profit of the company. The meaning of this significant improvement has to be understood as a balance between the cost of the resources and the effects on the profit: Bearing in mind that we are assuming linear relationships between resources and profit it could seem that the greater the input of resources, the better the result for the company's profit. However, it is a well known fact that in real life there is a maximum quantity of resources that can be input in a company during a recovery. If it is tried to introduce a higher quantity of resources, the structure of the company does not behave as was expected in the linear assumption, and its performance decays rapidly.

For this reason, one of the first decisions to be adopted by the group headquarters will be to determine the allocation and the overall magnitude of the resources to be input in the new company.

Our assumption will be that during the full first year, the cost of the total resources to be input on the company will add up to 10% of the total investment. This amount refers only to the 5 main variables that we have mentioned as suitable for the service companies (see Paragraph 8.3).

It should be noted that the two general resources, K and L, are not considered in this analysis. The reason for this are the assumptions that they exist in the outside market in sufficient quantities, and that their prices do not fluctuate significantly with the group's demand. The other assumption is that it is not worthwhile to increase their supply to the new company, during the first year.

The amount of capital necessary to finance the resources during the recovery will be considered either as incorporated to the costs, or as a rate of interest paid by the company to the group.

A far more important problem is to assess the relative sensitivity of of the new company's rate of return to the supply of each type of resource. That is, the relative values of the individual "k".

Although this evaluation could be performed on the basis of real data arising from private or state groups that specialise in recoveries, we will continue within the limits of this theoretical study. For this reason we will use a subjective evaluation of the "k" coefficients; this will be explained later on.

Assuming that we know the requirements of each resource during the recovery period we can express the change of r as:

$$\underset{1-12}{\Delta r} = \frac{\sum_{T=1}^{T=12} \Sigma k_{jt} \Delta_{jt} - \sum_{T=1}^{T=12} \Sigma c_{jt} \Delta_{jt}}{I}$$

In which we are assuming that all the costs of resources go to operational expenses.

- Δ_{jt} is the change of any resource between t and $(t+1)$
- k_{jt} is the change in profit caused by the change in resource j between t and $(t+1)$, and
- c_{jt} is the cost of resources j between t and $(t+1)$

As we have seen above, if $r_1 > r_0$, then in the general case:

$$\sum_{T=1}^{T=12} \sum_{\text{all } j} k_{jt} \cdot \Delta_{jt} > \sum_{T=1}^{T=12} \sum_{\text{all } j} c_{jt} \Delta_{jt}$$

and therefore:

$$\sum_{T=1}^{T=12} \sum_{\text{all } j} \left(k_{jt} - c_{jt} \right) \Delta_{jt} > 0$$

Now, in order to continue the analysis we have to use certain input-output techniques suitable to our particular case.

We will start by assuming that the effect of the variables, a compound effect of many variables, can be represented by the following matrix:

$$\Delta\Pi = \Sigma k_j \Delta_j$$

in which $\Sigma\Delta_j = 1$.

That is, the change in Π produced by the input of one unit of the compound resources.

In this formula:

Δj	=	ΔR	ΔE	ΔMS	ΔMK	ΔIC
kj	=	kR	kE	kMS	kMK	kIC

Of course this matrix corresponds only to one individual company, and only to one particular distribution of the unit of compound resources used as input.

As will be seen later on, the relationships $\Delta_j\ k_j$ can be assumed with certain independence for the variables R, E, MS and MK. However, the relationship $\Delta IC\ kIC$ is of a different nature, and cannot be assumed: it has to be evaluated as a function of other variables (see Paragraph 7.9).

As a summary of these last assumptions we can say that, the recovery period has been considered as a special period in which the ailing company needs the resources and each input of the variables produces a change in the total profit Π, i.e. a linear relationship between the profit and each one of the 5 variables is accepted during a short period of time. The effects are therefore commensurable after disregarding the second order effects.

In order to construct a more realistic model we will assume that any change in the profit Π of the new company will start with a delay of two months, after the respective input of the resource.

Using our pessimistic assumption that all the costs of new resources need to be treated as operational costs, the formula will be:

$$\Pi_T = \Pi_{T-2} + \sum_{t=1}^{t=T-2} \sum_{\text{all } j} k_{jt}\,\Delta_{jt} - \sum_{t=1}^{t=T} \sum_{\text{all } j} c_{jt}\,\Delta_{jt}$$

The difference in time for the costs is due to the fact that they have to be subtracted with no delay from the profit. Therefore, our formula for the rate of return will be:

$$r_T = \frac{\Pi_T}{I_T} = \frac{\Pi_{T-2} + \sum_{t=1}^{t=T-2} \sum_{\text{all } j} k_{jt}\,\Delta_{jt} - \sum_{t=1}^{t=T} \sum c_{jt}\,\Delta_{jt}}{I_T}$$

At this stage of the study our main goal is to work out a matrix suitable for classifying the companies under recovery, i.e. in a way which can be matched by a reduced number of recovery patterns.

In an attempt to simplify this problem we have assumed that for any company with its particular technology and particular kind of output there is a corresponding pattern of input resources that may achieve the best results during the recovery period.

In practice we can use the accepted criteria that the level of technology of a company (or a group of companies, i.e. a division of a state holding company) can be defined by

ℓ, the amount of labour required per unit of output

k, the capital coefficient, or amount of capital required per unit of output, and

δ, the rate of depreciation of capital goods.

What we are trying to produce is a clear way to classify the companies before or at the beginning of the recovery, between a certain number of divisions, or group of companies, in which the state group has been organised. Of course, the number of divisions depends on the diversity of the group, and also on the style of the management.

In this study, and because we have more data derived from the NEB than from other state groups, we will limit the number of divisions to three. Furthermore, we will assume that between the five variables chosen for the average recovery, three of them are the most important, i.e. *E*, *MS* and *MK*. Therefore, the weight of these 3 resources will be higher than the weight of *R* and *IC*, when the funds of the recovery period are apportioned.

Our view is that the recovery of a company which has been classified as suitable for one of the divisions, will be predominantly affected by one of the three main variables.

Of course, this will not be the case of a division set up on the basis of the regional location of the companies. However, it can be argued that in any case, including the case of a "miscellaneous division" where there are companies of great diversity of products and technologies, it is always possible to work out a best way to apportion the resources.

As a consequence, if we limit our model to three different divisions, in which the whole diversity of operations and technologies are represented, we will have to design three patterns of average recovery processes, each one mainly associated with one of the three principal resources. Let then be a SHC with 3 divisions, and call them DIV1, DIV2 and DIV3. Assume that:

DIV1 is mainly influenced by resource *E*

DIV2 is mainly influenced by resource *MK*, and

DIV3 is mainly influenced by resource *MS*.

Hence the matrices we are looking for will be as follows:

RESOURCES j

		1	2	3	4	5
DIVISIONS i	1	k_{11}	k_{12}	k_{13}	k_{14}	k_{15}
	2	k_{21}	k_{22}	k_{23}	k_{24}	k_{25}
	3	k_{31}	k_{32}	k_{33}	k_{34}	k_{35}

k_{ij} is transformation factor of resource j in division i.

RESOURCES j

		1	2	3	4	5
DIVISIONS i	1	c_{11}	c_{12}	c_{13}	c_{14}	c_{15}
	2	c_{21}	c_{22}	c_{23}	c_{24}	c_{25}
	3	c_{31}	c_{32}	c_{33}	c_{34}	c_{35}

c_{ij} is the cost of one compound unit of resource j in division i.

RESOURCES J

		1	2	3	4	5
DIVISIONS i	1	m_{11}	m_{12}	m_{13}	m_{14}	m_{15}
	2	m_{21}	m_{22}	m_{23}	m_{24}	m_{25}
	3	m_{31}	m_{32}	m_{33}	m_{34}	m_{35}

m_{ij} is the proportion in monetary terms of resource j in division i.

In the latter matrix exists the additional condition that in each division, $\sum_{\text{all } j} m_j = 1$, i.e. the sum of all the 'm' must add up to one unit of investment in new resources, in the same division.

The model, by the use of these 3 matrices, will be able to calculate the rate of return of any company under recovery, once it is classified in one of the divisions.

It is worth noting the following about these matrices:

1. The values of k_j are higher when the resources are used in the same division as that in which the respective service unit is located. This is due to the specialisation and expertise acquired by the service company in that particular area. However, as it is not possible to assume the existence of a service company of a particular resource in all the divisions, constant values of k_j among all the divisions have been assumed.

2. If we assume that the cost, under competitive conditions of a resource, is roughly equal to the expected present value of the average discounted flow of benefits that it can produce, we can conclude that the k_j have to be proportional to the market costs of j.
   Therefore $c_j \times k_j$
   This implies that if we assume a cost structure of the resources involved in a recovery we are assuming certain similar structure between the k_j, i.e. if we were to know the costs of individual resources, and also one of the k_j values we would be able to assume the other k_j values.

3. The general trend will be to approximate the internal cost structure of resources to the market structure of costs.
   For this reason we have accepted that the costs of similar resources are equal throughout all the divisions, i.e.

   $$c_{1j} = c_{2j} = c_{3j}$$

4. The m_{kj} proportions of the total resources to be input during the recovery represent the quantity that can maximise the effect on the rate of return, or the highest value of certain resource

that can be input profitably. The product of m_{ij} x total resource, represents therefore the total amount of a resource to be input during the recovery. The input of a resource cannot reach at once the highest value, but has to change as a function of the recovery time, and also be coordinated with the input and sequence of other resources.

As an example of this input of resources, we have plotted below a graph showing a hypothetical distribution:

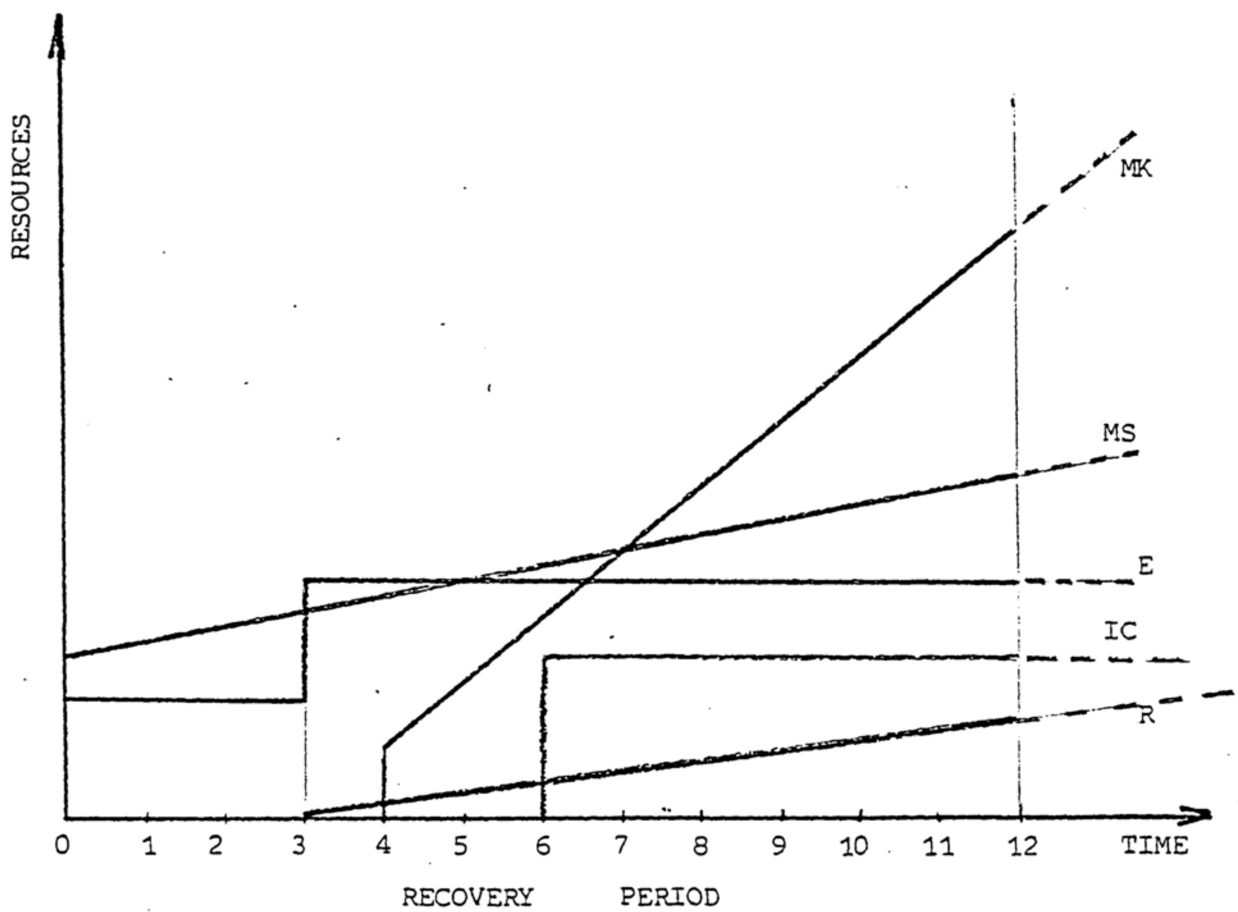


FIG.16. INPUT OF RESOURCES

5. It can be argued that the combined action of different resources has to produce a greater effect on the ailing company than the simple summation of the individual resources. In that respect it may be argued that a crucial aspect of the management task

is to determine what particular combination of resources is most suitable for a known company.

In our quantitative analysis the increase in "r" due to the simultaneous action of resources - which may be called a synergistic effect - could be represented by an additional multiplying factor greater than 1. However, it may also be argued that only if a proper combination of resources is utilised, will rate of return improve. Any resource used in isolation from the others will produce a poor result or no change at all. In that way we may assume that the k_j factor implicitly includes all these considerations and therefore, no special factor is needed. Bearing in mind that there is not a unique strategy to be used in a recovery, but a diversity of strategies that can achieve a successful recovery, our input-output matrices should be set up with different combinations of resources. However, as a concession to the simplicity of the model we will work with one set of figures. The probable variations in the shape of the input of resources graph will be considered in the sensitivity analysis to be performed by means of the computer programme (see Chapter VIII).

7.9 THE EVALUATION OF INTERMEDIATE COMMODITIES (IC) AS A RESOURCE

During this study a special imprtance has been given to the utilisation of products and/or services that are produced within the group by other companies that belong to the holding structure. We have taken it as axiomatic that collaboration among the firms of the state group was an indispensable characteristic of their operation. Intra-company trade is one of the main forms of this collaboration and it is extensively used by the private groups with which our state group performance is going to be compared. The idea was then to evaluate this intra-company trade as a tool for the recovery of an ailing firm. For this reason the variable IC was included in the formula for the output of a company under recovery and we attempted to give it a quantitative analysis.

First arises the problem of the definition of "intermediate commodity" and how it can be measured as a variable. We tried the following definition.

An intermediate commodity is any element of the group output, which may be consumed as an input by another firm or other firms of the group. Therefore, the IC has the characteristic of being an input linked to the output of other firms.

Following the general definition of compound units, we can say that: One compound unit of IC is the smallest quantity of resources needed to produce an increase in production of a particular IC. In this compound unit must be present and weighted all the inputs required, i.e. no bottle necks should appear within the structure due to the production of the additional unit of IC.

As may be seen the IC resource is considered as a network of idle capacities that are maintained as a matter of policy, to be in a position to increase their output and help the performance of companies under recovery.

The second problem is the cost of one unit of IC. Our approach was to use the shadow price of the resource IC, i.e. the amount by which the maximum attainable level of the profit function could be increased if an extra unit of IC were available. In this way the cost of IC is an opportunity cost linked to the profit function either of the whole group, or of the group recovery system, or of the company under recovery.

Regarded as an idle capacity two situations may arise in the production of IC.

a) The idle capacity consists purely of machinery and equipment which can increase their output without any additional cost or investment. It is assumed then as a capital intensive activity and the opportunity cost will be the rate of interest on the capital corresponding to the assets that are kept idle.*

b) The idle capacity is a mixture of capital and labour. In this case the cost cannot be evaluated without knowing the proportions between the two factors. This proportion could be worked out, as an average, assuming that the composition of the value added of IC for a given division of the group, is equal to the national average for that industry.

However, at that stage of the research, this approach was abandoned because it was realised that the model could not treat the variable IC in the same way as the other four variables. The approach was as follows.

During the recovery period the change in profit was evaluated by the model as:

$$\Delta\Pi = \Sigma k_j \Delta_j - \Sigma c_j \Delta_j \qquad \text{and} \qquad \Delta r = \frac{\Delta\Pi}{I}$$

where k_j = transformation factor of resource j into profit, c_j = cost

*If also additional labour will be necessary, it is assumed it can be contracted at once, without any additional cost.

of resource j, and I = total investment.

In the particular case of resource IC if we call $\Delta\Pi_{QIC}$ the change of profit achieved by one compound unit of IC, the total change of profit will be:

$$\Delta\Pi = \Sigma\, \Delta\Pi_{Q}$$

where $\Delta\Pi_{Q}$ is the profit per unit of output.

Because the quantity of IC compound units Q_{IC} will be proportional to the output Q of the company under recovery, then:

$$\Delta\Pi_{QIC} = k_{IC}\,\Delta_{IC} - c_{IC}\,\Delta_{IC} = \left(k_{IC} - c_{IC}\right)\Delta IC$$

i.e., the change of profit due to one compound unit of IC will be the difference between the transformation factor and the cost. Therefore, the total profit will be:

$$\Delta\Pi = \left(\Delta\Pi_{QIC}\right) \times Q = Q.\Delta_{IC}\left(k_{IC} - c_{IC}\right)$$

$\Delta_{IC}(k_{IC} - c_{IC})$, i.e. the profit that the company under recovery could achieve per unit of IC, bought at the new internal price (transfer price) c_{IC}, instead of at the old price (or cost) k_{IC}.

If we multiply this expression by Q we obtain the total profit. As a consequence, we have reached the conclusion that the input of IC resources is absolutely different than the input of the other four resources studied. The transformation factor of IC is simply the difference between old and new costs for the company under recovery.

The other variables - mainly linked with expertise - were treated by the model with no concern for the total output or for the composition of the output of the company under recovery.

As a summary we may say: The possibility of replacing an outside supplier by a supplier within the group at a lower cost may be important to the recovery process and should be included in the model. This is no less true of the case of replacing some intermediate products manufactured by the company itself by another supplier at a lower cost.

The effect of this replacement is a function of at least three factors:

a) The change in cost.

b) The output of the company under recovery.

c) The ratio of the cost of the IC per unit of output to the total cost per unit of output.

The change in rate of return due to the input of IC has to be evaluated by the following formula:

$$\Delta r = \frac{Q}{I} \Delta_{IC} \left(k_{IC} - c_{IC} \right)$$

i.e., Q/I, the output per unit of investment, multiplied by the quantity of IC needed per unit of output, multiplied by the net change in cost per unit of IC replaced.

Since the difference between the actual cost and the new cost is an important factor and one that cannot be calculated, we have chosen an indirect way of evaluation, i.e. to compare the probable results of using IC replacement with the average result that the model will work out through the use of the other 4 resources. This means that the opportunity cost of investing in maintaining IC idle capacity would be the investment in a compound unit of the other resources.

Using this approach it is unnecessary to express IC in compound units, because it can now be expressed directly in monetary units. On the other hand, to express IC in compound units has no relevance if the group output is too diversified. The cost of the IC resource is simply the cost of capital to maintain idle capacity within the group.

The model will proceed as follows:

Let ro = the rate of return at the beginning of the recovery

T = recovery period = 12 months

Z = months with input of IC

q = proportion of total new resources spent in IC

I = total investment = constant

$$r_T = ro + \Delta_{ra} + \Delta_{rb}$$

Δ_{ra} = change in r due to other resources

Δ_{rb} = change in r due to IC

$$\underset{\text{average}}{\Delta\Pi a} = \left(\Delta\Pi a_1 + \Delta\Pi a_2 + \ldots . \ \Delta\Pi a_{12}\right)\frac{1}{12}$$

$$\Delta\Pi b = 12 . \underset{\text{average}}{\Delta\Pi a} \times q$$

$$\underset{\text{average}}{\Delta\Pi b} = \frac{12}{Z} \times q \times \underset{\text{average}}{\Delta\Pi a} \qquad \text{and}$$

$$r_T = ro + ra_t + \frac{\Delta\Pi_b \text{ average}}{I}(t-T+Z)$$

The model will need to know the value of $q = m_{ij}$ in the input-output matrix shown earlier. We have assumed that no more than 10% of the total resources will be spent in IC idle capacity. There are no precise figures in the SHCs reviewed for the actual intra-company sales. Certain figures arising from big multinational corporations show levels around 30% of the total turnover. However this figure does not comprise exclusively intermediate products, but mainly final goods. For that reason those figures refer to terms of internal trade and not to intra-company production.

7.10 PROBABLE GOVERNMENT REQUIREMENTS

The purpose of this chapter is to discuss the approximate limits, within which government demands for using the state-holding company, as an economic tool, may vary.

Because the state group is a part of the state, any direction for intervention of government will have an economic cost to itself. In the long-term this might lead to an equilibrium between the group's costs, the group's performance and the government's demands. However, in the short-term it seems that this consideration cannot be used as a quantitative approach: in general, during economic emergencies governments do not care about an unbalanced budget.

For this reason we will study the loads (or overloads) that the group structure can expect to absorb in a short period. As was mentioned the expressions "recovery" or takeover may describe the most current forced involvements as directed by the government, i.e. being in charge of ailing-firms, expanding in new technologies or highly risky projects, expanding in pre-determined regional areas, etc.

Therefore, our main unknowns will be the sizes, the number, the frequency and the characteristics of the companies that could be referred to the state groups.

In this respect two situations with different characteristics may be identified.

First, the case of an existing state group that has to change its structure to match a change in government policy.

Second, the case of a totally new group which has just been established and wishes to prepare its organisation to conform to its terms of reference.

The experience shows that this kind of state body has never been set up as a 'green-field' organisation. The decision to set them up is followed immediately by involvement in a number of recoveries. In this way the group has to be set up while the tasks are already in full development.

If we assume that the state holding company is already set up, the data required may be worked out following two main routes.

a) An empirical study might be made of the companies which had requested government help, or which had received significant government support during the previous years.

b) It may be possible to assume that the companies that have been in the state holding group for some years are a true sample of the areas, the quantity and the characteristics of the enterprises in which the group might be involved in the future. Then, the prospective growth of the group and of its divisions could be assumed as proportional to their existing size.

In the second case, if the group has not yet been set up, or if there is no precedent of government involvement in industrial recoveries, another route has to be used. This may be outlined as follows:

c) The economic cycles of the country and their effects on the main industrial branches have to be analysed. If it is assumed that future cycles will follow a similar trend, it would be possible to forecast the number and the industrial branches from which enterprises will probably demand the group's support.

This method could be regarded as complementary to methods (a) and (b).

Alternatively, it would be possible to use experience and data arising from other countries with similar characteristics.

If the state group already exists it may be worth applying the three methods and to compare their results. Due to the fact that this study is not intended to be principally empirical, we will use mainly the latter method (c) but try to simplify its approach with certain assumptions, as will be seen later.

Firstly, we will apply methods (a) and (b) to the case of an existing SHC, assuming that the average rate of growth of the group's divisions in the last three years will be approximately the same in future (of course, a period shorter or longer can be used). We will work out figures adding the total investment per division in each of the past 3 years and assume that the total investment demands will follow a similar pattern.

Let the group be compared at the end of year 1 of Z_1 firms with a total investment of I_1. Then:

$$I_1 = \sum_{m=1}^{m=Z} Im$$

where Im_1 is the investment in firm m during year 1.

Let G_1 the rate of growth in year 1 be:

$$\frac{\Delta I}{I_1}$$

in which ΔI will be the difference of the total investment between the end of year $0(I_0)$ and the end of year $1(I_1)$

The total investment will represent the total assets of the companies (as the sum of fixed assets at depreciated value, total stocks, investment in other companies, cash and debtors). We assume in our analysis that the resources needed by a company are a function of the total assets (the liabilities being irrelevant) and not a function of the equity capital. For a similar reason we are considering the total assets of the group's companies as a whole, and not only that part owned by the state. The mixed ownership (private partners in certain firms) has an influence in the way companies are administered, and in the distribution of profits, but we assume it has not a significant influence in the amount of resources required.

If we call G_{0-1} the rate of growth during year 1 and respectively G_{1-2} and G_{2-3}, during years 2 and 3, the average change in the total investment of the group during years 1, 2 and 3 will be:

$$\Delta I_{0-3} = \frac{1}{3}\left(G_{0-1}\ I_1 + G_{1-2}\ I_2 + G_{2-3}\ I_3\right) \qquad \text{and} \qquad G_{0\ 3} = \frac{\Delta I_{0-3}}{I_{0-3}}$$

Although this calculation looks simple, the real situation is more complex because the growth of the group may arise from 2 different sources.

The first is the expected growth of companies already in the system, and the second may come from new companies either set up at the group's own initiative or on the instructions of government. This may be represented in the diagram below:

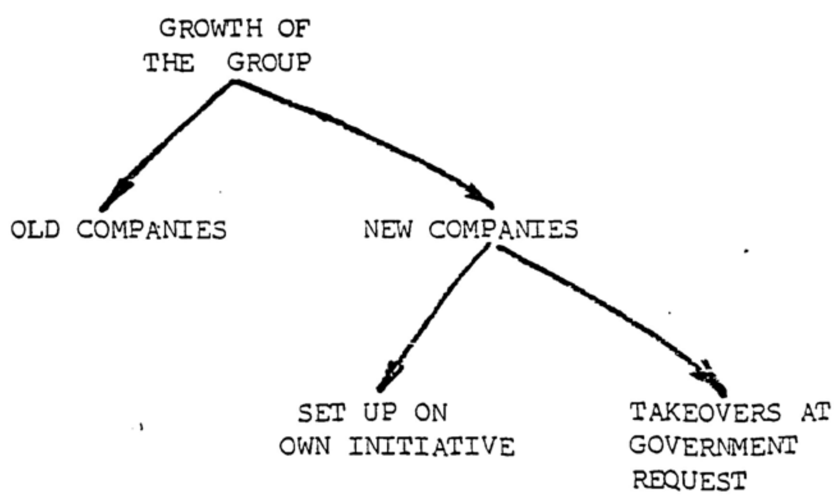


FIG.17. GROWTH OF THE SHC

In spite of the fact that it can be argued that all companies - old and new - have to use the group's resources, it is necessary to make this division between them, because old companies and new companies set up on the group's initiative, can be planned in advance. In that way their requirements could be forecasted in a more precise manner.

An estimation of the growth rate expected only from forced takeovers could be worked out as follows.

Let $$G_{0-3}\left(I_{0-3}\right) = G'_{0-3} \times I'_{0-3} + G''_{0-3} \times I''_{0-3}$$

In which G'_{0-3} will be the rate of growth of the group arising from planned and voluntary expansion. G''_{0-3} will be the rate of growth due to forced takeovers.

It has to be understood that changes in investment (ΔI) may have a positive or a negative sign. In this way divestments could be considered as negative when calculating the average values.

Let ΔZ_{0-1} be the change in the number of firms between the end of year 0 and the end of year 1, and analogously ΔZ_{1-2} , ΔZ_{2-3} .

Let $\Delta Z = \Delta Z' + \Delta Z''$, where $\Delta Z'$ will be the change in number of companies set up on the group's initiative, and $\Delta Z''$ the change in number of companies due to forced takeovers. It should be noted that in practice the reasons for government's requests and the group's initiative are very often interwoven. Therefore it may be difficult in practice to divide the companies into these two groups. Thus it seems reasonable to place all the new companies in a single group and to approximate $\Delta Z''$ to ΔZ.

Then $$\Delta Z_{0-3} = \frac{1}{3}\left(\Delta Z_{0-1} + \Delta Z_{1-2} + \Delta Z_{2-3}\right)$$

and the average takeover (or composite unit of investment expected when a takeover is requested by government) will be:

$$\Delta I_{0-3} / \Delta Z_{0-3}$$

Although this method might seem simple, it can be argued that wholly-forced decisions are not predictable and that any other method of determination of the average takeover could have the same force. Having in mind this argument, we will propose another method of approaching the data we need based on more general features.

In order to do that it is necessary to accept some assumptions about the behaviour of the economy, the national context and the relative importance of the SHC to the economy as a whole, the latter measured by the SHC turnover as a percentage of GDP. It is worth bearing in mind that the group's turnover does not, of course, contribute in total to GDP because as for all enterprises, it is the value added by the group that forms part of the GDP.

However, in practical cases, it would be difficult to get information from a group about the raw materials, components, energy and services they buy, in order to calculate value added. Neither is it easy to get information about the items that comprise added value such as wages and salaries, social service contributions, rent of premises, hire of equipment, etc. But in the context of our analysis and approach, this difference between the value added by the group and its turnover, is not too important because we are using only a ratio which can include all these aspects.

If we compare the relative importance of the SHCs in the three cases already studied, the magnitude of these organisations measured by their turnover as a percentage of GDP is as follows:

			Years since set up
NEB	(UK)	2.8% (0.75%)	4
Statsföretag	(Sweden)	3.0%	10
IRI	(Italy)	11.9%	30

In the IRI's case an important part of the turnover is related to non industrial activities. In the NEB's figure two large companies (British Leyland and Rolls Royce) have contributed substantially to the turnover figure during the initial years, without being really integrated into the structure.

The figures of UK, Sweden and Italy show that the highest sustained economic growth rate of these countries was achieved by Sweden between years 1960-70 at 8.5%. Bearing in mind that these state groups are expected to make a significant contribution to the performance of the economy as a whole we will assume that the rate of growth of the group will be 10% per year, and that only one half of this rate will be in the form of forced takeovers.

Assuming a starting point of 0.75% involvement of the group turnover in GDP (which means, as was explained above, a lower figure in value added terms), with a sustained growth ratio of 10%, it will take around 8 years, since the establishment of the group, to achieve 1.5% of GDP as a steady state (if we do not consider any significant growth of the country's economy).

Since this is the maximum assumed involvement of the group in the economy, any further takeover will have to be balanced by a similar divestment (although the number of takeovers might continue to be stable). In order to calculate the expected number of takeovers we shall estimate the average size of individual investment due to takeovers. This can be done as follows.

First, we shall assume an average number of personnel involved in an average takeover, and second, we shall assume the amount of assets per employee in the industrial branches where the group most probably will be involved. The latter figure can be regarded as a quotient between the capital/output ratio, divided by the labour/output ratio, i.e. k/ℓ, two of the coefficients that characterise the technology level (the third being the depreciation coefficient; see Paragraph 7.8, page 196).

As a summary the method may consist of:

1) Determine the change of the group investment per year = ΔI

$$\Delta I = \text{GDP} \times \textit{rate of group's growth} \times \begin{array}{c}\textit{relative importance}\\ \textit{of group turnover}\end{array}$$

$$\Delta I = \text{GDP} \times G \times \frac{\textit{Turnover}}{\text{GDP}}$$

If the absolute value of turnover is assumed, the GDP is not relevant for the calculation and could be eliminated from the formula. In general, however, it seems easier to estimate the relative importance of the group through the quotient: Turnover/GDP = R.

In this way we have estimated ΔI as the total annual investment of the group during the period of growth. This growth will stop when the assumed maximum size of the group is achieved.

2) Determine the average investment per takeover = Iav

$$Iav = \textit{average personnel} \times \textit{assets per employee}$$

$$\textit{average personnel} = \textit{av. pers.}$$

$$Iav = \textit{av. pers.} \times \frac{\textit{capital}}{\textit{output}} \Big/ \frac{\textit{output}}{\textit{labour}}$$

$$= \textit{av. pers.} \times k/\ell$$

in this way we are assuming that the ratios k and ℓ remain constant during the growth period.

3. Determine the number of takeovers per year $= \Delta Z$

$$\Delta Z = \frac{\Delta I}{Iav} = \frac{\text{GDP} \times G \times R}{av.pers. \times k/\ell}$$

and replacing the G and R figures already mentioned:

$$\Delta Z = 0.00075 \frac{\text{GDP}}{av.pers. \times k/\ell}$$

The k/ℓ ratio is a well known figure in each country and in each branch of industry; however in most of the cases it is related to existing industries with depreciated historic cost of assets. In our case, because we will use new resources for the recovery of industries, the figure concerned will be related to new assets per employee. The average personnel is the most uncertain figure and could be worked out only on the basis of empirical studies of the country concerned.

The use of k/ℓ ratios and average personnel figures which may vary from country to country and from one industrial branch to another, will give sensitivity to the approach, as will be seen in the following example.

In the UK's case we shall assume the figures as follows:

GDP (1977)	-	£124,000$\cdot 10^6$
Average Personnel	-	500 - 1,000 employees per takeover
k/ℓ	-	£10,000

Therefore, using the upper and lower limits of the average personnel we can estimate the following range of average total investments per takeover:

	Case 1	Case 2
Average Personnel	500	1,000
Investment/Employee	£ 10,000	£ 10,000
Average Investment	£5,000,000	£10,000,000 =

Then, the value of ΔZ will be:

$$\Delta Z = 0.00075 \frac{124,000 \times 10^6}{5 \times 10^6} = 18 \qquad \text{or}$$

$$\Delta Z = 0.00075 \frac{124,000 \times 10^6}{10 \times 10^6} = 9 \text{ takeovers per year}$$

and following our previous approach that means that approximately 9 or 4 new companies per year will be set up at the headquarters' initiative, and the group will be forced to takeover 9 or 5 enterprises per year.

If we use the UK's case to build our model we will have to allocate the assumed new investments between the 3 main divisions of the group. As was previously indicated Division 1 will be predominantly engineering orientated (E will be the most important variable); Division 2 will be marketing orientated (MK will be the most important variable); and in Division 3 the management services variable, MS, will be the most important. Fig.18 shows schematically a SHC, with 3 divisions and service companies set up within them.

The forced takeovers will be distributed in a way which reflects the vulnerability of companies during recession periods.

The following distribution of the forced takeovers has been chosen:

Division	1	50%
	2	20%
	3	30%

and using this distribution and the previous assumptions the group's growth will show the composition presented below:

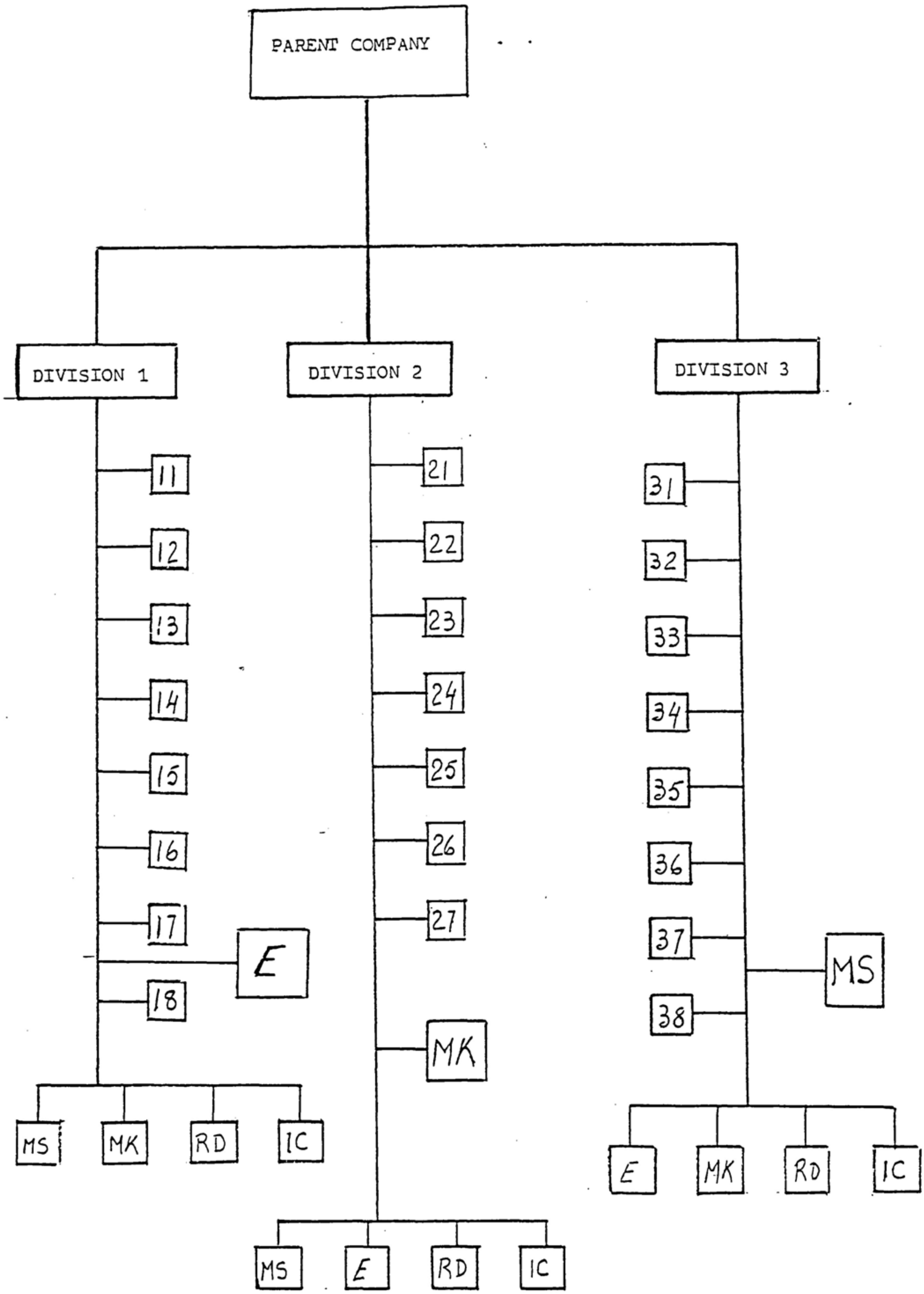


FIG.18. SHC ORGANISATION CHART

Case 1 (Iav = £5 million) ΔZ = 18

	Div1	Div2	Div3
By own plan (equally distributed)	3	3	3
By forced takeovers	4	2	3
Total number of companies	7	5	6

Case 2 (Iav = £10 million) ΔZ = 9

	Div1	Div2	Div3
By own plan (equally distributed)	1	1	1
By forced takeovers	3	1	2
Total number of companies	4	2	3

This arbitrary distribution of companies is not too significant because in the two cases the total investment per year (or the growth of the group per year) is the same, i.e. roughly £90 million per year. The usefulness of this kind of distribution will be seen later on, when the model will be tested in the computer.

As was already pointed out, the growth of the group due to own and planned decisions will not always give rise to new companies. However, in our model the most critical situation will appear when a new project is launched and will require resources. In this case it is irrelevant whether or not the new project is set up as a new firm or as a part of an old one. In both cases the resources will have to be supplied either by the group itself or from outside companies.

This approach to the probable government demands will allow us to produce a simulated flow of recoveries to be performed within the first 3 years of life of the system.

With this final set of data we can now go on to explain the computer programme and its results.

CHAPTER VIII

THE COMPUTER PROGRAMME

8.1 DESIGN OF THE PROGRAMME

The programme was set up with eight main blocks, following the flow chart shown in Fig.19.

The recovery system was devised following the scheme of Fig.18. (see paragraph 7.10). It is assumed that a "resource-slacks" strategy (see para graph 2.5) is being followed and that the resources in question are maintained in self-contained units or service companies. However, it is not assumed that in each and every division there is a service company for each resource. We have worked under the assumption that services can be provided, with equivalent effectiveness from any one division to any other.

8.2 IDENTITIES OF THE MAIN PROGRAMME VARIABLES

The names given to the resources E, MS, MK, IC and RD are the same in the model as in the programme.

r = rate of return = RATE

r_0 = RRATE

T = recovery period = ITIME

CE, CMS, CMK, CRD, costs of resources are called COSE, COMS, COMK and CORD respectively.

kE, kMS, kMK and kRD, the transformation factors of each resource (see page) are called: TRE, TRMS, TRMK and TRRD respectively.

kIC, the average cost of resource IC is called ASUMIC.

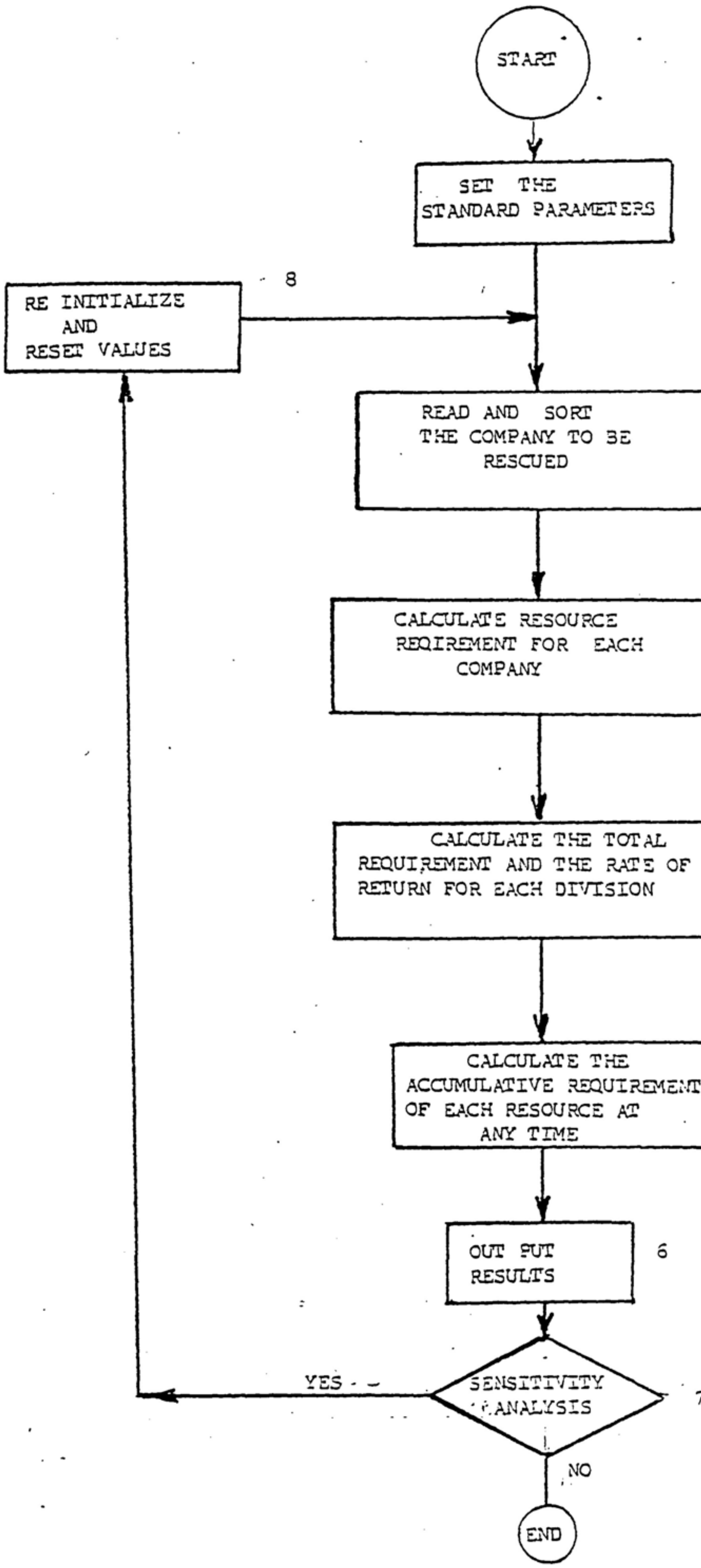


FIG.19. ORGANISATION OF THE PROGRAMME

ICLOCK is the point in time when a company enters the recovery system.

TOE(i), TOMS(i), TOMK(i), TORD(i) and TOIC(i) are the aggregate values of the respective resources at the end of period (i).

I, the total investment in the company undergoing recovery is called INV.

RESOR is the proportion of INV that will be invested in new resources during the recovery period.

Z, months with input of resource *IC* is called IZ.

q, proportion of total resources spent on resource *IC*, is called Q.

8.3 STANDARD PARAMETERS

The costs of the composite units (see page 198) of resources were chosen in a rather arbitrary way. The costs of management services and engineering services were fixed using average market prices charged by consultancy firms; research and development costs based on charges quoted by an independent research company in 1979. Having estimated these costs, the cost of marketing was then set at a higher figure bearing in mind the scale of the outlays needed for an effective sales promotion for widely-sold products.

The transformation factors were estimated in a purely subjective way by examining the potential areas of improvement of the rate of return that were identified in Paragraph 7.4; also considered were the probabilities of success during a recovery of each resource.

Finally, following an iterative approach, the main objective was to choose a combination of transformation factors that achieved an approximate breakeven, after 12 months of the recovery process. Another important decision was to select what was to be the quantity of resources - expressed in financial terms - to be input into the company as new resources, during the 12 months of recovery.

It was decided to use 10% of the total investment of the company, i.e. RESOR = 0.1 INV. The rationale for this figure lies in the fact that if the group acquires the company at a price equal to the value of its assets (and assuming that that value is at least maintained), then if all current outgoings were to be suspended, the group's losses would be reduced to the cost of the capital invested in the company, and this is the lowest level of loss which is possible before the recovery process.

Assuming that the cost of capital is 10% (i.e. the opportunity cost of funds represented by the value of the assets), an expenditure per annum on the recovery process of an amount which represents an equivalent percentage of the asset value may be acceptable although the figure to be chosen will in practice be arbitrary in view of the uncertainty which inevitably surrounds any assessment in advance, of the effects on performance of alternative resource input levels.

Finally, it was decided to spend in each division, the following proportion of the total funds:

	RD	E	IC	MS	MK		
Division 1	0.1	0.5	0.1	0.2	0.1	=	1.0
Division 2	0.1	0.1	0.1	0.2	0.5	=	1.0
Division 3	0.1	0.1	0.05	0.5	0.25	=	1.0

The approach then has consisted in giving a low importance to RD, and

IC assuming that they are not highly significant during a recovery. The other three variables were increased to 50% of the total resources in the respective division, i.e. E to 50% in Division 1, MK to 50% in Division 2, and MS to 50% in Division 3.

The level of MS was maintained at a minimum of 20%, because of the large variety of support activities grouped under this name.

The initial value of '*r*' is assumed to be -0.10 (i.e. minus 10 per cent). This value was chosen since it represents the opportunity cost of the funds tied up in the assets or the interest payable on the funds required to finance the assets, this being the negative return which would follow suspension of current outgoings and the highest return which can be achieved at this stage.

The programme sets all the resources consumed by a company under recovery at zero (0), when the recovery period exceeds ITIME, i.e. the standard time of recovery. This abrupt cutting off of the inputs signifies the release of that amount of resources, then available for use in a new company arriving in the system.

8.4 DESIGN OF THE SERIES OF TAKEOVERS

As was stated in Paragraph 7.10 in Case 1, 9 companies will be assumed to come into the recovery system per year, each with an average total investment of £5 million. In Case 2, 6 companies will be assumed to come into the recovery system per year, each with an average total investment of £10 million. Using these data and the other assumptions made in Paragraph 7.8 a list of companies was arranged in which each firm under recovery was characterized by the month in which its rescue

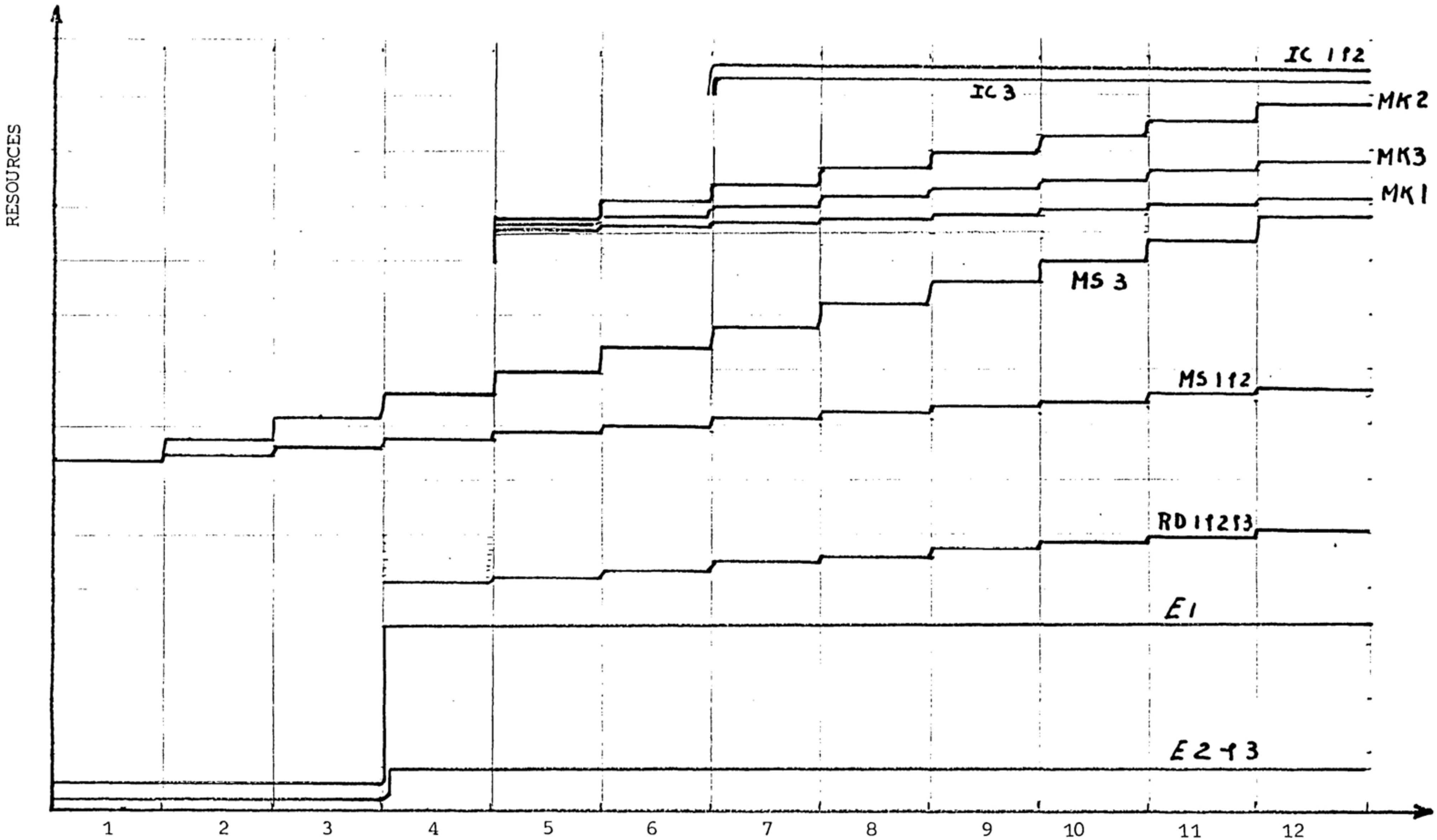


FIG.20. RESOURCES AGAINST TIME

224 a

begins and the division to which the company will be assigned. The list of companies (stored in file DUCK) spreads over a period of 38 months in Case 1 and of 36 months in Case 2.

Block 2 (see Fig.19) sorts each company from the list and inputs it into the recovery system in the month in which its rescue operation starts.

Each programme was run twice, first for list Case 1, and then for list Case 2.

8.5 THE AVERAGE RECOVERY

Each time that a company is input the programme calculates the quantity of resources required month by month during the recovery. This calculation is made by using the proportion of funds utilised in each resource category, as described in Paragraph 8.3.

Previously a standard profile against time of resources was assumed, that is equal for all the three divisions, although the proportions of funds devoted to each category of resources differ.

The standard recovery has been assumed to have the following characteristics (see Fig.20):

1. During periods 1, 2 and 3 resource E is input at a constant rate of 400 units per month into companies in Division 1, and at a rate of 200 units per month into companies in Divisions 2 and 3. From period 4 until the end of the recovery, E is input at a constant rate, that the programme regulates in order to achieve the corresponding proportion of total funds. This is done by

subroutine ENGINE.

2. Resource MS, starts to be input in period 1, with 400 units in all the divisions. The MS input is increased at a constant rate, month by month, until the end of the recovery. The programme regulates the rate of increase in each division needed to achieve the proportion of funds allocated to MS in each division. This is done by subroutine MANAGE.

3. Resource MK starts to be input into the companies in period 5, allowing time for the previous resources to elaborate a marketing strategy. From period 5 until the end of recovery, MK is increased period by period at a rate that subroutine MARKE calculates to achieve the proportion of funds allocated to MK in each division.

4. IC resources start to be input into the companies in period 7 until the end of the recovery. This input, which implies the use of idle capacity within the group, is made at a constant rate by subroutine RATOR. This rate is evaluated as in Paragraph 7.7 and achieves the proportion of funds allocated to IC in each division.

5. RD resources start to be input into the companies in period 4 and until the end of recovery. The input starts with 111.11 units and increases at a constant rate, that subroutine RDEVE calculates in order to achieve the proportion of funds assigned to RD in each division.

6. Since all the resources are allocated in BLOCK 3 (see Fig.19), and all the costs and transformation factors are known, BLOCK 4 calculates the rate of return at any period of time t, for each division. The initial value of r, is assumed to be -0.10.

7. In BLOCK 5, subroutine ACUM works out the aggregate value of

each resource, at any period of time, required by the series of takeovers in all the divisions.

8. In BLOCK 6 the subroutines OUT print the results of the programme.

8.6 SENSITIVITY ANALYSIS

The original program was modified in order to make it suitable for sensitivity analysis.

First, all the standard parameters were rewritten using variable profiles in the input of the variables i.e. the initial delay for the input of the resource can be increased or decreased.

Second, the total duration of the recovery period, can be changed, i.e. ITIME > 8.

Third, the total resources to be input during the recovery can be modified either by:

1. Changing any particular resource by a certain quantity, and changing the total resources by the same quantity or
2. Changing any resource by a fixed amount and then re-allocating that value among the other resources, in order to hold constant the total value of resources utilised i.e. RESOR = constant.

The modified program is called NEB5, and it takes the data from Program SENSOR which creates new files suitable for sensitivity analysis. Forty different runs of the programme were performed, each with a different input of one particular variable (or datum).

Runs 1 to 18 involved a changed in the time delay in the input of the variables.

Runs 19 to 26 used changes in the assumed costs of resources.

Runs 27 to 31 were made by increasing by a fixed amount one resource (£10,000) in each division, and increasing the total resources by the same amount.

Runs 32 to 36 were made by increasing one resource in each division by a fixed amount, but maintaining constant the total of resources invested during the recovery.

Finally, runs 37 to 40 were made by changing the period of recovery, ITIME.

In each run the changes in the rate of return were printed, and a graph was plotted with this variation.

Also, for each run values of the resources needed by the system were shown and the maximum required is pointed out at the bottom of the list. A graph with the accumulated requirement is shown in each trial.

In another printout the programme shows the simultaneous requirement of all the resources, expressed in compound units (IC in money terms), in each period of the series of recoveries.

The results of the programme will be commented on in the final conclusions which follows.*

*In order to save space, only one complete run of the programme is included in the binding.

TABLE XXI: RESULTS OF SENSITIVITY ANALYSIS

No/Case	Resor	Change	Maximum Required By The System					Rate of Return x 10^{-3}						Deviation From Standard Aver.		
								DIV1		DIV2		DIV3				
			E	MK	MS	RD	IC	At *I* Time	Aver	At *I* Time	Aver	At *I* Time	Aver	DIV2	DIV2	DIV3
0-1	500000		16067	6041	15632	4556	37500	-1	-68	-40	-82	-8	-71	-	-	-
0-2	1000000		24800	8403	24345	6667	58333	-2	-70	-41	-83	-9	-73	-	-	-
1-1	500000	E DELAY=2	14720	6041	15632	4556	37500	-6	-66	-41	-82	-9	-71	2	0	0
1-2	1000000	E DELAY=2	22540	8043	24345	6667	58333	-7	-68	-42	-83	-10	-73	2	0	0
2-1	500000	E DELAY=1	13968	6041	15632	4556	37500	1	-64	-40	-82	-8	-71	4	0	0
2-2	1000000	E DELAY=1	20690	8403	24345	6667	58333	1	-65	-40	-83	-8	-72	5	0	1
3-1	500000	E DELAY=4	14444	6041	15632	4556	37500	-10	-71	-41	-83	-9	-72	-3	-1	-1
3-2	1000000	E DELAY=4	26362	8403	24345	6667	58333	-12	-73	-42	-84	-10	-74	-3	-1	-1
4-1	500000	E DELAY=5	15585	6041	15632	4556	37500	-6	-74	-41	-83	-9	-73	-6	-1	-2
4-2	1000000	E DELAY=5	22614	8403	24345	6667	58333	-6	-76	-42	-85	-9	-74	-6	-2	-1
5-1	500000	MS DELAY=1	16067	6041	16069	4556	37500	-1	-70	-40	-84	-10	-75	-2	-2	-4
5-2	1000000	MS DELAY=1	24800	8403	25429	6667	58333	-3	-72	-41	-85	-12	-76	-2	-2	-3
6-1	500000	MS DELAY=2	16066	6041	16061	4556	37500	-5	-72	-44	-86	-16	-78	-4	-4	-7
6-2	1000000	MS DELAY=2	24800	8403	26400	6667	58333	-6	-73	-45	-87	-17	-79	-3	-4	-6
7-1	500000	MK DELAY=3	16067	5833	15632	4556	37500	-1	-68	-37	-81	-7	-71	0	1	0
7-2	1000000	MK DELAY=3	24800	8000	24345	6667	58333	-1	-70	-37	-83	-7	-73	0	0	0
8-1	500000	MK DELAY=2	16067	5704	15632	4556	37500	0	-68	-35	-80	-6	-70	0	2	1
8-2	1000000	MK DELAY=2	24800	7727	24345	6667	58333	-1	-70	-36	-82	-6	-72	0	1	1
9-1	500000	MK DELAY=5	16067	6161	15632	4556	37500	-2	-69	-43	-83	-9	-72	-1	-1	-1
9-2	1000000	MK DELAY=5	24800	9107	24345	6667	58333	-2	-71	-44	-85	-10	-74	-1	-2	-1
10-1	500000	MK DELAY=6	16067	6190	15632	4556	37500	-3	-69	-48	-85	-12	-73	-1	-3	-2
10-2	1000000	MK DELAY=6	24800	9880	24345	6667	58333	-3	-71	-49	-86	-12	-74	-1	-3	-1

RESULTS OF SENSITIVITY ANALYSIS

No/Case	Resor	Change	Maximum Required By The System					Rate of Return x 10^{-3}						Deviation From Standard Aver.		
								DIV1		DIV2		DIV3				
			E	MK	MS	RD	IC	At I Time	Aver	At I Time	Aver	At I Time	Aver	DIV2	DIV2	DIV3
11.1	500000	IC DELAY=5	16067	6041	15632	4556	35714	-1	-68	-40	-82	-8	-72	0	0	-1
11.2	1000000	IC DELAY=5	24800	8402	24345	6667	57142	-2	-70	-41	-83	-9	-73	0	0	0
12-1	500000	IC DELAY=4	16067	6041	15632	4556	37500	-1	-67	-40	-82	-8	-71	1	0	0
12-2	1000000	IC DELAY=4	24800	8402	24345	6667	56250	-2	-69	-41	-83	-9	-73	1	0	0
13-1	500000	IC DELAY=7	16067	6041	15632	4556	45000	-1	-69	-40	-83	-8	-72	-1	-1	-1
13-2	1000000	IC DELAY=7	24800	8402	24345	6667	60000	-2	-71	-41	-84	-9	-74	-1	-1	-1
14-1	500000	IC DELAY=8	16067	6041	15632	4556	43750	-1	-70	-40	-83	-8	-73	-2	-1	-2
14-2	1000000	IC DELAY=8	24800	8402	24345	6667	62500	-2	-72	-41	-85	-9	-74	-2	-2	-1
15-1	500000	RD DELAY=2	16067	6041	15632	4556	37500	-1	-69	-40	-82	-8	-72	-1	0	-1
15-2	1000000	RD DELAY=2	24800	8402	24345	6545	58333	-2	-71	-41	-84	-8	-73	-1	-1	0
16-1	500000	RD DELAY=1	16067	6041	15632	4394	37500	-1	-69	-40	-82	-8	-72	-1	0	-1
16-2	1000000	RD DELAY=1	24800	8402	24345	6364	58333	-1	-70	-40	-84	-8	-73	0	-1	0
17-1	500000	RD DELAY=4	16067	6041	15632	4583	37500	-2	-69	-40	-82	-8	-72	-1	0	-1
17-2	1000000	RD DELAY=4	24800	8403	24345	6944	58333	-2	-70	-41	-84	-9	-73	0	-1	0
18-1	500000	RD DELAY=5	16067	6041	15632	4643	37500	-2	-69	-41	-82	-9	-72	-1	0	-1
18-2	1000000	RD DELAY=5	24800	8403	24345	7143	58333	-2	-70	-41	-84	-9	-73	0	-1	0
19-1	500000	COSE=10	12733	6041	15632	4556	37500	-21	-75	-44	-84	-12	-73	-7	-2	-2
19-2	1000000	COSE=10	19800	8403	24345	6667	58333	-21	-77	-45	-85	-12	-75	-7	-2	-2
20-1	500000	COSE=12	10511	6041	15632	4556	37500	-34	-80	-47	-85	-14	-74	-12	-3	-3
20-2	1000000	COSE=12	16466	8403	24345	6667	58333	-24	-81	-47	-86	-15	-75	-11	-3	-2
21-1	500000	COSMS=10	16067	6041	12470	4556	37500	-10	-72	-49	-85	-29	-79	-4	-3	-8
21-2	1000000	COSMS=10	24800	8403	19345	6667	58333	-11	-73	-50	-87	-29	-80	-3	-4	-7

RESULTS OF SENSITIVITY ANALYSIS

No/Case	Resor	Change	Maximum Required By The System					Rate of Return x 10^{-3}						Deviation From Standard Aver.		
								DIV1		DIV2		DIV3				
			E	MK	MS	RD	IC	At I Time	Aver	At I Time	Aver	At I Time	Aver	DIV2	DIV2	DIV3
22-1	500000	COSMS=12	16067	6041	10361	4556	37500	-16	-74	-55	-87	-43	-83	-6	-5	-12
22-2	1000000	COSMS=12	24800	8403	16102	6667	58333	-17	-75	-56	-89	-43	-84	-5	-6	-11
23-1	500000	COSMK=24	16067	5034	15632	4556	37500	-3	-69	-48	-84	-12	-73	-1	-2	-2
23-2	1000000	COSMK=24	24800	7002	24345	6667	58333	-3	-71	-49	-86	-12	-74	-1	-3	-1
24-1	500000	COSMK=28	16067	4315	15632	4556	37500	-4	-69	-54	-86	-15	-74	-1	-4	-3
24-2	1000000	COSMK=28	24800	6002	24345	6667	58333	-5	-71	-55	-81	-15	-75	-1	-4	-2
25-1	500000	COSRD=12	16067	6041	15632	3796	37500	-2	-69	-41	-83	-9	-72	-1	-1	-1
25-2	1000000	COSRD=12	24800	8403	24345	5556	58333	-2	-71	-41	-84	-9	-73	-1	-1	0
26-1	500000	COSRD=14	16067	6041	15632	3254	37500	-3	-69	-41	-83	-9	-72	-1	-1	-1
26-2	1000000	COSRD=14	24800	8403	24345	4761	58333	-3	-71	-42	-84	-10	-74	-1	-1	-1
27-1	510000	ΔE=10000	17178	6042	15633	4556	29167	+1	-68	-38	-82	-6	-71	0	0	0
27-2	1010000	ΔE=10000	25633	8403	24345	6667	51667	-1	-70	-40	-84	-8	-73	0	-1	0
28-1	510000	ΔMS=10000	16067	6042	16617	4556	29167	-2	-68	-37	-82	-5	-71	0	0	0
28-2	1010000	ΔMS=10000	24800	8403	25141	6667	51667	0	-70	-39	-84	-7	-73	0	-1	0
29-1	510000	ΔMK=10000	16067	6486	15633	4556	29167	-1	-69	-40	-82	-8	-72	-1	0	-1
29-2	1010000	ΔMK=10000	24800	8694	24345	6667	51667	-2	-71	-40	-84	-8	-73	-1	-1	0
30-1	510000	ΔIC=10000	16067	6041	15633	4556	37500	1	-68	-38	-82	-5	-71	0	0	0
30-2	1010000	ΔIC=10000	24800	8403	24345	6667	58333	0	-70	-40	-84	-7	-73	0	-1	0
31-1	510000	ΔRD=10000	16067	6041	15633	5467	29167	-2	-69	-41	-83	-9	-72	-1	-1	-1
31-2	1010000	ΔRD=10000	24800	8403	24345	7333	51667	-2	-71	-41	-84	-9	-73	-1	-1	-1
32-1	500000	ΔE=10000	16844	5921	15316	4464	28417	-1	-68	-39	-82	-8	-72	0	0	-1
32-2	1000000	ΔE=10000	25383	8319	24095	6600	51083	-2	-70	-40	-84	-8	-73	0	-1	0

RESULTS OF SENSITIVITY ANALYSIS

No/Case	Resor	Change	Maximum Required By The System					Rate of Return x 10^{-3}						Deviation From Standard Aver.		
								DIV1		DIV2		DIV3				
			E	MK	MS	RD	IC	At I Time	Aver	At I Time	Aver	At I Time	Aver	DIV2	DIV2	DIV3
33-1	500000	ΔMS=10000	15733	5921	16301	4464	28417	0	-68	-38	-82	-7	-72	0	0	-1
33-2	1000000	ΔMS=10000	24550	8319	24890	6600	51083	-1	-70	-40	-84	-8	-73	0	-1	0
34-1	500000	ΔMK=10000	15733	6365	15316	4464	28417	-3	-69	-41	-83	-10	-72	-1	-1	-1
34-2	1000000	ΔMK=10000	24550	8610	24095	6600	51083	-3	-71	-41	-84	-9	-73	-1	-1	0
35-1	500000	ΔIC=10000	15733	5921	15316	4464	36750	-1	-68	-40	-82	-7	-72	0	0	-1
35-2	1000000	ΔIC=10000	24550	8317	24095	6600	57750	-1	-70	-41	-84	-8	-73	0	-1	0
36-1	500000	ΔRD=10000	15733	5921	15316	5375	28417	-4	-69	-42	-83	-11	-73	-1	-1	-2
36-2	1000000	ΔRD=10000	24550	8319	24095	7267	51083	-3	-71	-42	-84	-10	-74	-1	-1	-1
37-1	500000	I TIME=13	14880	5833	15478	4455	35714	0	-66	-33	-80	-2	-69	2	2	2
37-2	1000000	I TIME=13	22360	8000	23638	6545	57143	-3	-68	-36	-81	-4	-71	2	2	2
38-1	500000	I TIME=14	14095	5704	15553	4394	37500	5	-64	-32	-78	0	-68	4	4	3
38-2	1000000	I TIME=14	20563	7727	23579	6364	56250	5	-65	-32	-80	0	-69	5	3	4
39-1	500000	I TIME=15	13371	5530	15590	4295	38889	7	-62	-26	-76	5	-66	6	6	5
39-2	1000000	I TIME=15	23608	7924	23171	6154	55556	4	-64	-28	-78	3	-68	4	5	5
40-1	500000	I TIME=16	14530	5369	15203	4231	35000	10	-59	-26	-75	6	-64	9	7	7
40-2	1000000	I TIME=16	22207	7115	23042	6044	50000	10	-62	-26	-77	6	-66	8	6	7

CONCLUSIONS

1. The SHCs reviewed in this study show that this type of organisation has a considerable capacity for adaptation both in the sense that it can assume a variety of forms and that it can adjust to a variety of circumstances. Many structural devices have been described in the preceding chapters, and what we have attempted with our model is to design a special rescue system suitable to face an exceptional task: to be in charge of forced acquisitions and divestments, and simultaneously being assessed on the basis of quantitative profitability criteria.
The model we have presented is based on a 'slack resources' strategy, in which resources are concentrated, within the group, in service companies. Thus the rescue system will absorb the main impact of government demands, without altering the main structure of the group.

2. The model of the recovery system has been developed on a theoretical basis and we cannot expect that actual rescue operations will perform in the form we have assumed. However, the computer programme has proved the consistency of the model and some of its results deserve further discussion and study.
In Table XXI are shown the results of the sensitivity analysis.
In the Appendix TEST RUN 0, are the results of a complete run of the programme that corresponds to the assumed standard recovery of companies.
It can be seen that using the standard data, after 12 months, companies in Division 1 achieve breakeven, and companies in Division 3 are very close to it. In contrast, companies in

Division 2 (marketing orientated) achieve scarcely r =-0.04. The reason lies in the delay with which the input of MK starts (after four periods).

These results could lead us to the conclusion that a marketing orientated company is not suitable for a shock recovery, i.e. a recovery planned in a short time, due to the longer time necessary to devise a market strategy and to adapt the output to that strategy. However, this conclusion deserves further analysis because a different profile for the input of MK, and a greater assumed transformation factor kMK may change the outcome and achieve better results in Division 2.

3. The maximum resources required by the system in Case 2 (six takeovers per year with a total investment of £60 million) are approximately 50% greater than the maximum resources required in Case 1 (nine takeovers per year with a total investment of £45 million). Thus, it is implied that if the series of takeovers is concentrated in fewer but larger companies, the system is subjected to greater demands not directly proportional to the total for a year's investment.

These results suggest that if the rescue system has to cope with takeovers that on average are of a larger size than was anticipated, the efficiency of the system will tend to diminish or, part of the required resources will have to be supplied by outside companies.

4. The annual cost of maintaining, within the system the maximum quantity of resources calculated by the model can be worked out by multiplying each maximum value by the cost of each compound unit of the resource and then multiplying it by 12

months. This calculation made for the standard recoveries, in Case 1 and Case 2 (see Table XXI) gives the following results:

Case 1: £5,488,000, i.e. 12% of the total for a year's investment in takeovers.

Case 2: £8,234,000, i.e. 14% of the total for a year's investment in takeovers.

These annual costs of the rescue system seem suitable for a SHC of the size we have considered in the model. A more conservative decision could be to set up service companies that can provide only a proportion of the maximum composite units expected to be required by the rescue system. After a period of empirical trial, it would be possible to increase the capacities. This approach combines two advantages:

a) To increase the rate of utilization of the service company capacities using external services mainly in order to cope with overloads or exceptionally large takeovers.

b) To maintain within the system the expertise indispensable for any emergency; furthermore the services to be contracted could be controlled and negotiated in a better way.

5. The sensitivity analysis shows the following trends:

a) Increased delays in the input of resources produce lower average rates of return in all the divisions. However, the reduction is more pronounced in the cases when the resource delayed coincides with the predominant variable of the division. As was expected delays in *RD* and *IC* resources do not produce significant changes.

b) Diminished delays in *E* improve results in Division 1, but do not affect the other divisions. Diminished delays in

MK improve slightly results in Division 2, but do not affect Divisions 1 and 3.

c) Increased costs of *E* affect significantly Division 1 and slightly the other Divisions. Increased costs of *MS* affect significantly all the divisions. Increased costs of *MK*, affect only slightly each of the divisions.

d) Increased input of individual resources by £10,000, either increasing the total resources or maintaining constant the total resources, do not produce significant changes in any division. Changes might be produced by increasing substantially the input of an individual resource, but that increase would imply a change in the basis of the model, changing the matrix that was set up in Chapter VIII.

e) Finally, increasing ITIME from the standard value of 12 to 13, 14, 15 or 16 months improves significantly the rate of return at the end of the recovery in all the divisions, as well as improving the average rates of return.

   Since the investment in new resources is kept constant, it seems sensible to suggest longer periods of recovery. However, if the companies are achieving a negative average rate of return, in spite of the fact that this average may improve, the total cost of the recovery will remain approximately the same (i.e. the diminished negative average will have to be multiplied by a greater number of months).

   Thus, what seems more important in our approach is the necessity to change from the shock period to a more definite and medium-term strategy as soon as possible.

6. As a summary, the analysis of a strategy for company recoveries plus the results obtained through the computer model tend to reaffirm what emerged from the analysis of extant SHCs and from the application to the SHC case of models of organisation such as those advanced by Khandwalla, Galbraith and Williamson. This is that the multidivisional form is of the essence of the SHC model and that the more mature the organisation and the greater its liability to government-imposed operations, the more clearly will this form evolve.

This is also supported by the structures of two European SHCs that we have not reviewed in this study: the West German Vereinigte Industrie-Unternehmungen AG-VIAG [42] composed of twenty companies and 22,000 employees which has a clear divisional structure with three main divisions, and the Spanish Instituto Nacional de Industria - INI [33], composed of 209 companies with around 230,000 employees which also has a well defined divisional structure with seven industrial divisions. These examples together with those of the Statsföretag and the IRI seem to demonstrate that the divisional structure does not arise exclusively as a consequence of the large size of the state group, as has been traditionally the case of the large private corporations.

In the SHCs the M-form has been adopted as a result of the combined effects of:

a) the autonomous status of the operating companies
b) the existence of a central strategic plan for the whole group

c) the setting up of a rescue system to meet government demands, and last but not least,

d) the need to develop integrative patterns among the companies in order to realise synergistic potential and a consequent better performance.

The NEB case has appeared as the unique exception to the general pattern and, as was discussed in Chapter IV, the reasons for this may originate more in the effects of the political uncertainty surrounding its role during the founding stages than in conscious managerial decisions concerning the optimal organisational design.

As a matter of record, in September 1980 the NEB's chairman announced the abolition of the original divisions that were partially based on sectors of industry [Financial Times, 25/9/80, Page 28]. This move seems strongly suggestive of the argument presented above in that just as NEB has been pruned of its main objectives as a SHC, the embryonic divisional form that existed, has been simultaneously abolished.

7. Mixed ownership of the operating units has not proved to be an indispensable feature of the SHC. In practice, the Statsföretag does not apply that pattern, the IRI uses mainly partnerships with other state groups and only to a subsidiary degree the partnership with very large private corporations. The NEB has either formed unstable partnership (as, for instance, with Ferranti and ICL) or has resorted to a lending policy that, it has been argued, runs counter to the main objectives of the group.

As a conclusion in this respect, mixed ownership seems to be predominantly related to the degree of consensus that the use of public sector involvement in manufacturing industry achieves in each country. In this case mixed ownership seems not to be a pattern of better management, but rather a defensive attitude towards the environment.

8. In the model we have proposed for a SHC, the rescue system is chiefly based on service companies that will provide the resources needed for the recoveries. Since individual profitability in those firms seems unlikely to be achieved, their establishment as companies fully owned by the group, without private partnership, would involve fewer difficulties in accounting and presentation. If this were the case, the total cost to the state of a series of recoveries would be the cost of running the service companies, plus the costs of the resources bought in from outside the group, plus the financial costs incurred during the recovery period upto the point at which breakeven is achieved.
The so called "quotation principle", that we have seen is used by the Swedish Statsföretag, follows a very similar procedure to that proposed above. In that way the SHC has shown itself to be particularly well adapted to perform commercial and non-commercial operations, keeping separate accounting records on different roles and objectives.

9. The information we have collected and presented in this study indicates that the SHC as a distinct form of organisation has performed relatively well as an instrument of economic policy of governments in different countries.
However, it ought to be remarked that, at present, this kind of organisation is so closely linked to the mixed economy

pattern, that its future seems to be indissolubly connected to the preservation of a mixed economy. The ups and downs of opposed economic theories are deeply affecting the performance of SHCs all over the world. What were regarded as a promising innovations in the methods of state industrial intervention during the 1970s, are in many cases considered, at present, to be survivors of past policies. Nevertheless, it would seem that whilst the SHCs are pruned, reduced, reorganised and, in extremis maintained "dormant", they are not dissolved or abolished. Their role as effective economic tools seems to have been accepted and no reasonable modern government has the confidence to abandon what has proved to be a useful instrument of industrial intervention.

APPENDICES

Programme NEB3

Programme SENSOR

Programme NEB5

File DUCK

TEST RUN (standard) 0

PROGRAMME NEB3

```
      PROGRAM STATEHO(ANGEL,INPUT,OUTPUT,DUCK,TAPE 5=INPUT,
     1                TAPE6=OUTPUT,TAPE7=DUCK,TAPE8=ANGEL)
      REAL      MS,MK,IC,INV
      INTEGER COMTYPE
C     DEFINE VARIABLES , COMPS. NUMBER AND TIME PERIODS.
      DIMENSION IPRINT(3)
      COMMON/RES/  E(32,55),MS(32,55),IC(32,55), MK(32,55),RD(32,55),
     1             COMTYPE(50),COSE,COSMS,COSIC,COSMK,COSRD,INV(10),
     1             TRE(3,10),TRMS(3,10),TRMK(3,10),TRRD(3,10),
     1             TRIC(3,10),RATE(32,55),IREC(36,2),ITIME,ICLOCK,
     1             TE(3,55),TMS(3,55),TMK(3,55),TRD(3,55),TIC(3,55),
     1             NRESQ,Q

C     THIS PROGRAM CALCULATES EFFECTS OF INPUT
C     VARIABLES IN THE RATE OF RETURN



C      STANDARD PARAMETERS
C
      COSE      =8.0
      COSMS     =8.0
      COSMK     =20.0
      COSRD     =10.0
      TRE (1,1)=30.0
      TRMS(1,1)=40.0
      TRMK(1,1)=50.0
      TRRD(1,1)=10.0
      TRE (2,1)=30.0
      TRMS(2,1)=40.0
      TRMK(2,1)=50.0
      TRRD(2,1)=10.0
      TRE (3,1)=30.0
      TRMS(3,1)=40.0
      TRMK(3,1)=50.0
      TRRD(3,1)=10.0
      RRATE     =-0.100
      ITIME     =12
      ICLOCK    =0
      NRUN      =0
      RESOR     =500000.0
 9500 FORMAT(1X,/////,30X,' TRIAL RUN NUMBER ',I3,/////)
 9000 FORMAT(3I5)
      READ(7,9000) NSET
      DO 1000 IJK=1,NSET
      IF(IJK.GT.1)
     1    THEN
              WRITE(6,9500) IJK
              DO 30 I=1,32
              DO 30 J=1,55
                 E   (I,J)=0.0
                 MS  (I,J)=0.0
                 MK  (I,J)=0.0
                 RD  (I,J)=0.0
                 IC  (I,J)=0.0
                 RATE(I,J)=0.0
                 TE  (1,J)=0.0
```

```
                  TE  (2,J)=0.0
                  TE  (3,J)=0.0
                  TMS (1,J)=0.0
                  TMS (2,J)=0.0
                  TMS (3,J)=0.0
                  TMK (1,J)=0.0
                  TMK (2,J)=0.0
                  TMK (3,J)=0.0
                  TRD (1,J)=0.0
                  TRD (2,J)=0.0
                  TRD (3,J)=0.0
                  TIC (1,J)=0.0
                  TIC (2,J)=0.0
                  TIC (3,J)=0.0
   30         CONTINUE
              RESOR=RESOR*2.0
          ENDIF
      READ(7,9000) NRESQ
C     WRITE(6,9001) NRESQ
      DO 50 I=1,NRESQ
        READ(7,9000) IREC(I,1),IREC(I,2) ,K
      COMTYPE(IREC(I,1))=K
   50 CONTINUE
 9001 FORMAT(3X,'.....',3I5)


      CALL BBSORT(IREC,NRESQ)


      DO   100   J=1,NRESQ
      I=IREC(J,1)
      ICLOCK=IREC(J,2)
C     CALL  PARA (I,RESOR,COMTYPE(I))
      INV(1)=10.0*RESOR
C
C
C     THESE SUBROUTINES CALCULATE  THE DISTRIBUTION OF VARIABLES
C      DURING THE RECOVERY PERIOD,EXPRESSED IN COMPOSITE UNITS
      CALL ENGINE (I,RESOR)
      CALL MANAGE (I,RESOR)
      CALL MAPKE (I,RESOR)
      CALL RDEVE (I,RESOR)
      CALL RATOR (I,RRATE,RESOR,IPRINT)
      IF(IPRINT (COMTYPE(I)).EQ.1)  GO TO 100
      CALL OUT2 (I)
      IPRINT(COMTYPE(I))=1
  100 CONTINUE

      CALL ACUM
      CALL OUT3
      CALL OUT
      CALL OUT4
 1000 CONTINUE

      END
C
C
C
```

```
      SUBROUTINE   PARA (I,RESOR.K)

9500  FORMAT (' INPUT ERROR PLEASE RE-ENTRY ' )

9510  FORMAT (1X,///,'ENTER THE NEW RESOURCES FOR COMPANY' ,I3,
     1' D I V I S I O N',1X,I2)
 100  WRITE (6,9510) I, K
      READ ( 5.*,END=100) RESOR
      IF ( RESOR.LT.0.0)
     1     THEN
                WRITE (6,9500)
                GO TO 100
           ENDIF
      RETURN
      END




      SUBROUTINE ENGINE ( NCOM,  RESOR )
      REAL      MS,MK,IC,INV
      INTEGER COMTYPE

      COMMON/RES/  E(32,55),MS(32,55).IC(32,55), MK(32,55),RD(32.55),
     1             COMTYPE(50),COSE.COSMS,COSIC,COSMK.COSRD,INV(10),
     1             TRE(3,10),TRMS(3,10),TRMK(3,10),TRRD(3.10),
     1             TRIC(3,10),RATE(32.55),IREC(36,2).ITIME.ICLOCK,
     1             TE(3,55),TMS(3,55),TMK(3,55).TRD(3,55).TIC(3,55),
     1             NRESO,Q

      IF (COMTYPE(NCOM).EQ.1)
     1      THEN
              A=400.0
              B=RESOR/(18.0*COSE) -133.3
            ELSE
              A =200.0

              B=RESOR/(90.0*COSE)-66.7
           ENDIF

      DO 100  I=ICLOCK+1,ICLOCK+3

      E(NCOM,I ) = A

 100  CONTINUE

      DO 200 I =ICLOCK+4,ICLOCK+ITIME
      E(NCOM,I)= B
 200  CONTINUE


      RETURN
      END
```

```
      SUBROUTINE MANAGE(NCOM,RESOR)


      REAL      MS,MK, IC,INV
      INTEGER COMTYPE



      COMMON/RES/  E(32,55),MS(32,55),IC(32,55), MK(32,55),RD(32,55),
     1             COMTYPE(50),COSE,COSMS,COSIC,COSMK,COSRD,INV(10),
     1             TRE(3,10),TRMS(3,10),TRMK(3,10),TRRD(3,10),
     1             TRIC(3,10),RATE(32,55),IREC(36,2),ITIME,ICLOCK,
     1             TE(3,55),TMS(3,55),TMK(3,55),TRD(3,55),TIC(3,55),
     1             NRESO,Q
      IF(COMTYPE(NCOM).EQ.3)
     1    THEN
              C=RESOR/(132.0*COSMS)-72.727
          ELSE
              C=RESOR/(330.0*COSMS)- 72.727
          ENDIF


      DO 100 I=ICLOCK+1,ICLOCK+ITIME
      MS(NCOM,I)=400.0+C*(I-ICLOCK-1)
  100 CONTINUE

      RETURN
      END
C
C
C
C
      SUBROUTINE  MARKE(NCOM,RESOR)
      REAL    MS,MK, IC,INV
      INTEGER COMTYPE


      COMMON/RES/  E(32,55),MS(32,55),IC(32,55), MK(32,55),RD(32,55),
     1             COMTYPE(50),COSE,COSMS,COSIC,COSMK,COSRD,INV(10),
     1             TRE(3,10),TRMS(3,10),TRMK(3,10),TRRD(3,10),
     1             TRIC(3,10),RATE(32,55),IREC(36,2),ITIME,ICLOCK,
     1             TE(3,55),TMS(3,55),TMK(3,55),TRD(3,55),TIC(3,55),
     1             NRESO,Q
      IF(COMTYPE(NCOM).EQ.2)
     1    THEN
             D=RESOR/(72.0*COSMK)
      ELSEIF(COMTYPE(NCOM).EQ.1)
     1    THEN
            D=RESOR/(360.0*COSMK)
      ELSE
            D= RESOR /(144.0*COSMK)
      ENDIF
      DO 300  I=ICLOCK+1,ICLOCK+4
      MK(NCOM,I)=0
  300 CONTINUE
      DO 310 I=ICLOCK+5,ICLOCK+ITIME
      MK(NCOM,I) =D*(I-ICLOCK-4)
```

```
310 CONTINUE
    RETURN
    END
    SUBROUTINE INCOM(NCOM,RESOR)
    REAL  MS,MK,IC,INV
    INTEGER COMTYPE
    COMMON/RES/  E(32,55),MS(32,55),IC(32,55), MK(32,55),RD(32,55),
   1             COMTYPE(50),COSE,COSMS,COSIC,COSMK,COSRD,INV(10),
   1             TRE(3,10),TRMS(3,10),TRMK(3,10),TRRD(3,10),
   1             TRIC(3,10),RATE(32,55),IREC(36,2),ITIME,ICLOCK,
   1             TE(3,55),TMS(3,55),TMK(3,55),TRD(3,55),TIC(3,55),
   1             NRESO,Q
    IF(COMTYPE(NCOM).EQ.3)
   1     THEN
            F=RESOR/(120.0*COSIC)
         ELSE
             F=RESOR/(60.0*COSIC)
         ENDIF
    DO 400 I=ICLOCK+1,ICLOCK+6
    IC(NCOM,I)=0
400 CONTINUE
    DO 410 I= ICLOCK+7,ICLOCK+ITIME
    IC(NCOM,I)=F
410 CONTINUE

    RETURN
    END
C
C
C
C
    SUBROUTINE RDEVE(NCOM,RESOR)
C
C
C
C
    REAL     MS,MK,IC,INV
    INTEGER COMTYPE
    COMMON/RES/  E(32,55),MS(32,55),IC(32,55), MK(32,55),RD(32,55),
   1             COMTYPE(50),COSE,COSMS,COSIC,COSMK,COSRD,INV(10),
   1             TRE(3,10),TRMS(3,10),TRMK(3,10),TRRD(3,10),
   1             TRIC(3,10),RATE(32,55),IREC(36,2),ITIME,ICLOCK,
   1             TE(3,55),TMS(3,55),TMK(3,55),TRD(3,55),TIC(3,55),
   1             NRESO,Q
    IF(COMTYPE(NCOM).EQ.3)
   1      THEN
            F=RESOR/(450.0*COSRD)
          ELSE
            F=RESOR/(450.0*COSRD)
          ENDIF
    DO 500  I=ICLOCK+1,ICLOCK+3
    RD(NCOM,I) =0
500 CONTINUE
    DO 510 I=ICLOCK+4,ICLOCK+ITIME
    RD(NCOM,I)=F*(I-ICLOCK-3)
510 CONTINUE
    RETURN
    END
```

```
      SUBROUTINE RATOR (NCOM,RRATE,RESOR,IPRINT)
C
C
C
C
      REAL MS,MK,IC,INV
      INTEGER COMTYPE
      COMMON/RES/  E(32,55),MS(32,55),IC(32,55), MK(32,55),RD(32,55),
     1             COMTYPE(50),COSE,COSMS,COSIC,COSMK,COSRD,INV(10),
     1             TRE(3,10),TRMS(3,10),TRMK(3,10),TRRD(3,10),
     1             TRIC(3,10),RATE(32,55),IREC(36,2),ITIME,ICLOCK,
     1             TE(3,55),TMS(3,55),TMK(3,55),TRD(3,55),TIC(3,55),
     1             NRESO,Q
      DIMENSION IPRINT(3),CA(62),CB(62),TCB(62)
      TTCB=0.0
      SUMCB=0.0
      CAB=0.0
      IZ=6
      DO 50 I=1,62
          CA (I)=0.0
          CB (I)=0.0
          TCB(I)=0.0
   50 CONTINUE
      IY=ITIME-IZ
      DO 100 I=ICLOCK+1,ICLOCK+ITIME
        J=I-ICLOCK
      IDIV = COMTYPE(NCOM)
      IF(J.LE.2)
     1          THEN
                   CA(I)=0.0
                ELSE
                   CA(I)=(E(NCOM,I-2))*TRE(IDIV,1)+ (MS(NCOM,I-2))*
     1             TRMS(IDIV,1)+
     1             (MK(NCOM,I-2))*TRMK(IDIV,1)+(RD(NCOM,I-2))*
     1             TRRD(IDIV,1)
                ENDIF
                   CB(I)= (E(NCOM,I))*COSE+(MS(NCOM,I))*COSMS
     1                 + (RD(NCOM,I))*COSRD
     1                 + (MK(NCOM,I))*COSMK
      TTCB=TTCB+CB(I)
      TCB(I)=TTCB
      IF (J.EQ.1)
     1          THEN
                   RATE(NCOM,I)=RRATE-CB(I)/INV(1)

      ELSEIF (J.EQ.2)
     1          THEN
                   RATE(NCOM,I)=RATE(NCOM,I-1)-CB(I)/INV(1)
      ELSE
               RATE(NCOM,I)=RATE(NCOM,I-2)+(CA(I)-CB(I))/INV(1)
      ENDIF

      SUMCB=SUMCB+CB(I)
      CAB=CAB+CA(I)-CB(I)
  100 CONTINUE

      Q=(RESOR-SUMCB)/RESOR
      ACAB=Q*CAB/IZ
```

```
      ASUMIC=(RESOR-SUMCB)/IZ

      DO 200 I=ICLOCK+IY+1,ICLOCK+ITIME
      J=I-ICLOCK-IY
      IC(NCOM,I)=ASUMIC
C    THESE ARE NOT COMPOSITE UNITS OF IC,BUT THE COSTS
C    OF IC,AFTER J MONTHS OF INPUT,IN MONETARY UNITS.
      RATE(NCOM,I)=RATE(NCOM,I)+ACAB*J/INV(1)
      TCB(I)=TCB(I)+ASUMIC*J
  200 CONTINUE

      DO 300 I=ICLOCK+1,ICLOCK+ITIME
C         IF(IPRINT(COMTYPE(NCOM)).NE.1)
C    1         CALL OUT1 (I,NCOM,IPRINT,CA,CB,TCB)

  300 CONTINUE
 9000 FORMAT(12F10.2)
      RETURN
      END


      SUBROUTINE BBSORT(IREC,NIREC)

      DIMENSION IREC(36,2)

C     IREC( ,2) IS THE PARAMETER TO BE SORTED

      DO 100 I=1,NIREC
       J=NIREC
   50  IF(IREC(J,2).LT.IREC(J-1,2))
     1    THEN
              K1        =IREC(J,1)
              K2        =IREC(J,2)
              IREC(J,1)=IREC(J-1,1)
              IREC(J,2)=IREC(J-1,2)
              IREC(J-1,1)=K1
              IREC(J-1,2)=K2
           ENDIF
           J=J-1
           IF(J.LE.I)
     1          THEN
                    GO TO 100
                ELSE
                    GO TO 50
                ENDIF
  100 CONTINUE

      RETURN
      END
      SUBROUTINE OUT2 (NCOM)
C
C
C
C
      REAL MS,MK,IC,INV
      INTEGER COMTYPE
      COMMON/RES/  E(32,55),MS(32,55),IC(32,55), MK(32,55),RD(32,55),
     1             COMTYPE(50),COSE,COSMS,COSIC,COSMK,COSRD,INV(10),
```

```
     1              TRE(3,10),TRMS(3,10),TRMK(3,10),TRRD(3,10),
     1              TRIC(3,10),RATE(32,55),IREC(36,2),ITIME,ICLOCK,
     1              TE(3,55),TMS(3,55),TMK(3,55),TRD(3,55),TIC(3,55),
     1              NRESO,Q
 9570 FORMAT(5X,24I5)
 9010 FORMAT(5X,24(F5.3))
      WRITE (6,9580)COMTYPE(NCOM)
      WRITE (6,9570) (I,I=ICLOCK+1,ICLOCK+ITIME)
      WRITE (6,9010) (RATE(NCOM,I),I=ICLOCK+1,ICLOCK+ITIME)
 9580 FORMAT (1X,/,15X,'VALUES OF THE RATE OF RETURN OF COMP.DIV',I2)
      WRITE(6,9590) Q
 9590 FORMAT(5X,' THE RATIO OF IC IS ',F6.3,//)
      RETURN
      END
      SUBROUTINE OUT4
C
C
C
C
      REAL     MS,MK, IC,INV
      INTEGER COMTYPE


      COMMON/RES/  E(32,55),MS(32,55),IC(32,55), MK(32,55),RD(32,55),
     1              COMTYPE(50),COSE,COSMS,COSIC,COSMK,COSRD,INV(10),
     1              TRE(3,10),TRMS(3,10),TRMK(3,10),TRRD(3,10),
     1              TRIC(3,10),RATE(32,55),IREC(36,2),ITIME,ICLOCK,
     1              TE(3,55),TMS(3,55),TMK(3,55),TRD(3,55),TIC(3,55),
     1              NRESO,Q
 9500 FORMAT(25X,' MONTH ',4X,' DIVISION 1 ',4X,'DIVISION 2',4X,
     1                       'DIVISION 3',4X, 'TOTAL')
 9520 FORMAT (X,/,25X,' ENGINEERING RESOURCES',/)
 9530 FORMAT (X,/,25X,' MANAGEMENT  RESOURCES',/)
 9540 FORMAT (X,/,25X,' MARKETING RESOURCES',/)
 9550 FORMAT (X,/,25X,' INTERMEDIATE  OMMODITY RESOURCES',/)
 9560 FORMAT (X,/,25X,' RESEARCH & DEVELOPMENT RESOURCES',/)
 9000 FORMAT (25X,I5,6X,4(F8.1,6X))

      ICLOCK=IREC(1,1)
      WRITE(6,9520)
      WRITE (6,9500)
      DO 100 I=1,55
      A=TE(1,I)+TE(2,I)+TE(3,I)
      WRITE (6,9000) I,TE(1,I),TE(2,I),TE(3,I),A
  100 CONTINUE
      WRITE(6,9530)
      WRITE(6,9500)
      DO 200 I=1,55
      A=TMS(1,I)+TMS(2,I)+TMS(3,I)
      WRITE(6,9000) I,TMS(1,I),TMS(2,I),TMS(3,I),A
  200 CONTINUE
      WRITE(6,9540)
      WRITE(6,9500)
      DO 300 I=1,55
      A=TMK(1,I)+TMK(2,I)+TMK(3,I)
      WRITE (6,9000) I,TMK(1,I),TMK(2,I),TMK(3,I),A
  300 CONTINUE
      WRITE (6,9550)
```

```
      WRITE (6,9500)
      DO 400 I=1,55
      A=TIC(1,I)+TIC(2,I)+TIC(3,I)
      WRITE (6,9000) I,TIC(1,I),TIC(2,I),TIC(3,I),A
  400 CONTINUE
      WRITE (6,9560)
      WRITE (6,9500)
      DO 500 I=1,55
      A=TRD(1,I)+TRD(2,I)+TRD(3,I)
      WRITE (6,9000) I,TRD(1,I),TRD(2,I),TRD(3,I),A
  500 CONTINUE
      RETURN
      END
      SUBROUTINE OUT
C
C
C
C
      REAL     MS,MK, IC,INV
      INTEGER COMTYPE


      COMMON/RES/  E(32,55),MS(32,55),IC(32,55), MK(32,55),RD(32,55),
     1             COMTYPE(50),COSE,COSMS,COSIC,COSMK,COSRD,INV(10),
     1             TRE(3,10),TRMS(3,10),TRMK(3,10),TRRD(3,10),
     1             TRIC(3,10),RATE(32,55),IREC(36,2),ITIME,ICLOCK,
     1             TE(3,55),TMS(3,55),TMK(3,55),TRD(3,55),TIC(3,55),
     1             NRESO,Q
 9500 FORMAT(' MONTH ',5X,' COMPANY 1 ',5X,'COMPANY 2',5X, 'COMPANY 3' )
 9520 FORMAT(' ENGINEERING RESOURCES')
 9530 FORMAT(' MANAGEMENT  RESOURCES')
 9540 FORMAT ('MARKETING RESOURCES')
 9550 FORMAT ('INTERMEDIATE COMMODITY RESOURCES')
 9560 FORMAT ('RESEARCH & DEVELOPMENT RESOURCES')
 9000 FORMAT ( I5,6X,3(F8.2,6X))

      ICLOCK=IREC(1,1)
      WRITE(6,9520)
      WRITE (6,9500)
      DO 100 I=1,55
      WRITE (6,9000) I,E(1,I),E(2,I),E(3,I)
  100 CONTINUE
      WRITE(6,9530)
      WRITE(6,9500)
      DO 200 I=1,55
      WRITE(6,9000) I,MS(1,I),MS(2,I),MS(3,I)
  200 CONTINUE
      WRITE(6,9540)
      WRITE(6,9500)
      DO 300 I=1,55

      WRITE (6,9000) I,MK(1,I),MK(2,I),MK(3,I)
  300 CONTINUE
      WRITE (6,9550)
      WRITE (6,9500)
      DO 400 I=1,55
      WRITE (6,9000) I,IC(1,I),IC(2,I),IC(3,I)
  400 CONTINUE
```

```
      WRITE (6,9560)
      WRITE (6,9500)
      DO 500 I=1,55
      WRITE (6,9000) I,RD(1,I),RD(2,I),RD(3,I)
  500 CONTINUE
      RETURN
      END
      SUBROUTINE OUT1 (I,NCOM,IPRINT,CA,CB,TCB)
C
C
C
C
      REAL MS,MK,IC,INV
      INTEGER COMTYPE
      DIMENSION IPRINT(3),CA(62),CB(62),TCB(62)
      COMMON/RES/  E(32,55),MS(32,55),IC(32,55), MK(32,55),RD(32,55),
     1             COMTYPE(50),COSE,COSMS,COSIC,COSMK,COSRD,INV(10),
     1             TRE(3,10),TRMS(3,10),TRMK(3,10).TRRD(3.10),
     1             TRIC(3,10),RATE(32,55),IREC(36,2),ITIME,ICLOCK,
     1             TE(3,55),TMS(3,55).TMK(3,55),TRD(3,55),TIC(3,55),
     1             NRESQ,O
      IF(IPRINT(COMTYPE(NCOM)).NE.2)
     1    THEN
            WRITE(6,8010)
            IPRINT(COMTYPE(NCOM))=2
         ENDIF
 8000 FORMAT(2X,I5,4X,F8.3,2X,F9.1,2X,F9.1,2X,F9.1,4(F8.1),3X,F8.1)
 8010 FORMAT(1X,3X,'MONTH',3X,'RATE OF R',4X,'EFFECTS',
     11X,' COSTS',4X,'TOT RESOR',1X,'ENG RES',1X,
     1'MAN RES',3X,'MARKRES',1X,'RD. RES',3X,'INT.RES')
      WRITE(6,8000)I,RATE(NCOM,I),CA(I),CB(I),TCB(I),E(NCOM,I),
     1MS(NCOM,I),MK(NCOM,I),RD(NCOM,I),IC(NCOM,I)
      RETURN
      END
      SUBROUTINE ACUM
C
C
C
C
      REAL    MS,MK,IC,INV
      INTEGER COMTYPE
      COMMON/RES/  E(32,55),MS(32,55).IC(32,55), MK(32,55),RD(32,55),
     1             COMTYPE(50).COSE,COSMS,COSIC,COSMK,COSRD,INV(10),
     1             TRE(3,10),TRMS(3,10).TRMK(3,10),TRRD(3,10),
     1             TRIC(3,10),RATE(32,55),IREC(36,2),ITIME,ICLOCK,
     1             TE(3,55),TMS(3,55),TMK(3,55),TRD(3,55),TIC(3,55),
     1             NRESQ,O
      DO 100  K=1,NRESQ
      I=IREC(K,1)
      J=COMTYPE(I)
      DO 100 NCLOCK=1,55
            TE(J,NCLOCK)=TE(J,NCLOCK)+E(I,NCLOCK)
            TMS(J,NCLOCK)=TMS(J,NCLOCK)+MS(I,NCLOCK)
            TMK(J,NCLOCK)=TMK(J,NCLOCK)+MK(I,NCLOCK)
            TRD(J,NCLOCK)=TRD(J.NCLOCK)+RD(I,NCLOCK)
            TIC(J,NCLOCK)=TIC(J,NCLOCK)+IC(I,NCLOCK)
  100 CONTINUE
      RETURN
```

```
      END
      SUBROUTINE OUT3
C
C
C
C
      REAL   MS,MK,IC,INV
      INTEGER COMTYPE
      COMMON/RES/  E(32,55),MS(32,55),IC(32,55), MK(32,55),RD(32,55),
     1             COMTYPE(50),COSE,COSMS,COSIC,COSMK,COSRD,INV(10),
     1             TRE(3,10),TRMS(3,10),TRMK(3,10),TRRD(3,10),
     1             TRIC(3,10),RATE(32,55),IREC(36,2),ITIME,ICLOCK,
     1             TE(3,55),TMS(3,55),TMK(3,55),TRD(3,55),TIC(3,55),
     1             NRESQ,Q
      DIMENSION TOE(55),TOMS(55),TOMK(55),TOIC(55),TORD(55)
      IW=12
      ND=55/IW
      WRITE(6,9400)
      IF(55.GT.ND*IW) ND=ND+1


      DO 100 I=1,55
         TOE (I)=TE (1,I) +TE (2,I) +TE (3,I)
         TOMS(I)=TMS(1,I) +TMS(2,I) +TMS(3,I)
         TOMK(I)=TMK(1,I) +TMK(2,I) +TMK(3,I)
         TOIC(I)=TIC(1,I) +TIC(2,I) +TIC(3,I)
         TORD(I)=TRD(1,I) +TRD(2,I) +TRD(3,I)
  100 CONTINUE

      DO 500   K=1,ND
      J=12*(K-1) +1
      IF(K.NE.ND)
     1    THEN
             JJ=12*K
          ELSE
             JJ=55
          ENDIF
      WRITE (6,9500) (I,I=J,JJ)
      WRITE (6,9510) (TOE (I),I=J,JJ)
      WRITE (6,9520) (TOMS(I),I=J,JJ)
      WRITE (6,9530) (TOMK(I),I=J,JJ)
      WRITE (6,9540) (TOIC(I),I=J,JJ)
      WRITE (6,9550) (TORD(I),I=J,JJ)
 9400 FORMAT (15X,'TOTAL DEMAND OF RESOURCE UNITS DURING MONTH N..',/)
 9500 FORMAT (12X,12(I5,5X))
 9510 FORMAT (1X,'ENG.RES....',12(F8.0,2X))
 9520 FORMAT (1X,'MAN.RES....',12(F8.0,2X))
 9530 FORMAT (1X,'MARK.RES...',12(F8.0,2X))
 9540 FORMAT (1X,'INT.COM.RES',12(F8.0,2X))
 9550 FORMAT (1X,'RES&DEV.RES',12(F8.0,2X),/)
  500 CONTINUE
      RETURN
      END
END OF FILE
```

PROGRAMME SENSOR

```
      PROGRAM SENSOR (INPUT,OUTPUT,ANGEL,TAPE5=INPUT,TAPE6=OUTPUT,
     1                                   TAPE7=ANGEL)
      INTEGER DUMMY,DUMMY1,DIV

C     THIS PROGRAM IS FOR CREATING NEW FILES FOR
C     SENSITIVITY ANLYSIS OF THE PROGRAM STATEHO
C     THE DATA GENERATED WILL BE HOLD IN FILE ANGEL
C
C

C     STANDARD VALUES OF PARAMETERS

      XTRA =0.0
      INJE =3
      INJMK=4
      INJMS=0
      INJRD=3
      INJIC=6
      ITIME=12
      INC=0


 9500 FORMAT(" IF THE STANDARD FIGURE IS NOT TO BE CHANGED ",
     1        "ENTER  (CR)",/," ELSE ENTER THE REQUIRED FIGURE",///)
      WRITE(6,9500)

C     ENTER THE RESOURCE PARAMETER

  100 WRITE(6,9510) XTRA
 9510 FORMAT(" SPECIAL RESOURCE TO BE ASSIGNED IS ",F10.2)
      WRITE(6,9501)
 9501 FORMAT(" INPUT NEW VALUE     ELSE (CR) ")
      READ(5,*,ERR=100,END=130)ADUMMY
      WRITE(6,9502)
 9502 FORMAT(" THE NEW VALUE ....IF NO CHANGE  (CR)",/,
     1        " ELSE ENTER 1")
      READ(5,*,END=120,ERR=120) DUMMY
      IF(DUMMY.EQ.1) GO TO 100
  120 XTRA=ADUMMY
  130 IF(XTRA.EQ.0.0)
     1    THEN
             DIV=0
          ELSE
  150        WRITE(6,9515)
             READ(5,*,ERR=150,END=150)DIV
             IF(DIV.GT.5.OR.DIV.LT.1) GO TO 150
  180        WRITE(6,9518)
             READ(5,*,ERR=180,END=180) INC
             IF(INC.LT.0.OR.INC.GT.1)GO TO 180
          ENDIF

 9515 FORMAT(" SELECT THE DEPARTMENT FOR THE EXTRA RESOURCES",/,
     1        " ENTER   1  FOR ENGINEERING",/,
     2        "         2       MARKETING",/,
     3        "         3       MANAGEMENT",/,
     4        "         4       R&D",/,
     5        "         5       INTERMEDIATE RESOURCES")
 9518 FORMAT(" IF TOTAL RESOURCES IS TO BE MANITAIN ENTER  0",/,
```

```
 9518 FORMAT(" IF TOTAL RESOURCES IS TO BE MANITAIN ENTER  0",/,
     1        " IF TOTAL RESOURCES IS TO BE INCREASED  ENTER  1")
C      ENTER THE DELAY OF ENGINEERING RESOURCE INPUT


  200 WRITE(6,9520)INJE
 9520 FORMAT(" THE STANDARD DELAY FOR ENGINEERING RESOURCE IS",
     1          I5," PERIOD(S)")
      WRITE(6,9501)
      READ(5,*,ERR=200,END=300) DUMMY
      WRITE(6,9502)
      READ(5,*,ERR=250,END=250) DUMMY1
      IF(DUMMY1.EQ.1) GO TO 200
  250 INJE=DUMMY



C      ENTER THE DELAY OF MARKETING RESOURCE INPUT


  300 WRITE(6,9530)INJMK
 9530 FORMAT(" THE STANDARD DELAY FOR MARKETING RESOURCE IS",
     1          I5," PERIOD(S)")
      WRITE(6,9501)
      READ(5,*,ERR=300,END=400) DUMMY
      INJMK=DUMMY
      WRITE(6,9502)
      READ(5,*,ERR=350,END=350) DUMMY1
      IF(DUMMY.EQ.1) GO TO 300
  350 INJMK=DUMMY



C      ENTER THE DELAY OF MANAGENENT RESOURCE INPUT


  400 WRITE(6,9540)INJMS
 9540 FORMAT(" THE STANDARD DELAY FOR MANAGEMENT RESOURCE IS",
     1          I5," PERIOD(S)")
      WRITE(6,9501)
      READ(5,*,ERR=400,END=500) DUMMY
      WRITE(6,9502)
      READ(5,*,ERR=450,END=450) DUMMY1
      IF(DUMMY1.EQ.1) GO TO 400
  450 INJMS=DUMMY



C      ENTER THE DELAY OF R&D RESOURCE INPUT


  500 WRITE(6,9550)INJRD
 9550 FORMAT(" THE STANDARD DELAY FOR R&D RESOURCE IS",
     1          I5," PERIOD(S)")
      WRITE(6,9501)
      READ(5,*,ERR=500,END=600) DUMMY
      WRITE(6,9502)
      READ(5,*,ERR=550,END=550) DUMMY1
      IF(DUMMY1.EQ.1) GO TO 500
```

```
  550 INJRD=DUMMY

C     ENTER THE DELAY OF INTERMEDIATE RESOURCE INPUT

  600 WRITE(6,9560)INJIC
 9560 FORMAT(" THE STANDARD DELAY FOR INTERMEDIATE RESOURCE IS",
     1          I5," PERIOD(S)")
      WRITE(6,9501)
      READ(5,*,ERR=600,END=700) DUMMY
      WRITE(6,9502)
      READ(5,*,ERR=650,END=650) DUMMY1
      IF(DUMMY1.EQ.1) GO TO 600
  650 INJIC=DUMMY

C     ENTER THE RECOVERY PERIODS

  700 WRITE(6,9570) ITIME
 9570 FORMAT(' THE STANDARD RECOVERY IS',I5,' PERIOD(S)',/,
     1         ' RECOVERY SHOULD NOT BE LESS THAN 8 PERIODS')
      WRITE(6,9501)
      READ(5,*,ERR=700,END=800) DUMMY
      IF(DUMMY.LT.8) GO TO 700
      WRITE(6,9502)
      READ(5,*,ERR=750,END=750) DUMMY1
      IF(DUMMY1.EQ.1) GO TO 700
  750 ITIME=DUMMY

  800 CONTINUE

C     HEADING  FOR THIS PARTICULAR RUN

  850 WRITE(6,9580)
 9580 FORMAT(" ENTER TEST RUN NUMBER ")
      READ(5,*,ERR=850,END=850) NRUN

C      WRITE INFORMATION TO FILE ANGEL

 9000 FORMAT(5I5)
 9010 FORMAT(F12.2)
      WRITE(7,9000) NRUN
      WRITE(7,9010) XTRA
      WRITE(7,9000) DIV,INC,ITIME
      WRITE(7,9000) INJE,INJMK,INJMS,INJRD,INJIC

      END
END OF FILE
```

PROGRAMME NEB5

```
      PROGRAM STATEHO(ANGEL,OUTPUT,DUCK,INPUT,TAPE 5=INPUT,
     1                TAPE6=OUTPUT,TAPE7=DUCK,TAPE8=ANGEL)
      REAL     MS,MK,IC,INV
      INTEGER COMTYPE
C     DEFINE VARIABLES , COMPS. NUMBER AND TIME PERIODS.
      DIMENSION IPRINT(3),IPR(3)
      COMMON/RES/  E(32,61),MS(32,61),IC(32,61), MK(32,61),RD(32,61),
     1             COMTYPE(50),COSE,COSMS,COSIC,COSMK,COSRD,INV(10),
     1             TRE(3,10),TRMS(3,10),TRMK(3,10),TRRD(3,10),
     1             TRIC(3,10),RATE(32,61),IREC(36,2),ITIME,ICLOCK,
     1             TE(3,61),TMS(3,61),TMK(3,61),TRD(3,61),TIC(3,61),
     1             NRESO,O,NRUN,INJE,INJMK,INJMS,INJRD,INJIC,LAST

C     THIS PROGRAM CALCULATES EFFECTS OF INPUT
C     VARIABLES IN THE RATE OF RETURN



C
C     STANDARD PARAMETERS
C
      COSE      =8.0
      COSMS     =8.0
      COSMK     =20.0
      COSRD     =10.0
      TRE (1,1)=30.0
      TRMS(1,1)=40.0
      TRMK(1,1)=50.0
      TRRD(1,1)=10.0
      TRE (2,1)=30.0
      TRMS(2,1)=40.0
      TRMK(2,1)=50.0
      TRRD(2,1)=10.0
      TRE (3,1)=30.0
      TRMS(3,1)=40.0
      TRMK(3,1)=50.0
      TRRD(3,1)=10.0
      RRATE     =-0.100
      NRUN      =0
      ICLOCK    =0
      RESOR     =500000.0
      XE        =0.0
      XMS       =0.0
      XMK       =0.0
      XRD       =0.0
      YIC       =0.0
      EXTRA     =0.0
 9500 FORMAT(1X,/////,30X,' COMPANIES IN LIST NUMBER ',I3,/////)
 9000 FORMAT(3I5)
      READ(7,9000) NSET
      DO 1000 IJK=1,NSET
      WRITE(6,9500) IJK
      IF(IJK.GT.1)
     1    THEN
C
C             RESET VARIABLES
C
              DO 30 I=1,32
              DO 30 J=1,61
```

```
                    E   (I,J)=0.0
                    MS  (I,J)=0.0
                    MK  (I,J)=0.0
                    RD  (I,J)=0.0
                    IC  (I,J)=0.0
                    RATE(I,J)=0.0
                    TE  (1,J)=0.0
                    TE  (2,J)=0.0
                    TE  (3,J)=0.0
                    TMS (1,J)=0.0
                    TMS (2,J)=0.0
                    TMS (3,J)=0.0
                    TMK (1,J)=0.0
                    TMK (2,J)=0.0
                    TMK (3,J)=0.0
                    TRD (1,J)=0.0
                    TRD (2,J)=0.0
                    TRD (3,J)=0.0
                    TIC (1,J)=0.0
                    TIC (2,J)=0.0
                    TIC (3,J)=0.0
  30          CONTINUE
              DO 40 I=1,3
              IPRINT(I)=0
  40          CONTINUE
C
C             DOUBLE RESOURCES FOR THE SECOND RUN
C
              IF(IJK.EQ.2) RESOR=RESOR*2.0
          ENDIF
C
C     READ THE LIST OF COMPANIES TO BE RESCUED
C
      READ(7,9000) NRESO
      DO 50 I=1,NRESO
        READ(7,9000) IREC(I,1),IREC(I,2) ,K
        COMTYPE(IREC(I,1))=K
  50 CONTINUE
      CALL BBSORT(IREC,NRESO)
C
C     READ IN SENSITIVITY TEST PARAMETERS
C
      CALL SELECT(XE,XMS,XMK,XRD,XIC,INC,EXTRA,RESOR)
      REWIND 8


      LAST=IREC(NRESO,2)+ITIME


C
C     CALCULATE THE RESOURES REQUIRED BY EACH COMPANY
C     DURING THE RECOVER PERIODS EXPRESSED IN COMPOSITE UNITS
C
      INV(1)=10.0*RESOR
      DO   100   J=1,NRESO
      I=IREC(J,1)
      ICLOCK=IREC(J,2)
C     CALL  PARA (I,RESOR,COMTYPE(I))
      IF(INC.EQ.0)
     1     THEN
```

```
                RESOR1=RESOR-EXTRA
            ELSE
                RESOR1=RESOR
            ENDIF
        CALL ENGINE (I,RESOR1,XE)
        CALL MANAGE (I,RESOR1,XMS)
        CALL MARKE (I,RESOR1,XMK)
        CALL RDEVE (I,RESOR1,XRD)
        CALL RATOR (I,RRATE,RESOR1,EXTRA,IPRINT)
        IF(IPRINT (COMTYPE(I)).NE.0)  GO TO 100
        CALL OUT2 (I)
        IPRINT(COMTYPE(I))=I
        IPR(COMTYPE(I))=ICLOCK
  100 CONTINUE

C
C       OUTPUT ROUTINES
C
        CALL ACUM
        CALL OUT3
C       CALL OUT(IPRINT,IPR)
        CALL OUT4
 1000 CONTINUE

        END




        SUBROUTINE   PARA (I,RESOR,K)

 9500 FORMAT (' INPUT ERROR PLEASE RE-ENTRY ' )

 9510 FORMAT (1X,///,'ENTER THE NEW RESOURCES FOR COMPANY' ,I3,
     1' D I V I S I O N',1X,I2)
  100 WRITE (6,9510) I, K
        READ ( 5,*,END=100) RESOR
        IF ( RESOR.LT.0.0)
     1    THEN
                WRITE (6,9500)
                GO TO 100
            ENDIF
        RETURN
        END




        SUBROUTINE SELECT (XE,XMS,XMK,XRD,XIC,INC,EXTRA,RESOR)

        COMMON/RES/  E(32,61),MS(32,61),IC(32,61), MK(32,61),RD(32,61),
     1              COMTYPE(50),COSE,COSMS,COSIC,COSMK,COSRD,INV(10),
     1              TRE(3,10),TRMS(3,10),TRMK(3,10),TRRD(3,10),
     1              TRIC(3,10),RATE(32,61),IREC(36,2),ITIME,ICLOCK,
     1              TE(3,61),TMS(3,61),TMK(3,61),TRD(3,61),TIC(3,61),
     1              NRESO,O,NRUN,INJE,INJMK,INJMS,INJRD,INJIC,LAST
```

```
9000 FORMAT(5I5)
9010 FORMAT(F12.2)
9020 FORMAT(X,//////,10X,'THE SENSITIVITY TEST RUN NUMBER ',I5,///)
9030 FORMAT(10X,'THE SPECIAL RESOURCE IS ',F10.2)
9040 FORMAT(10X,'SPECIAL RESOURCE IS FOR ENGINEERING')
9050 FORMAT(10X,'SPECIAL RESOURCE IS FOR MARKETING')
9060 FORMAT(10X,'SPECIAL RESOURCE IS FOR MANAGEMENT')
9070 FORMAT(10X,'SPECIAL RESOURCE IS FOR RESEARCH & DEVELOPMENT')
9080 FORMAT(10X,'SPECIAL RESOURCE IS FOR INTERMIDIATE COMMODITIES')
9090 FORMAT(10X,'THE RECOVERY PERIOD IS ',I5,////)
9100 FORMAT(10X,'STANDARD DELAY PERIOD(S) FOR',/,
    1        15X,'ENGINEERING',I3,/,
    2        15X,'MARKETING  ',I3,/,
    3        15X,'MANAGEMENT ',I3,/,
    4        15X,'R&D        ',I3,/,
    5        15X,'INT RES    ',I3,///////)
9110 FORMAT(10X,'TOTAL RESOURCES ARE KEPT CONSTANT AT',F12.2)
9120 FORMAT(10X,'TOTAL RESOURCES ARE INCREASED TO ',F12.2)

     READ(8,9000) NRUN
     READ(8,9010) EXTRA
     READ(8,9000) IEXTRA,INC,ITIME
     READ(8,9000) INJE,INJMK,INJMS,INJRD,INJIC
     WRITE(6,9020) NRUN
     WRITE(6,9030) EXTRA
     IF(INC.EQ.0)
    1    THEN
             WRITE(6,9110) RESOR
         ELSE
             R1=RESOR+EXTRA
             WRITE(6,9120) R1
         ENDIF

         IF(IEXTRA.EQ.1)
    1        THEN
                 XE  =EXTRA
                 WRITE(6,9040)
     ELSEIF(IEXTRA.EQ.2)
    1        THEN
                 XMK=EXTRA
                 WRITE(6,9050)
     ELSEIF(IEXTRA.EQ.3)
    1        THEN
                 XMS=EXTRA
                 WRITE(6,9060)
     ELSEIF(IEXTRA.EQ.4)
    1        THEN
                 XRD=EXTRA
                 WRITE(6,9070)
     ELSEIF(IEXTRA.EQ.5)
    1        THEN
                 XIC=EXTRA
                 WRITE(6,9080)
             ENDIF
     WRITE(6,9090) ITIME
     WRITE(6,9100) INJE,INJMK,INJMS,INJRD,INJIC

     RETURN
     END
```

```
      SUBROUTINE ENGINE (NCOM,RESOR,EXTRA)
      REAL      MS,MK,IC,INV
      INTEGER COMTYPE

      COMMON/RES/  E(32,61),MS(32,61),IC(32,61), MK(32,61),RD(32,61),
     1             COMTYPE(50),COSE,COSMS,COSIC,COSMK,COSRD,INV(10),
     1             TRE(3,10),TRMS(3,10),TRMK(3,10),TRRD(3,10),
     1             TRIC(3,10),RATE(32,61),IREC(36,2),ITIME,ICLOCK,
     1             TE(3,61),TMS(3,61),TMK(3,61),TRD(3,61),TIC(3,61),
     1             NRESO,Q,NRUN,INJE,INJMK,INJMS,INJRD,INJIC,LAST

      IF (COMTYPE(NCOM).EQ.1)
     1     THEN
             A=400.0
             B=((.5*RESOR+EXTRA)/COSE-400.0*INJE)/(ITIME-INJE)
           ELSE
             A =200.0
             B=((.1*RESOR+EXTRA)/COSE-200.0*INJE)/(ITIME-INJE)
          ENDIF
      IF(INJE.LE.0) GO TO 150
      DO 100  I=ICLOCK+1,ICLOCK+INJE
      E(NCOM,I ) = A
  100 CONTINUE

  150 DO 200 I =ICLOCK+INJE+1,ICLOCK+ITIME
      E(NCOM,I)= B
  200 CONTINUE


      RETURN
      END




      SUBROUTINE MANAGE(NCOM,RESOR,EXTRA)


      REAL      MS,MK, IC,INV
      INTEGER COMTYPE


      COMMON/RES/  E(32,61),MS(32,61),IC(32,61), MK(32,61),RD(32,61),
     1             COMTYPE(50),COSE,COSMS,COSIC,COSMK,COSRD,INV(10),
     1             TRE(3,10),TRMS(3,10),TRMK(3,10),TRRD(3,10),
     1             TRIC(3,10),RATE(32,61),IREC(36,2),ITIME,ICLOCK,
     1             TE(3,61),TMS(3,61),TMK(3,61),TRD(3,61),TIC(3,61),
     1             NRESO,Q,NRUN,INJE,INJMK,INJMS,INJRD,INJIC,LAST
      IF(COMTYPE(NCOM).EQ.3)
     1    THEN
            C=((    RESOR+2.*EXTRA)/COSMS-800.0*(ITIME-INJMS))/
     1                             ((ITIME-INJMS)*(ITIME-INJMS-1))
        ELSE
            C=((.4*RESOR+2.*EXTRA)/COSMS-800.0*(ITIME-INJMS))/
     1                             ((ITIME-INJMS)*(ITIME-INJMS-1))
        ENDIF

      DO 100 I=ICLOCK+INJMS+1,ICLOCK+ITIME
      MS(NCOM,I)=400.0+C*(I-ICLOCK-INJMS-1)
  100 CONTINUE
```

```
      RETURN
      END
C
C
C
C
      SUBROUTINE MARKE(NCOM,RESOR,EXTRA)
      REAL    MS,MK, IC,INV
      INTEGER COMTYPE


      COMMON/RES/  E(32,61),MS(32,61),IC(32,61), MK(32,61),RD(32,61),
     1             COMTYPE(50),COSE,COSMS,COSIC,COSMK,COSRD,INV(10),
     1             TRE(3,10),TRMS(3,10),TRMK(3,10),TRRD(3,10),
     1             TRIC(3,10),RATE(32,61),IREC(36,2),ITIME,ICLOCK,
     1             TE(3,61),TMS(3,61),TMK(3,61),TRD(3,61),TIC(3,61),
     1             NRESQ,Q,NRUN,INJE,INJMK,INJMS,INJRD,INJIC,LAST
      IF(COMTYPE(NCOM).EQ.1)
     1    THEN
              D=(.2*RESOR+2.*EXTRA)/(COSMK*(ITIME-INJMK)*
     1                                   (ITIME-INJMK+1))
      ELSEIF(COMTYPE(NCOM).EQ.2)
     1    THEN
              D=(    RESOR+2.*EXTRA)/(COSMK*(ITIME-INJMK)*
     1                                   (ITIME-INJMK+1))
          ELSE
              D=(.5*RESOR+2.*EXTRA)/(COSMK*(ITIME-INJMK)*
     1                                   (ITIME-INJMK+1))
          ENDIF
      IF(INJMK.LE.0) GO TO 305
      DO 300  I=ICLOCK+1,ICLOCK+INJMK
      MK(NCOM,I)=0
  300 CONTINUE
  305 DO 310 I=ICLOCK+INJMK+1,ICLOCK+ITIME
      MK(NCOM,I) =D*(I-ICLOCK-INJMK)
  310 CONTINUE
      RETURN
      END
      SUBROUTINE INCOM(NCOM,RESOR)
      REAL  MS,MK,IC,INV
      INTEGER COMTYPE
      COMMON/RES/  E(32,61),MS(32,61),IC(32,61), MK(32,61),RD(32,61),
     1             COMTYPE(50),COSE,COSMS,COSIC,COSMK,COSRD,INV(10),
     1             TRE(3,10),TRMS(3,10),TRMK(3,10),TRRD(3,10),
     1             TRIC(3,10),RATE(32,61),IREC(36,2),ITIME,ICLOCK,
     1             TE(3,61),TMS(3,61),TMK(3,61),TRD(3,61),TIC(3,61),
     1             NRESQ,Q,NRUN,INJE,INJMK,INJMS,INJRD,INJIC,LAST
      IF(COMTYPE(NCOM).EQ.3)
     1     THEN
               F=RESOR/(120.0*COSIC)
           ELSE
                F=RESOR/(60.0*COSIC)
           ENDIF
      DO 400 I=ICLOCK+1,ICLOCK+6
      IC(NCOM,I)=0
  400 CONTINUE
      DO 410 I= ICLOCK+7,ICLOCK+ITIME
      IC(NCOM,I)=F
  410 CONTINUE
```

```
      RETURN
      END
C
C
C
C
      SUBROUTINE RDEVE(NCOM,RESOR,EXTRA)
C
C
C
C
      REAL    MS,MK,IC,INV
      INTEGER COMTYPE
      COMMON/RES/  E(32,61),MS(32,61),IC(32,61), MK(32,61),RD(32,61),
     1             COMTYPE(50),COSE,COSMS,COSIC,COSMK,COSRD,INV(10),
     1             TRE(3,10),TRMS(3,10),TRMK(3,10),TRRD(3,10),
     1             TRIC(3,10),RATE(32,61),IREC(36,2),ITIME,ICLOCK,
     1             TE(3,61),TMS(3,61),TMK(3,61),TRD(3,61),TIC(3,61),
     1             NRESO,Q,NRUN,INJE,INJMK,INJMS,INJRD,INJIC,LAST

      F=(.2*RESOR+2.0*EXTRA)/(COSRD*(ITIME-INJRD)*(ITIME-INJRD+1))

      IF(INJRD.LE.0) GO TO 505
      DO 500  I=ICLOCK+1,ICLOCK+INJRD
      RD(NCOM,I) =0
  500 CONTINUE
  505 DO 510 I=ICLOCK+INJRD+1,ICLOCK+ITIME
      RD(NCOM,I)=F*(I-ICLOCK-INJRD)
  510 CONTINUE
      RETURN
      END
      SUBROUTINE RATOR (NCOM,RRATE,RESOR,EXTRA,IPRINT)
C
C
C
C
      REAL MS,MK,IC,INV
      INTEGER COMTYPE
      COMMON/RES/  E(32,61),MS(32,61),IC(32,61), MK(32,61),RD(32,61),
     1             COMTYPE(50),COSE,COSMS,COSIC,COSMK,COSRD,INV(10),
     1             TRE(3,10),TRMS(3,10),TRMK(3,10),TRRD(3,10),
     1             TRIC(3,10),RATE(32,61),IREC(36,2),ITIME,ICLOCK,
     1             TE(3,61),TMS(3,61),TMK(3,61),TRD(3,61),TIC(3,61),
     1             NRESO,Q,NRUN,INJE,INJMK,INJMS,INJRD,INJIC,LAST
      DIMENSION IPRINT(3),CA(62),CB(62),TCB(62)
      TTCB=0.0
      SUMCB=0.0
      CAB=0.0
      IY=INJIC
      DO 50 I=1,62
          CA (I)=0.0
          CB (I)=0.0
          TCB(I)=0.0
   50 CONTINUE
      IZ=ITIME-IY
      DO 100 I=ICLOCK+1,ICLOCK+ITIME
        J=I-ICLOCK
      IDIV = COMTYPE(NCOM)
      IF(J.LE.2)
```

```
     1           THEN
                    CA(I)=0.0
                 ELSE
                    CA(I)=(E(NCOM,I-2))*TRE(IDIV,1)+ (MS(NCOM,I-2))*
     1              TRMS(IDIV,1)+
     1              (MK(NCOM,I-2))*TRMK(IDIV,1)+(RD(NCOM,I-2))*
     1              TRRD(IDIV,1)
                 ENDIF
                    CB(I)= (E(NCOM,I))*COSE+(MS(NCOM,I))*COSMS
     1                   + (RD(NCOM,I))*COSRD
     1                   + (MK(NCOM,I))*COSMK
      TTCB=TTCB+CB(I)
      TCB(I)=TTCB
      IF (J.EQ.1)
     1           THEN
                    RATE(NCOM,I)=RRATE-CB(I)/INV(1)

      ELSEIF (J.EQ.2)
     1           THEN
                    RATE(NCOM,I)=RATE(NCOM,I-1)-CB(I)/INV(1)
      ELSE
                RATE(NCOM,I)=RATE(NCOM,I-2)+(CA(I)-CB(I))/INV(1)
      ENDIF

      SUMCB=SUMCB+CB(I)
      CAB=CAB+CA(I)-CB(I)
  100 CONTINUE

      Q=(RESOR+EXTRA-SUMCB)/(RESOR+EXTRA)
      ACAB=Q*CAB/IZ
      ASUMIC=(RESOR-SUMCB)/IZ

      DO 200 I=ICLOCK+IY+1,ICLOCK+ITIME
      J=I-ICLOCK-IY
      IC(NCOM,I)=ASUMIC
C     THESE ARE NOT COMPOSITE UNITS OF IC,BUT THE COSTS
C     OF IC,AFTER J MONTHS OF INPUT,IN MONETARY UNITS.
      RATE(NCOM,I)=RATE(NCOM,I)+ACAB*J/INV(1)
      TCB(I)=TCB(I)+ASUMIC*J
  200 CONTINUE

      DO 300 I=ICLOCK+1,ICLOCK+ITIME
C         IF(IPRINT(COMTYPE(NCOM)).NE.1)
C    1         CALL OUT1 (I,NCOM,IPRINT,CA,CB,TCB)

  300 CONTINUE
 9000 FORMAT(12F10.2)
      RETURN
      END


      SUBROUTINE BBSORT(IREC,NIREC)

      DIMENSION IREC(36,2)

C     IREC( ,2) IS THE PARAMETER TO BE SORTED

      DO 100 I=1,NIREC
       J=NIREC
   50  IF(IREC(J,2).LT.IREC(J-1,2))
```

```
     1    THEN
              K1       =IREC(J,1)
              K2       =IREC(J,2)
              IREC(J,1)=IREC(J-1,1)
              IREC(J,2)=IREC(J-1,2)
              IREC(J-1,1)=K1
              IREC(J-1,2)=K2
          ENDIF
          J=J-1
          IF(J.LE.I)
     1        THEN
                  GO TO 100
              ELSE
                  GO TO 50
              ENDIF
  100 CONTINUE

      RETURN
      END
      SUBROUTINE OUT (IPRINT,IPR)
C
C
C
C
      REAL     MS,MK, IC,INV
      INTEGER COMTYPE

      DIMENSION IPRINT(3),IPR(3)
      COMMON/RES/  E(32,61),MS(32,61),IC(32,61), MK(32,61),PD(32,61),
     1             COMTYPE(50),COSE,COSMS,COSIC,COSMK,COSPD,INV(10),
     1             TRE(3,10),TRMS(3,10),TRMK(3,10),TRPD(3,10),
     1             TRIC(3,10),RATE(32,61),IREC(36,2),ITIME,ICLOCK,
     1             TE(3,61),TMS(3,61),TMK(3,61),TPD(3,61),TIC(3,61),
     1             NRESO,Q,NRUN,INJE,INJMK,INJMS,INJPD,INJIC,LAST
 9500 FORMAT(' MONTH',6X,'DIVISION 1',5X,'DIVISION 2',5X,'DIVISION 3')
 9510 FORMAT(12X,3('COMPANY',I3,5X))
 9520 FORMAT(X,///' ENGINEERING RESOURCES')
 9530 FORMAT(X,///' MANAGEMENT  RESOURCES')
 9540 FORMAT(X,///' MARKETING RESOURCES')
 9550 FORMAT(X,///' INTERMEDIATE COMMODITY RESOURCES')
 9560 FORMAT(X,///' RESEARCH & DEVELOPMENT RESOURCES')
 9000 FORMAT ( I5,9X,3(F8.2,7X))

      ILOW=999999
      IHIGH=0

      DO 30 I=1,3
      IF(ILOW.GT.IPR(I)) ILOW=IPR(I)
      IF(IHIGH.LT.IPR(I)) IHIGH=IPR(I)
   30 CONTINUE
      ILOW=ILOW+1
      WRITE(6,9520)

      WRITE (6,9500)
      WRITE(6,9510) IPRINT(1),IPRINT(2),IPRINT(3)
      DO 100 I=ILOW,IHIGH+ITIME
      WRITE (6,9000) I,E(IPRINT(1),I),E(IPRINT(2),I),E(IPRINT(3),I)
  100 CONTINUE
      WRITE(6,9530)
      WRITE(6,9500)
```

```
      WRITE(6,9510) IPRINT(1),IPRINT(2),IPRINT(3)
      DO 200 I=ILOW,IHIGH+ITIME
      WRITE (6,9000) I,MS(IPRINT(1),I),MS(IPRINT(2),I),MS(IPRINT(3),I)
  200 CONTINUE
      WRITE(6,9540)
      WRITE(6,9500)
      WRITE(6,9510) IPRINT(1),IPRINT(2),IPRINT(3)
      DO 300 I=ILOW,IHIGH+ITIME

      WRITE (6,9000) I,MK(IPRINT(1),I),MK(IPRINT(2),I),MK(IPRINT(3),I)
  300 CONTINUE
      WRITE (6,9550)
      WRITE (6,9500)
      WRITE(6,9510) IPRINT(1),IPRINT(2),IPRINT(3)
      DO 400 I=ILOW,IHIGH+ITIME
      WRITE (6,9000) I,IC(IPRINT(1),I),IC(IPRINT(2),I),IC(IPRINT(3),I)
  400 CONTINUE
      WRITE (6,9560)
      WRITE (6,9500)
      WRITE(6,9510) IPRINT(1),IPRINT(2),IPRINT(3)
      DO 500 I=ILOW,IHIGH+ITIME
      WRITE (6,9000) I,RD(IPRINT(1),I),RD(IPRINT(2),I),RD(IPRINT(3),I)
  500 CONTINUE
      RETURN
      END
      SUBROUTINE OUT2 (NCOM)
C
C
C
C
      REAL MS,MK,IC,INV
      INTEGER COMTYPE
      DIMENSION A(100), C(100)
      COMMON/RES/  E(32,61),MS(32,61),IC(32,61), MK(32,61),RD(32,61),
     1             COMTYPE(50),COSE,COSMS,COSIC,COSMK,COSRD,INV(10),
     1             TRE(3,10),TRMS(3,10),TRMK(3,10),TRRD(3,10),
     1             TRIC(3,10),RATE(32,61),IREC(36,2),ITIME,ICLOCK,
     1             TE(3,61),TMS(3,61),TMK(3,61),TRD(3,61),TIC(3,61),
     1             NRESQ,Q,NRUN,INJE,INJMK,INJMS,INJRD,INJIC,LAST
 9570 FORMAT(5X,24I5)
 9010 FORMAT(5X,24(F5.3))
      DO 100 I,I=ICLOCK+1,ICLOCK+ITIME
      A(I-ICLOCK)=RATE(NCOM,I)
  100 C(I-ICLOCK)=FLOAT(I)
      CALL GRAFIC(C,A,ITIME)
      WRITE (6,9580)COMTYPE(NCOM)
      WRITE (6,9570) (I,I=ICLOCK+1,ICLOCK+ITIME)
      WRITE (6,9010) (RATE(NCOM,I),I=ICLOCK+1,ICLOCK+ITIME)
 9580 FORMAT (1X,//,15X,'VALUES OF THE RATE OF RETURN OF COMP.DIV',I2)
      WRITE(6,9590) Q
 9590 FORMAT(5X,' THE RATIO OF IC IS ',F6.3)
      RETURN
      END
      SUBROUTINE OUT4
C
C
C
C
      REAL     MS,MK, IC,INV
      INTEGER COMTYPE
```

```
      DIMENSION A(100),C(100)
      COMMON/RES/  E(32,61),MS(32,61),IC(32,61), MK(32,61),RD(32,61),
     1             COMTYPE(50),COSE,COSMS,COSIC,COSMK,COSRD,INV(10),
     1             TRE(3,10),TRMS(3,10),TRMK(3,10),TRRD(3,10),
     1             TRIC(3,10),RATE(32,61),IREC(36,2),ITIME,ICLOCK,
     1             TE(3,61),TMS(3,61),TMK(3,61),TRD(3,61),TIC(3,61),
     1             NRESO,O,NRUN,INJE,INJMK,INJMS,INJRD,INJIC,LAST
 9500 FORMAT(25X,' MONTH ',2X,'DIVISION 1',4X,'DIVISION 2',4X,
     1                  'DIVISION 3',7X, 'TOTAL')
 9520 FORMAT (X,//////,25X,' ENGINEERING RESOURCES',/)
 9530 FORMAT (X,//////,25X,' MANAGEMENT  RESOURCES',/)
 9540 FORMAT (X,//////,25X,' MARKETING RESOURCES',/)
 9550 FORMAT (X,//////,25X,' INTERMEDIATE COMMODITY RESOURCES',/)
 9560 FORMAT (X,//////,25X,' RESEARCH & DEVELOPMENT RESOURCES',/)
 9570 FORMAT(' THE MAXIMUM RESOURCE USED IS ',F12.2,'  AT PERIOD',I6)
 9000 FORMAT (25X,I5,6X,4(F8.1,6X))

      ICLOCK=IREC(1,1)
      J=0
      AMAX=0.0
      DO 50 I=1,LAST
   50 C(I)=FLOAT(I)
      WRITE(6,9520)
      WRITE (6,9500)
      DO 100 I=1,LAST
      A(I)=TE(1,I)+TE(2,I)+TE(3,I)
      IF(A(I).GT.AMAX)
     1    THEN
              J=I
              AMAX=A(I)
          ENDIF
      WRITE (6,9000) I,TE(1,I),TE(2,I),TE(3,I),A(I)
  100 CONTINUE
      WRITE(6,9570) AMAX,J
      CALL GRAFIC(C,A,LAST)
      WRITE(6,9530)
      WRITE(6,9500)
      J=0
      AMAX=0.0
      DO 200 I=1,LAST
      A(I)=TMS(1,I)+TMS(2,I)+TMS(3,I)
      IF(A(I).GT.AMAX)
     1    THEN
              J=I
              AMAX=A(I)
          ENDIF
      WRITE(6,9000) I,TMS(1,I),TMS(2,I),TMS(3,I),A(I)
  200 CONTINUE
      WRITE(6,9570) AMAX,J
      CALL GRAFIC(C,A,LAST)
      WRITE(6,9540)
      WRITE(6,9500)
      J=0
      AMAX=0.0
      DO 300 I=1,LAST
      A(I)=TMK(1,I)+TMK(2,I)+TMK(3,I)
      IF(A(I).GT.AMAX)
     1    THEN
```

```
             J=I
             AMAX=A(I)
         ENDIF
      WRITE (6,9000) I,TMK(1,I),TMK(2,I),TMK(3,I),A(I)
  300 CONTINUE
      WRITE(6,9570) AMAX,J
      CALL GRAFIC(C,A,LAST)
      WRITE (6,9550)
      WRITE (6,9500)
      J=0
      AMAX=0.0
      DO 400 I=1,LAST
      A(I)=TIC(1,I)+TIC(2,I)+TIC(3,I)
      IF(A(I).GT.AMAX)
     1    THEN
             J=I
             AMAX=A(I)
         ENDIF
      WRITE (6,9000) I,TIC(1,I),TIC(2,I),TIC(3,I),A(I)
  400 CONTINUE
      WRITE(6,9570) AMAX,J
      CALL GRAFIC(C,A,LAST)
      WRITE (6,9560)
      WRITE (6,9500)
      J=0
      AMAX=0.0
      DO 500 I=1,LAST
      A(I)=TRD(1,I)+TRD(2,I)+TRD(3,I)
      IF(A(I).GT.AMAX)
     1    THEN
             J=I
             AMAX=A(I)
         ENDIF
      WRITE (6,9000) I,TRD(1,I),TRD(2,I),TRD(3,I),A(I)
  500 CONTINUE
      WRITE(6,9570) AMAX,J
      CALL GRAFIC(C,A,LAST)
      RETURN
      END
      SUBROUTINE OUT1 (I,NCOM,IPRINT,CA,CB,TCB)
C
C
C
C
      REAL MS,MK,IC,INV
      INTEGER COMTYPE
      DIMENSION IPRINT(3),CA(62),CB(62),TCB(62)
      COMMON/RES/  E(32,61),MS(32,61),IC(32,61), MK(32,61),RD(32,61),
     1             COMTYPE(50),COSE,COSMS,COSIC,COSMK,COSRD,INV(10),
     1             TRE(3,10),TRMS(3,10),TRMK(3,10),TRRD(3,10),
     1             TRIC(3,10),RATE(32,61),IREC(36,2),ITIME,ICLOCK,
     1             TE(3,61),TMS(3,61),TMK(3,61),TRD(3,61),TIC(3,61),
     1             NRESQ,Q,NRUN,INJE,INJMK,INJMS,INJRD,INJIC,LAST
      IF(IPRINT(COMTYPE(NCOM)).NE.2)
     1    THEN
             WRITE(6,8010)
             IPRINT(COMTYPE(NCOM))=2
         ENDIF
 8000 FORMAT(2X,I5,4X,F8.3,2X,F9.1,2X,F9.1,2X,F9.1,4(F8.1),3X,F8.1)
 8010 FORMAT(1X,3X,'MONTH',3X,'RATE OF R',4X,'EFFECTS',
```

```
   11X,' COSTS',4X,'TOT RESOR',1X,'ENG RES',1X,
   1'MAN RES',3X,'MARKRES',1X,'RD. RES',3X,'INT.RES')
    WRITE(6,8000)I,RATE(NCOM,I),CA(I),CB(I),TCB(I),E(NCOM,I),
   1MS(NCOM,I),MK(NCOM,I),RD(NCOM,I),IC(NCOM,I)
    RETURN
    END
    SUBROUTINE ACUM
C
C
C
C
    REAL    MS,MK,IC,INV
    INTEGER COMTYPE
    COMMON/RES/  E(32,61),MS(32,61),IC(32,61), MK(32,61),RD(32,61),
   1             COMTYPE(50),COSE,COSMS,COSIC,COSMK,COSRD,INV(10),
   1             TRE(3,10),TRMS(3,10),TRMK(3,10),TRRD(3,10),
   1             TRIC(3,10),RATE(32,61),IREC(36,2),ITIME,ICLOCK,
   1             TE(3,61),TMS(3,61),TMK(3,61),TRD(3,61),TIC(3,61),
   1             NRESQ,Q,NRUN,INJE,INJMK,INJMS,INJRD,INJIC,LAST
    DO 100  K=1,NRESQ
    I=IREC(K,1)
    J=COMTYPE(I)
    DO 100 NCLOCK=1,LAST
          TE(J,NCLOCK)=TE(J,NCLOCK)+E(I,NCLOCK)
          TMS(J,NCLOCK)=TMS(J,NCLOCK)+MS(I,NCLOCK)
          TMK(J,NCLOCK)=TMK(J,NCLOCK)+MK(I,NCLOCK)
          TRD(J,NCLOCK)=TRD(J,NCLOCK)+RD(I,NCLOCK)
          TIC(J,NCLOCK)=TIC(J,NCLOCK)+IC(I,NCLOCK)
100 CONTINUE
    RETURN
    END
    SUBROUTINE OUT3
C
C
C
C
    REAL   MS,MK,IC,INV
    INTEGER COMTYPE
    COMMON/RES/  E(32,61),MS(32,61),IC(32,61), MK(32,61),RD(32,61),
   1             COMTYPE(50),COSE,COSMS,COSIC,COSMK,COSRD,INV(10),
   1             TRE(3,10),TRMS(3,10),TRMK(3,10),TRRD(3,10),
   1             TRIC(3,10),RATE(32,61),IREC(36,2),ITIME,ICLOCK,
   1             TE(3,61),TMS(3,61),TMK(3,61),TRD(3,61),TIC(3,61),
   1             NRESQ,Q,NRUN,INJE,INJMK,INJMS,INJRD,INJIC,LAST
    DIMENSION TOE(55),TOMS(55),TOMK(55),TOIC(55),TORD(55)
    IW=12
    ND=LAST/IW
    WRITE(6,9400)
    IF(LAST.GT.ND*IW) ND=ND+1


    DO 100 I=1,LAST
       TOE (I)=TE (1,I) +TE (2,I) +TE (3,I)
       TOMS(I)=TMS(1,I) +TMS(2,I) +TMS(3,I)
       TOMK(I)=TMK(1,I) +TMK(2,I) +TMK(3,I)
       TOIC(I)=TIC(1,I) +TIC(2,I) +TIC(3,I)
       TORD(I)=TRD(1,I) +TRD(2,I) +TRD(3,I)
100 CONTINUE

    DO 500   K=1,ND
```

```
      J=12*(K-1) +1
      IF(K.NE.ND)
     1    THEN
              JJ=12*K
          ELSE
              JJ=LAST
          ENDIF
      WRITE (6,9500) (I,I=J,JJ)
      WRITE (6,9510) (TOE (I),I=J,JJ)
      WRITE (6,9520) (TOMS(I),I=J,JJ)
      WRITE (6,9530) (TOMK(I),I=J,JJ)
      WRITE (6,9550) (TORD(I),I=J,JJ)
      WRITE (6,9540) (TOIC(I),I=J,JJ)
 9400 FORMAT (15X,'TOTAL DEMAND OF RESOURCE UNITS DURING MONTH N..',/)
 9500 FORMAT (12X,12(I5,5X))
 9510 FORMAT (1X,'ENG.RES....',12(F8.0,2X))
 9520 FORMAT (1X,'MAN.RES....',12(F8.0,2X))
 9530 FORMAT (1X,'MARK.RES...',12(F8.0,2X))
 9540 FORMAT (1X,'INT.COM.RES',12(F8.0,2X),/)
 9550 FORMAT (1X,'RES&DEV.RES',12(F8.0,2X))
  500 CONTINUE
      RETURN
      END
END OF FILE
```

FILE DUCK

```
  2
 30
  1    0    1
  2    4    1
  3    8    1
  4   11    1
  5   12    1
  6   16    1
  7   20    1
  8   23    1
  9   24    1
 10   28    1
 11   32    1
 12   35    1
 13   36    1
 14    3    2
 15    9    2
 16   15    2
 17   21    2
 18   27    2
 19   33    2
 20   39    2
 21    2    3
 22    6    3
 23   10    3
 24   14    3
 25   18    3
 26   22    3
 27   26    3
 28   30    3
 29   34    3
 30   38    3
 19
  1    1    1
  2    4    1
  3    8    1
  4   12    1
  5   16    1
  6   20    1
  7   24    1
  8   28    1
  9   32    1
 10   36    1
 11    6    2
 12   18    2
 13   30    2
 14    3    3
 15    9    3
 16   15    3
 17   21    3
 18   27    3
 19   33    3
END OF FILE
```

```
JOBNUMBER UU      UU  MM      MM  TTTTTTTT    SSSSSS    000000    222222    999999  UMTS029          ORIGIN  BATCH.
JOBNUMBER UU      UU  MMM    MMM  TTTTTTTT   SSSSSSSS  00000000  22222222  99999999 UMTS029          ORIGIN  BATCH.
JOBNUMBER UU      UU  MM MM MM       TT      SS      SS 00      00        22 99      99 UMTS029     ORIGIN  BATCH.
JOBNUMBER UU      UU  MM MM MM       TT      SS        00      00        22 99      99 UMTS029      ORIGIN  BATCH.
JOBNUMBER UU      UU  MM MM MM       TT      SS        00      00       22  99      99 UMTS029      ORIGIN  BATCH.
JOBNUMBER UU      UU  MM      MM     TT      SSSSSSS   00      00      22   99999999 UMTS029       ORIGIN  BATCH.
JOBNUMBER UU      UU  MM      MM     TT       SSSSSSS  00      00     22     9999999 UMTS029       ORIGIN  BATCH.
JOBNUMBER UU      UU  MM      MM     TT            SS  00      00    22           99 UMTS029       ORIGIN  BATCH.
JOBNUMBER UU      UU  MM      MM     TT            SS  00      00   22            99 UMTS029       ORIGIN  BATCH.
JOBNUMBER UU      UU  MM      MM     TT      SS    SS  00      00  22             99 UMTS029       ORIGIN  BATCH.
JOBNUMBER UUUUUUUU    MM      MM     TT      SSSSSSSS  00000000  22222222         99 UMTS029       ORIGIN  BATCH.
JOBNUMBER  UUUUUU     MM      MM     TT       SSSSSS    000000   22222222         99 UMTS029       ORIGIN  BATCH.
```

TEST RUN (STANDARD) O

COMPANIES IN LIST NUMBER 1

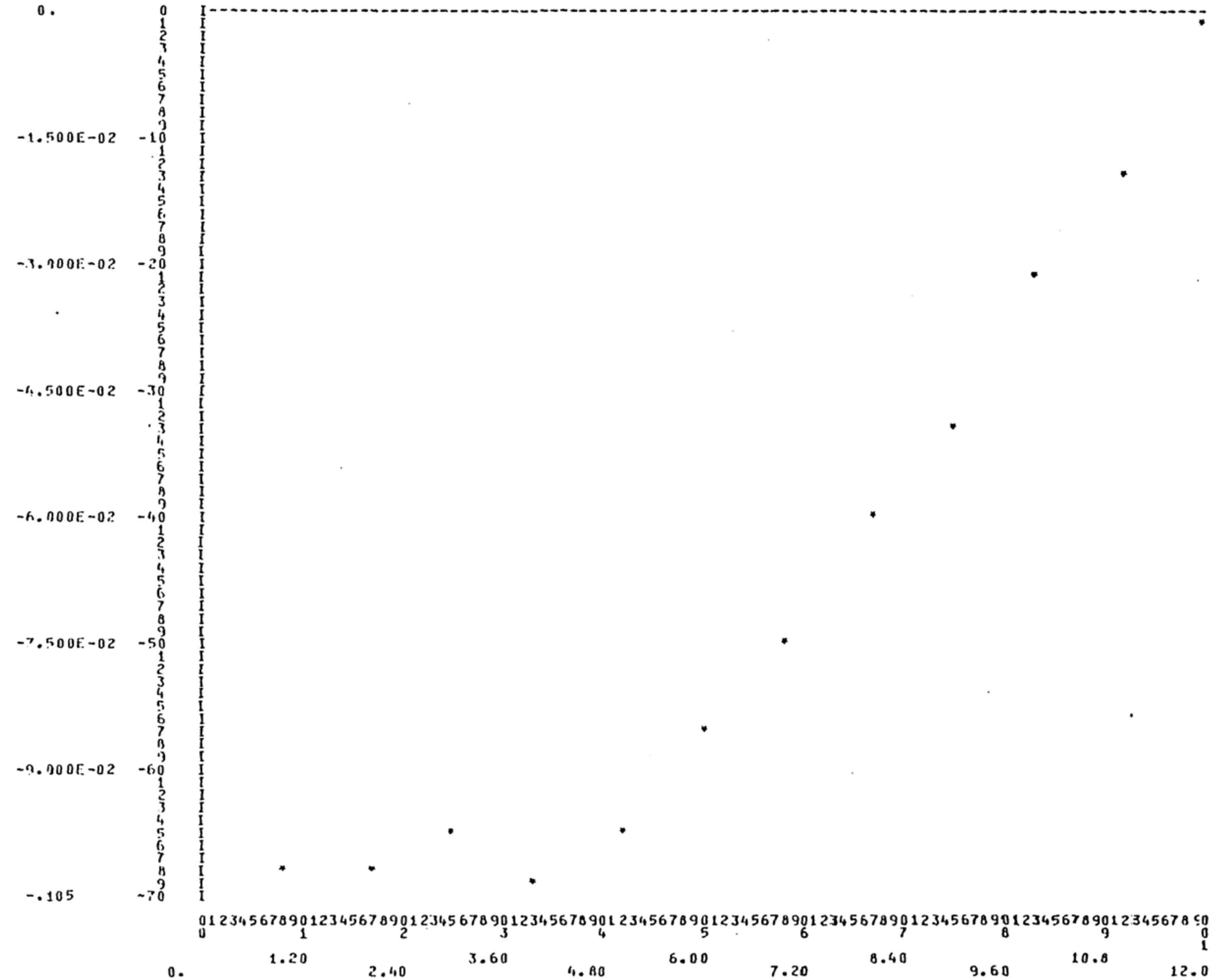
THE SENSITIVITY TEST RUN NUMBER 0

THE SPECIAL RESOURCE IS 0
TOTAL RESOURCES ARE KEPT CONSTANT AT 500000.00
THE RECOVERY PERIOD IS 12

STANDARD DELAY PERIOD(S) FOR

ENGINEERING	3
MARKETING	4
MANAGEMENT	0
R&D	3
INT RES	6

X INCREMENT = .12
Y INCREMENT = .15E-02

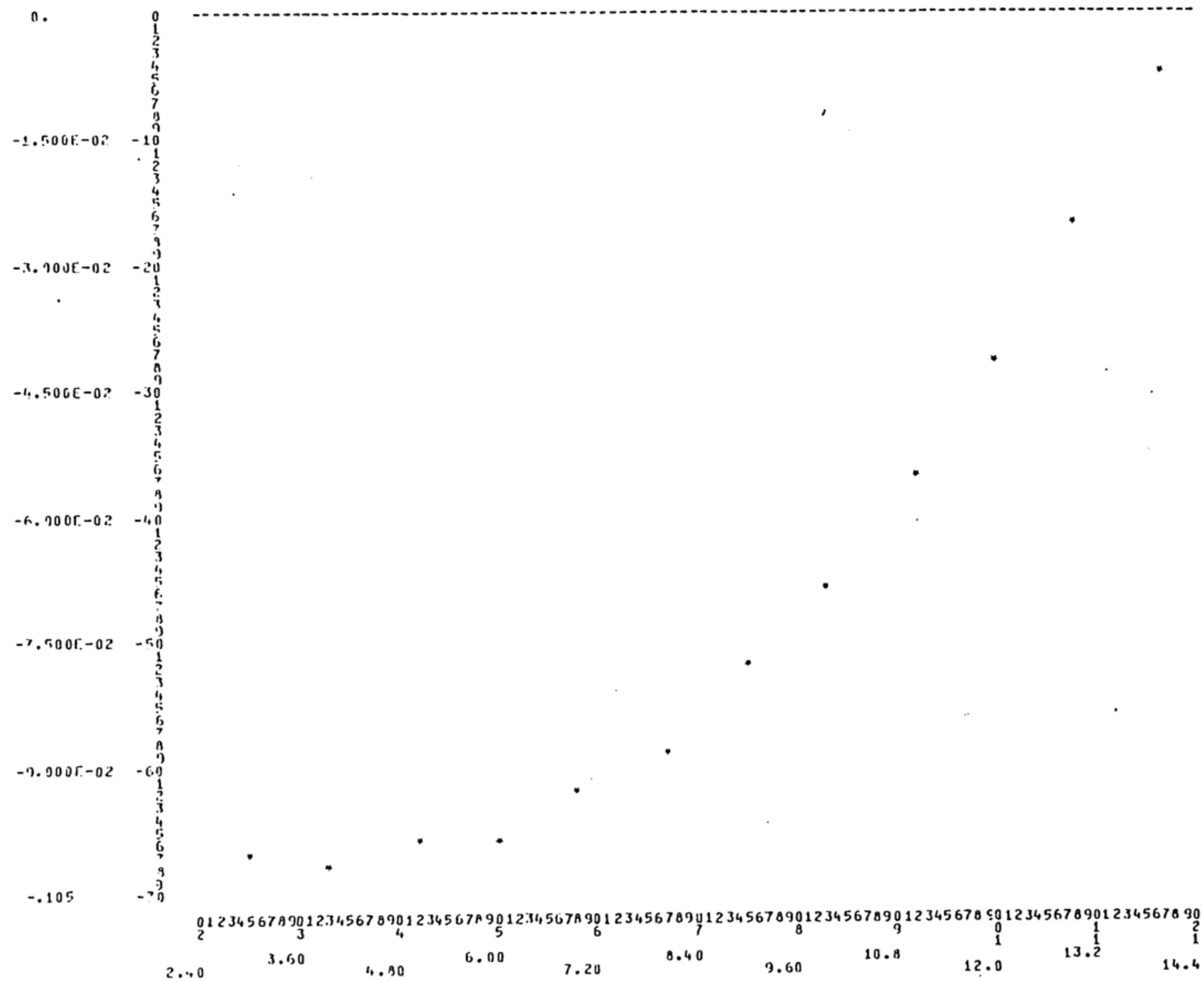


VALUES OF THE RATE OF RETURN OF COMP.DIV 1

1	2	3	4	5	6	7	8	9	10	11	12
-.101	-.103	-.097	-.103	-.097	-.085	-.075	-.059	-.049	-.031	-.020	-.001

THE RATIO OF IC IS .100

X INCREMENT = .12
Y INCREMENT = .15E-02



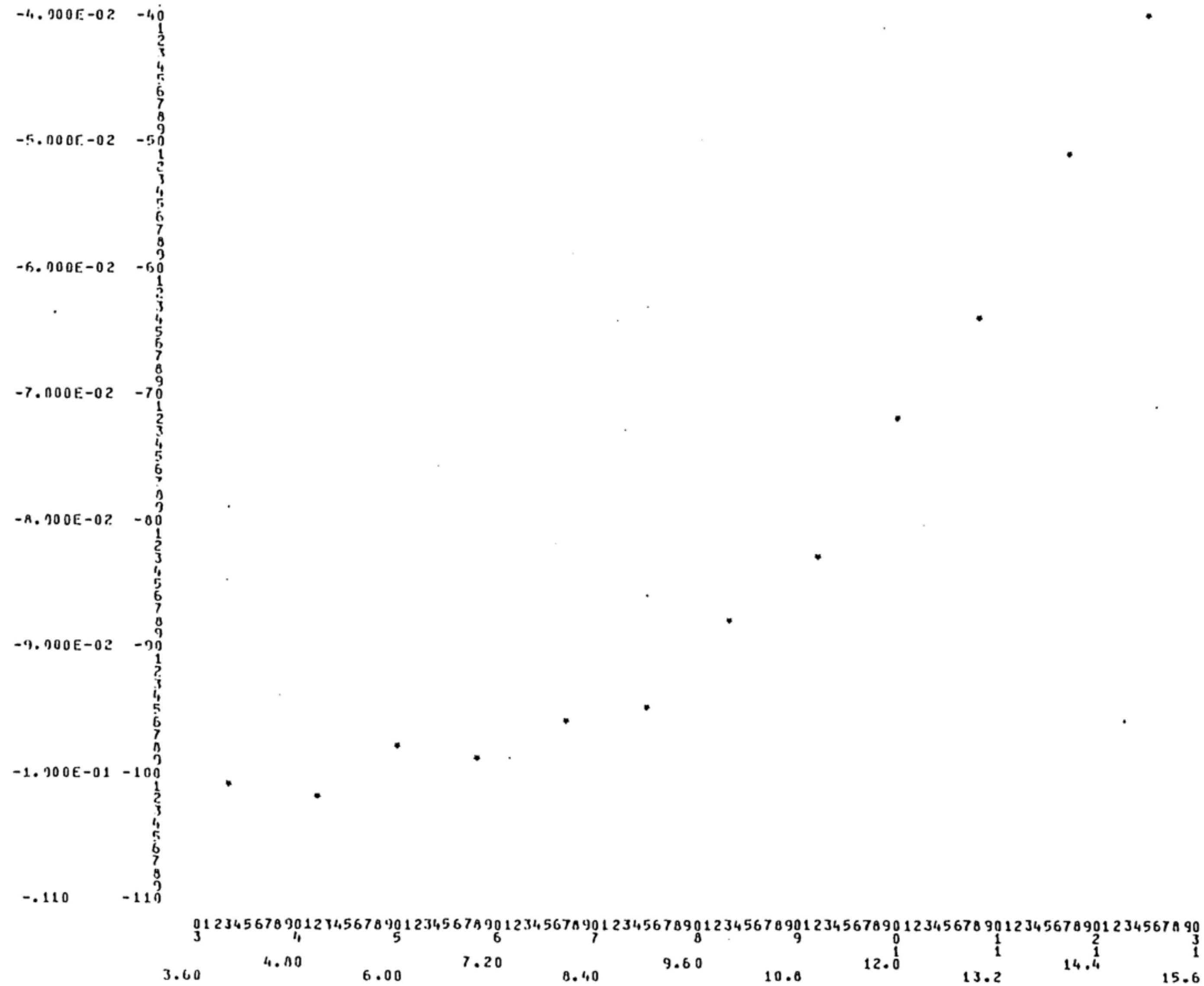
3

VALUES OF THE RATE OF RETURN OF COMP.DIV 3

3	4	5	6	7	8	9	10	11	12	13	14
-.101	-.103	-.099	-.099	-.093	-.089	-.079	-.069	-.055	-.042	-.025	-.008

X INCREMENT = .12
Y INCREMENT = .10E-02

4



VALUES OF THE RATE OF RETURN OF COMP.DIV 2

4	5	6	7	8	9	10	11	12	13	14	15
-.101	-.102	-.098	-.099	-.096	-.095	-.088	-.083	-.072	-.064	-.051	-.040

THE RATIO OF TC IS .100

5

TOTAL DEMAND OF RESOURCE UNITS DURING MONTH N..

	1	2	3	4	5	6	7	8	9	10	11	12
ENG.RES....	400.	400.	600.	3739.	4139.	4567.	5194.	8133.	8533.	9161.	9361.	12700.
MAN.RES....	400.	517.	1033.	1951.	2985.	3736.	4886.	6038.	7589.	9258.	11042.	13228.
MARK.RES...	0	0	0	0	69.	139.	382.	972.	1632.	2292.	3125.	3958.
RES&DEV.RES	0	0	0	111.	222.	444.	778.	1222.	1667.	2222.	2778.	3444.
INT.COM.RES	0	0	0	0	0	0	8333.	8333.	12500.	20833.	29167.	29167.

	13	14	15	16	17	18	19	20	21	22	23	24
ENG.RES....	10189.	10617.	13128.	15639.	12700.	13128.	13128.	16067.	13128.	13128.	12700.	12700.
MAN.RES....	13730.	15633.	12726.	13228.	13730.	15633.	12726.	14628.	15130.	15633.	12726.	13228.
MARK.RES...	4236.	5417.	5208.	3333.	3681.	4583.	4097.	5347.	6042.	4167.	3681.	3958.
RES&DEV.RES	3111.	3889.	3667.	3444.	3111.	3889.	3667.	4556.	4333.	4111.	3778.	3444.
INT.COM.RES	25000.	25000.	29167.	29167.	25000.	33333.	37500.	37500.	33333.	33333.	37500.	29167.

	25	26	27	28	29	30	31	32	33	34	35	36
ENG.RES....	10189.	10617.	13128.	15639.	12700.	13128.	13128.	16067.	13128.	13128.	12700.	12700.
MAN.RES....	13730.	15633.	12726.	13228.	13730.	15633.	12726.	14628.	15130.	15633.	12726.	13228.
MARK.RES...	4236.	5417.	5208.	3333.	3681.	4583.	4097.	5347.	6042.	4167.	3681.	3958.
RES&DEV.RES	3111.	3889.	3667.	3444.	3111.	3889.	3667.	4556.	4333.	4111.	3778.	3444.
INT.COM.RES	25000.	25000.	29167.	29167.	25000.	33333.	37500.	37500.	33333.	33333.	37500.	29167.

	37	38	39	40	41	42	43	44	45	46	47	48
ENG.RES....	10189.	10617.	13128.	15639.	12300.	12728.	12528.	12528.	9189.	8561.	7933.	4594.
MAN.RES....	13730.	15633.	12726.	13228.	13330.	15116.	11692.	13077.	12662.	12130.	8073.	7023.
MARK.RES...	4236.	5417.	5208.	3333.	3681.	4583.	4097.	5347.	5972.	4028.	3299.	3333.
RES&DEV.RES	3111.	3889.	3667.	3444.	3111.	3889.	3667.	4444.	4111.	3667.	3111.	2444.
INT.COM.RES	25000.	25000.	29167.	29167.	25000.	33333.	37500.	37500.	33333.	33333.	29167.	20833.

	49	50	51
ENG.RES....	1256.	1256.	628.
MAN.RES....	5858.	6375.	1693.
MARK.RES...	3299.	3819.	2778.
RES&DEV.RES	1667.	1889.	1000.
INT.COM.RES	12500.	12500.	8333.

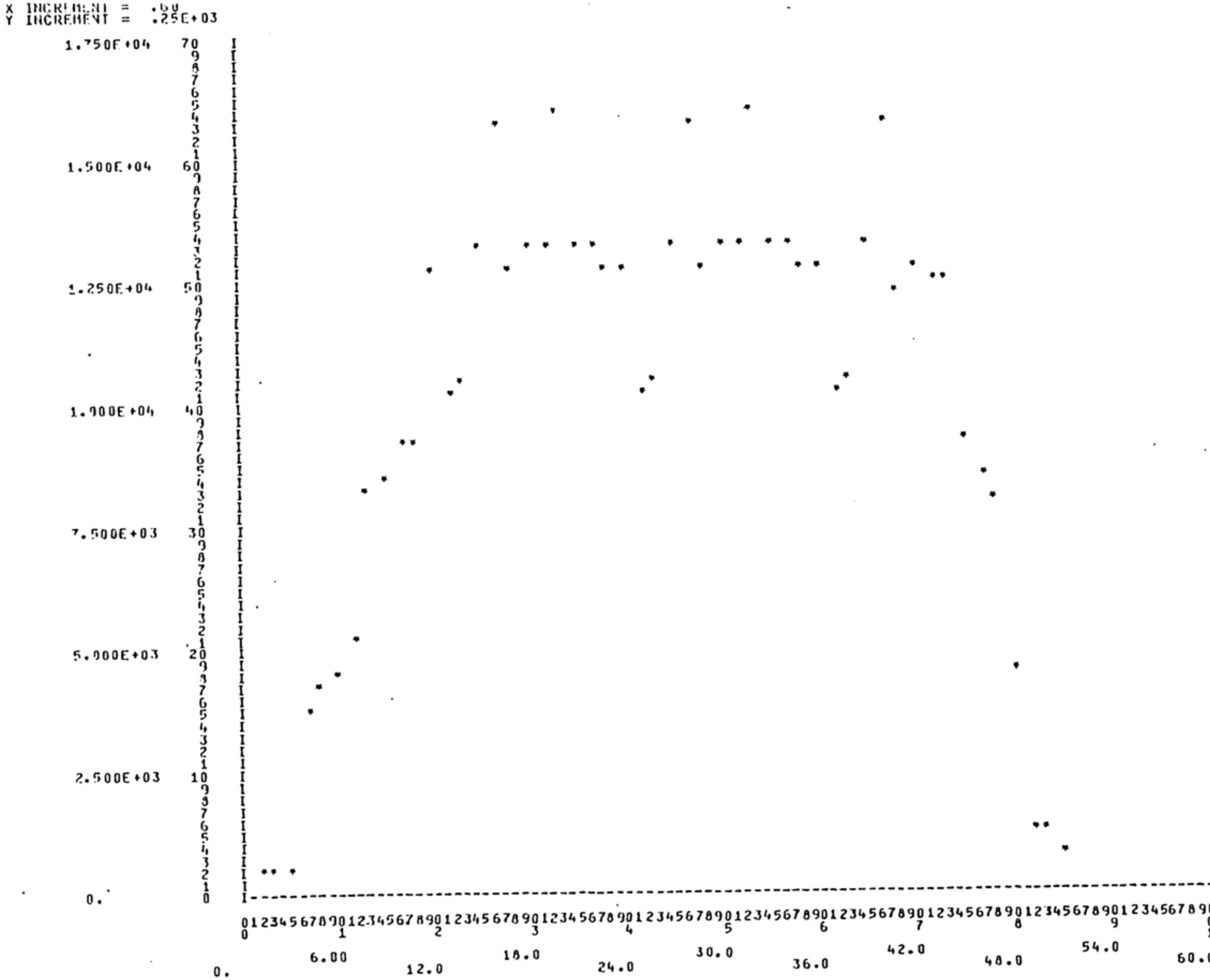
ENGINEERING RESOURCES

MONTH	DIVISION 1	DIVISION 2	DIVISION 3	TOTAL
1	400.0	0	0	400.0
2	400.0	0	0	400.0
3	400.0	0	200.0	600.0
4	3338.9	200.0	200.0	3738.9
5	3738.9	200.0	200.0	4138.9
6	3738.9	200.0	627.8	4566.7
7	3738.9	627.8	827.8	5194.4
8	6677.8	627.8	827.8	8133.3
9	7077.8	627.8	827.8	8533.3
10	7077.8	827.8	1255.6	9161.1
11	7077.8	827.8	1455.6	9361.1
12	10416.7	827.8	1455.6	12700.0
13	7477.8	1255.6	1455.6	10188.9
14	7477.8	1255.6	1883.3	10616.7
15	10416.7	1255.6	1455.6	13127.8
16	13355.6	827.8	1455.6	15638.9
17	10416.7	827.8	1455.6	12700.0
18	10416.7	827.8	1883.3	13127.8
19	10416.7	1255.6	1455.6	13127.8
20	13355.6	1255.6	1455.6	16066.7
21	10416.7	1255.6	1455.6	13127.8
22	10416.7	827.8	1883.3	13127.8
23	10416.7	827.8	1455.6	12700.0
24	10416.7	827.8	1455.6	12700.0
25	7477.8	1255.6	1455.6	10188.9
26	7477.8	1255.6	1883.3	10616.7
27	10416.7	1255.6	1455.6	13127.8
28	13355.6	827.8	1455.6	15638.9
29	10416.7	827.8	1455.6	12700.0
30	10416.7	827.8	1883.3	13127.8
31	10416.7	1255.6	1455.6	13127.8
32	13355.6	1255.6	1455.6	16066.7
33	10416.7	1255.6	1455.6	13127.8
34	10416.7	827.8	1883.3	13127.8
35	10416.7	827.8	1455.6	12700.0
36	10416.7	827.8	1455.6	12700.0
37	7477.8	1255.6	1455.6	10188.9
38	7477.8	1255.6	1883.3	10616.7
39	10416.7	1255.6	1455.6	13127.8
40	13355.6	827.8	1455.6	15638.9
41	10016.7	827.8	1455.6	12300.0

6

42	10016.7	827.8	1883.3	12727.8
43	10016.7	1255.6	1255.6	12527.8
44	10016.7	1255.6	1255.6	12527.8
45	6677.8	1255.6	1255.6	9188.9
46	6677.8	627.8	1255.6	8561.1
47	6677.8	627.8	627.8	7933.3
48	3338.9	627.8	627.8	4594.4
49	0	627.8	627.8	1255.6
50	0	627.8	627.8	1255.6
51	0	627.8	0	627.8

THE MAXIMUM RESOURCE USED IS 16066.67 AT PERIOD 20

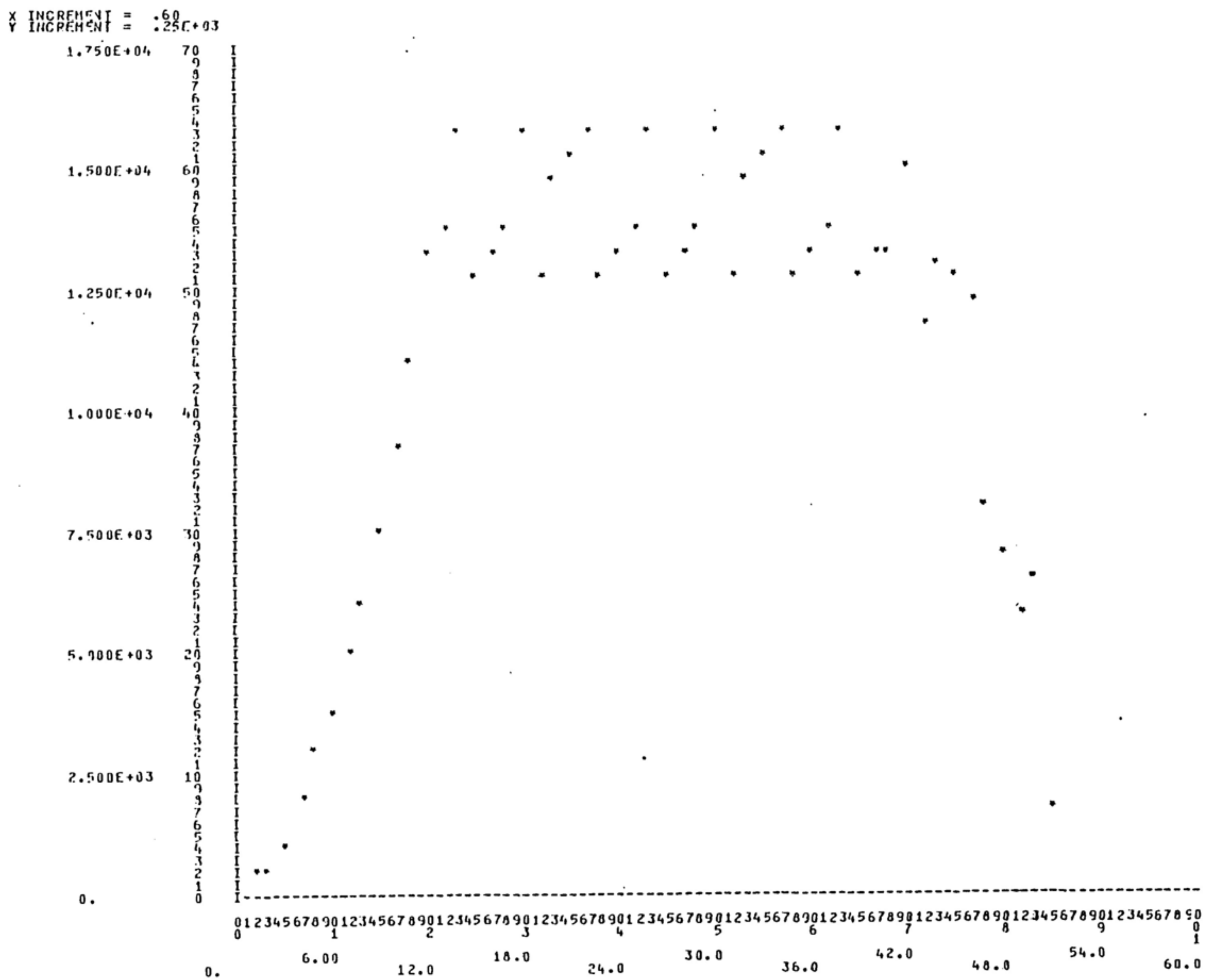

X INCREMENT = .60
Y INCREMENT = .25E+03
1.750E+04
1.500E+04
1.250E+04
1.000E+04
7.500E+03
5.000E+03
2.500E+03
0.
0.
6.00
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0

8

MANAGEMENT RESOURCES

MONTH	DIVISION 1	DIVISION 2	DIVISION 3	TOTAL
1	400.0	0	0	400.0
2	516.7	0	0	516.7
3	633.3	0	400.0	1033.3
4	750.0	400.0	800.8	1950.8
5	1266.7	516.7	1201.5	2984.8
6	1500.0	633.3	1602.3	3735.6
7	1733.3	750.0	2403.0	4886.4
8	1966.7	866.7	3204.5	6037.9
9	2600.0	983.3	4006.1	7589.4
10	2950.0	1500.0	4807.6	9257.6
11	3300.0	1733.3	6009.1	11042.4
12	4050.0	1966.7	7211.4	13228.0
13	3116.7	2200.0	8413.6	13730.3
14	3583.3	2433.3	9615.9	15632.6
15	4050.0	2666.7	6009.1	12725.8
16	4516.7	1500.0	7211.4	13228.0
17	3583.3	1733.3	8413.6	13730.3
18	4050.0	1966.7	9615.9	15632.6
19	4516.7	2200.0	6009.1	12725.8
20	4983.3	2433.3	7211.4	14628.0
21	4050.0	2666.7	8413.6	15130.3
22	4516.7	1500.0	9615.9	15632.6
23	4983.3	1733.3	6009.1	12725.8
24	4050.0	1966.7	7211.4	13228.0
25	3116.7	2200.0	8413.6	13730.3
26	3583.3	2433.3	9615.9	15632.6
27	4050.0	2666.7	6009.1	12725.8
28	4516.7	1500.0	7211.4	13228.0
29	3583.3	1733.3	8413.6	13730.3
30	4050.0	1966.7	9615.9	15632.6
31	4516.7	2200.0	6009.1	12725.8
32	4983.3	2433.3	7211.4	14628.0
33	4050.0	2666.7	8413.6	15130.3
34	4516.7	1500.0	9615.9	15632.6
35	4983.3	1733.3	6009.1	12725.8
36	4050.0	1966.7	7211.4	13228.0
37	3116.7	2200.0	8413.6	13730.3
38	3583.3	2433.3	9615.9	15632.6
39	4050.0	2666.7	6009.1	12725.8
40	4516.7	1500.0	7211.4	13228.0
41	3183.3	1733.3	8413.6	13330.3
42	3533.3	1966.7	9615.9	15115.9
43	3883.3	2200.0	5609.1	11692.4
44	4233.3	2433.3	6410.6	13077.3
45	2783.3	2666.7	7212.1	12662.1
46	3016.7	1100.0	8013.6	12130.3
47	3250.0	1216.7	3606.1	8072.7
48	1683.3	1333.3	4006.8	7023.5
49	0	1450.0	4407.6	5857.6
50	0	1566.7	4808.3	6375.0
51	0	1683.3	0	1683.3

THE MAXIMUM RESOURCE USED IS 15632.58 AT PERIOD 14

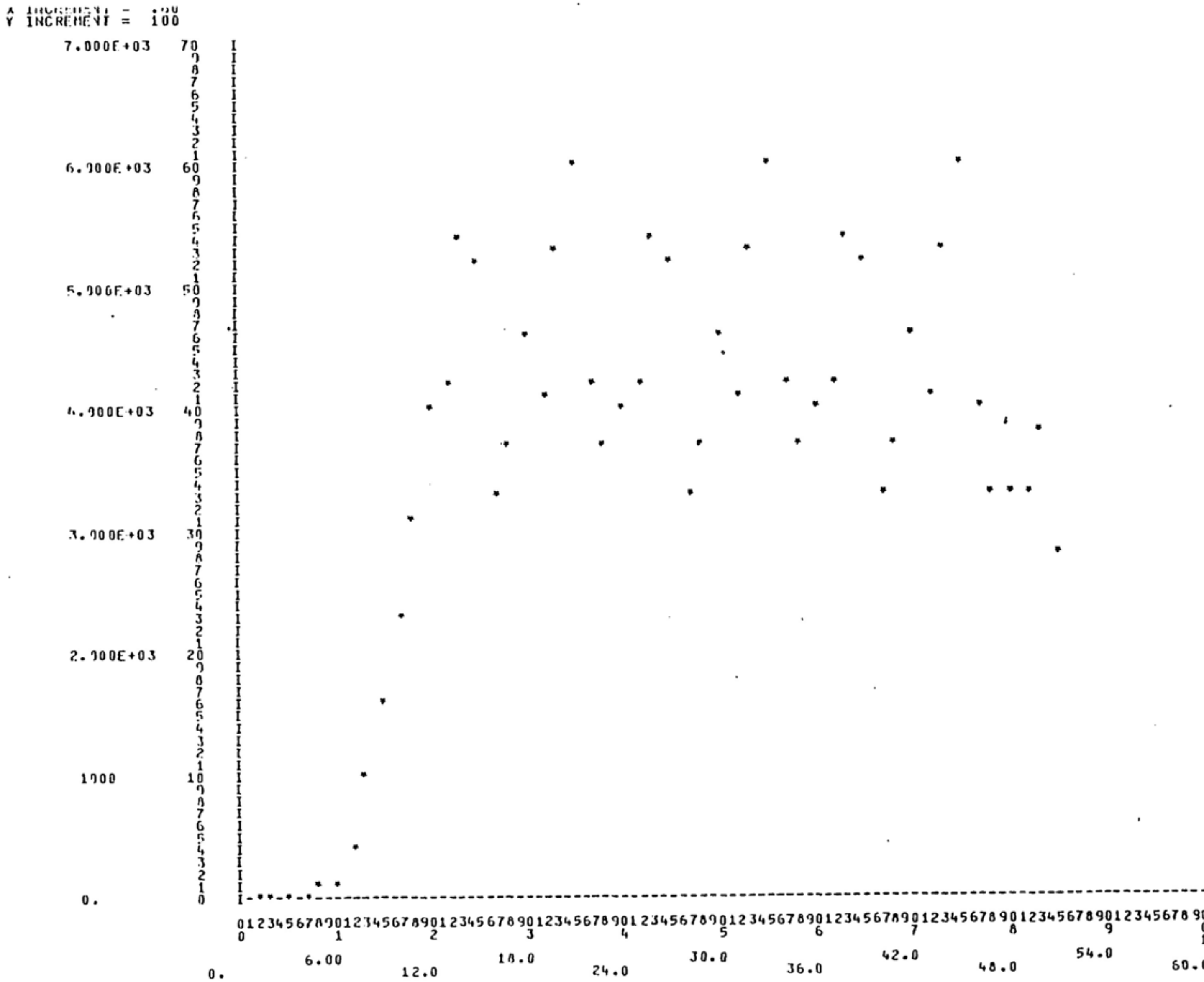

X INCREMENT = .60
Y INCREMENT = .250E+03
1.750E+04
1.500E+04
1.250E+04
1.000E+04
7.500E+03
5.000E+03
2.500E+03
0.
0.
6.00
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0

10

MARKETING RESOURCES

MONTH	DIVISION 1	DIVISION 2	DIVISION 3	TOTAL
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0
4	0	0	0	0
5	69.4	0	0	69.4
6	138.9	0	0	138.9
7	208.3	0	173.6	381.9
8	277.8	347.2	347.2	972.2
9	416.7	694.4	520.8	1631.9
10	555.6	1041.7	694.4	2291.7
11	694.4	1388.9	1041.7	3125.0
12	833.3	1736.1	1388.9	3958.3
13	416.7	2083.3	1736.1	4236.1
14	555.6	2777.8	2083.3	5416.7
15	694.4	3472.2	1041.7	5208.3
16	902.8	1041.7	1388.9	3333.3
17	555.6	1388.9	1736.1	3680.6
18	763.9	1736.1	2083.3	4583.3
19	972.2	2083.3	1041.7	4097.2
20	1180.6	2777.8	1388.9	5347.2
21	833.3	3472.2	1736.1	6041.7
22	1041.7	1041.7	2083.3	4166.7
23	1250.0	1388.9	1041.7	3680.6
24	833.3	1736.1	1388.9	3958.3
25	416.7	2083.3	1736.1	4236.1
26	555.6	2777.8	2083.3	5416.7
27	694.4	3472.2	1041.7	5208.3
28	902.8	1041.7	1388.9	3333.3
29	555.6	1388.9	1736.1	3680.6
30	763.9	1736.1	2083.3	4583.3
31	972.2	2083.3	1041.7	4097.2
32	1180.6	2777.8	1388.9	5347.2
33	833.3	3472.2	1736.1	6041.7
34	1041.7	1041.7	2083.3	4166.7
35	1250.0	1388.9	1041.7	3680.6
36	833.3	1736.1	1388.9	3958.3
37	416.7	2083.3	1736.1	4236.1
38	555.6	2777.8	2083.3	5416.7
39	694.4	3472.2	1041.7	5208.3
40	902.8	1041.7	1388.9	3333.3
41	555.6	1388.9	1736.1	3680.6
42	763.9	1736.1	2083.3	4583.3
43	972.2	2083.3	1041.7	4097.2
44	1180.6	2777.8	1388.9	5347.2
45	763.9	3472.2	1736.1	5972.2
46	902.8	1041.7	2083.3	4027.8
47	1041.7	1388.9	868.1	3298.6
48	555.6	1736.1	1041.7	3333.3
49	0	2083.3	1215.3	3298.6
50	0	2430.6	1388.9	3819.4
51	0	2777.8	0	2777.8

THE MAXIMUM RESOURCE USED IS 6041.67 AT PERIOD 21

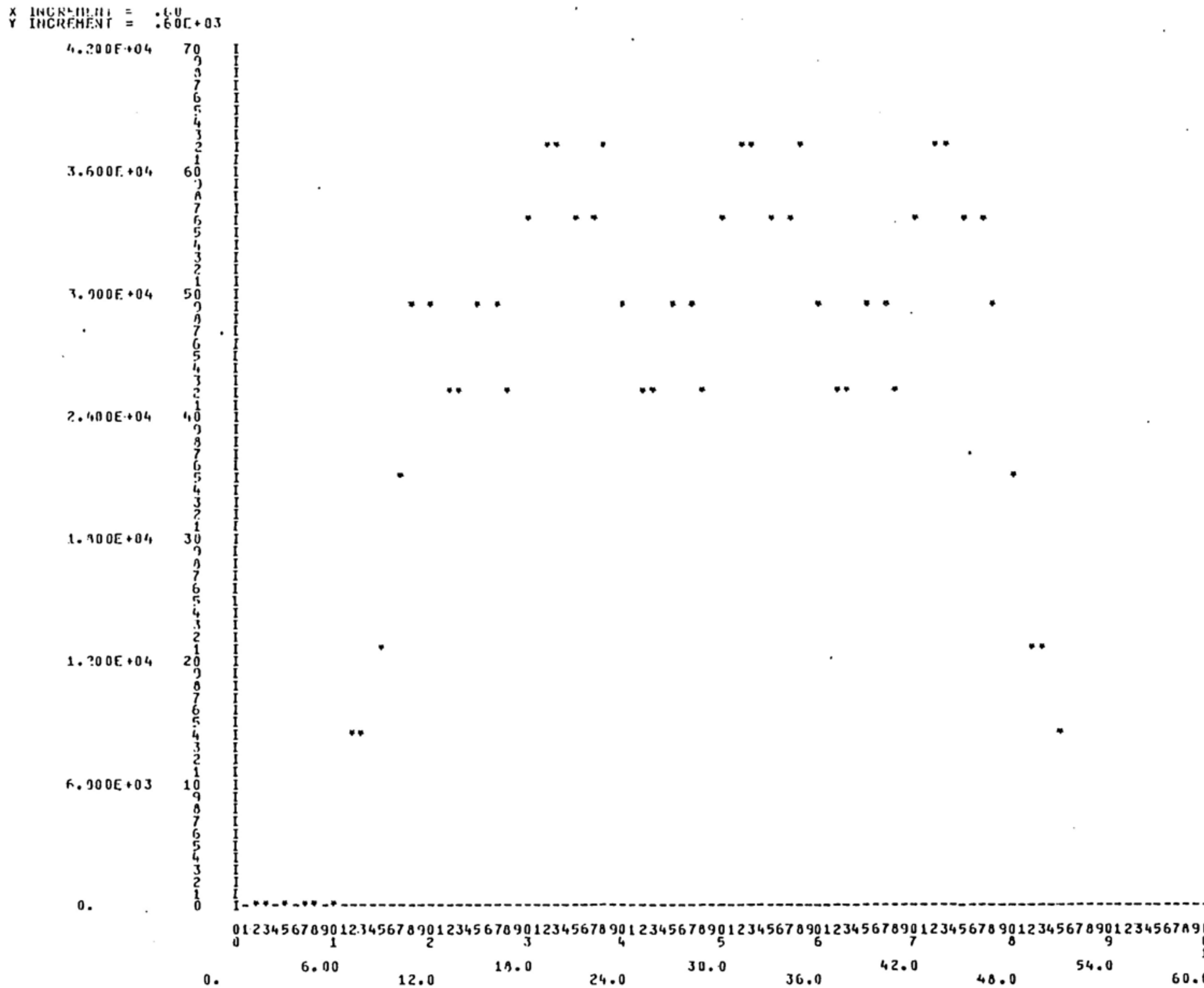

Y INCREMENT = 100
7.000E+03
6.000E+03
5.000E+03
4.000E+03
3.000E+03
2.000E+03
1000
0.
0.
6.00
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0

12

MONTH	DIVISION 1	DIVISION 2	DIVISION 3	TOTAL
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0
4	0	0	0	0
5	0	0	0	0
6	0	0	0	0
7	8333.3	0	0	8333.3
8	8333.3	0	0	8333.3
9	8333.3	0	4166.7	12500.0
10	8333.3	8333.3	4166.7	20833.3
11	16666.7	8333.3	4166.7	29166.7
12	16666.7	8333.3	4166.7	29166.7
13	8333.3	8333.3	8333.3	25000.0
14	8333.3	8333.3	8333.3	25000.0
15	16666.7	8333.3	4166.7	29166.7
16	16666.7	8333.3	4166.7	29166.7
17	8333.3	8333.3	8333.3	25000.0
18	16666.7	8333.3	8333.3	33333.3
19	25000.0	8333.3	4166.7	37500.0
20	25000.0	8333.3	4166.7	37500.0
21	16666.7	8333.3	8333.3	33333.3
22	16666.7	8333.3	8333.3	33333.3
23	25000.0	8333.3	4166.7	37500.0
24	16666.7	8333.3	4166.7	29166.7
25	8333.3	8333.3	8333.3	25000.0
26	8333.3	8333.3	8333.3	25000.0
27	16666.7	8333.3	4166.7	29166.7
28	16666.7	8333.3	4166.7	29166.7
29	8333.3	8333.3	8333.3	25000.0
30	16666.7	8333.3	8333.3	33333.3
31	25000.0	8333.3	4166.7	37500.0
32	25000.0	8333.3	4166.7	37500.0
33	16666.7	8333.3	8333.3	33333.3
34	16666.7	8333.3	8333.3	33333.3
35	25000.0	8333.3	4166.7	37500.0
36	16666.7	8333.3	4166.7	29166.7
37	8333.3	8333.3	8333.3	25000.0
38	8333.3	8333.3	8333.3	25000.0
39	16666.7	8333.3	4166.7	29166.7
40	16666.7	8333.3	4166.7	29166.7
41	8333.3	8333.3	8333.3	25000.0
42	16666.7	8333.3	8333.3	33333.3
43	25000.0	8333.3	4166.7	37500.0
44	25000.0	8333.3	4166.7	37500.0
45	16666.7	8333.3	8333.3	33333.3
46	16666.7	8333.3	8333.3	33333.3
47	16666.7	8333.3	4166.7	29166.7
48	8333.3	8333.3	4166.7	20833.3
49	0	8333.3	4166.7	12500.0
50	0	8333.3	4166.7	12500.0
51	0	8333.3	0	8333.3

THE MAXIMUM RESOURCE USED IS 37500.00 AT PERIOD 19

13

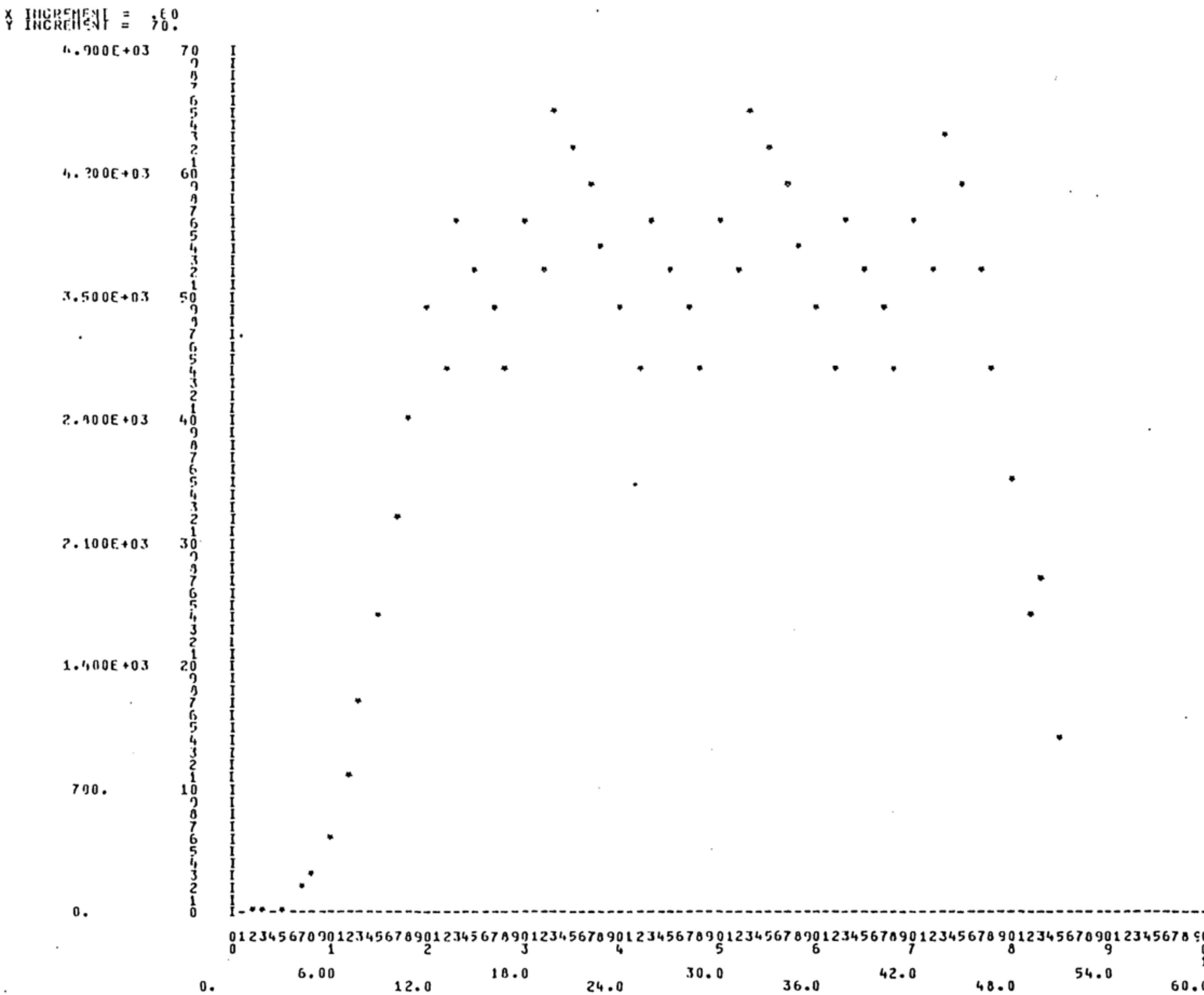

X INCREMENT = .60
Y INCREMENT = .60E+03
4.200E+04
3.600E+04
3.000E+04
2.400E+04
1.800E+04
1.200E+04
6.000E+03
0.
0.
6.00
12.0
18.0
24.0
30.0
36.0
42.0
48.0
54.0
60.0

RESEARCH & DEVELOPMENT RESOURCES

MONTH	DIVISION 1	DIVISION 2	DIVISION 3	TOTAL
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0
4	111.1	0	0	111.1
5	222.2	0	0	222.2
6	333.3	0	111.1	444.4
7	444.4	111.1	222.2	777.8
8	666.7	222.2	333.3	1222.2
9	888.9	333.3	444.4	1666.7
10	1111.1	444.4	666.7	2222.2
11	1333.3	555.6	888.9	2777.8
12	1666.7	666.7	1111.1	3444.4
13	888.9	888.9	1333.3	3111.1
14	1111.1	1111.1	1666.7	3888.9
15	1444.4	1333.3	888.9	3666.7
16	1888.9	444.4	1111.1	3444.4
17	1222.2	555.6	1333.3	3111.1
18	1555.6	666.7	1666.7	3888.9
19	1888.9	888.9	888.9	3666.7
20	2333.3	1111.1	1111.1	4555.6
21	1666.7	1333.3	1333.3	4333.3
22	2000.0	444.4	1666.7	4111.1
23	2333.3	555.6	888.9	3777.8
24	1666.7	666.7	1111.1	3444.4
25	888.9	888.9	1333.3	3111.1
26	1111.1	1111.1	1666.7	3888.9
27	1444.4	1333.3	888.9	3666.7
28	1888.9	444.4	1111.1	3444.4
29	1222.2	555.6	1333.3	3111.1
30	1555.6	666.7	1666.7	3888.9
31	1888.9	888.9	888.9	3666.7
32	2333.3	1111.1	1111.1	4555.6
33	1666.7	1333.3	1333.3	4333.3
34	2000.0	444.4	1666.7	4111.1
35	2333.3	555.6	888.9	3777.8
36	1666.7	666.7	1111.1	3444.4
37	888.9	888.9	1333.3	3111.1
38	1111.1	1111.1	1666.7	3888.9
39	1444.4	1333.3	888.9	3666.7
40	1888.9	444.4	1111.1	3444.4
41	1222.2	555.6	1333.3	3111.1
42	1555.6	666.7	1666.7	3888.9
43	1888.9	888.9	888.9	3666.7
44	2222.2	1111.1	1111.1	4444.4
45	1444.4	1333.3	1333.3	4111.1
46	1666.7	444.4	1555.6	3666.7
47	1888.9	555.6	666.7	3111.1
48	1000.0	666.7	777.8	2444.4
49	0	777.8	888.9	1666.7
50	0	888.9	1000.0	1888.9
51	0	1000.0	0	1000.0

THE MAXIMUM RESOURCE USED IS 4555.56 AT PERIOD 20

15



COMPANIES IN LIST NUMBER 2

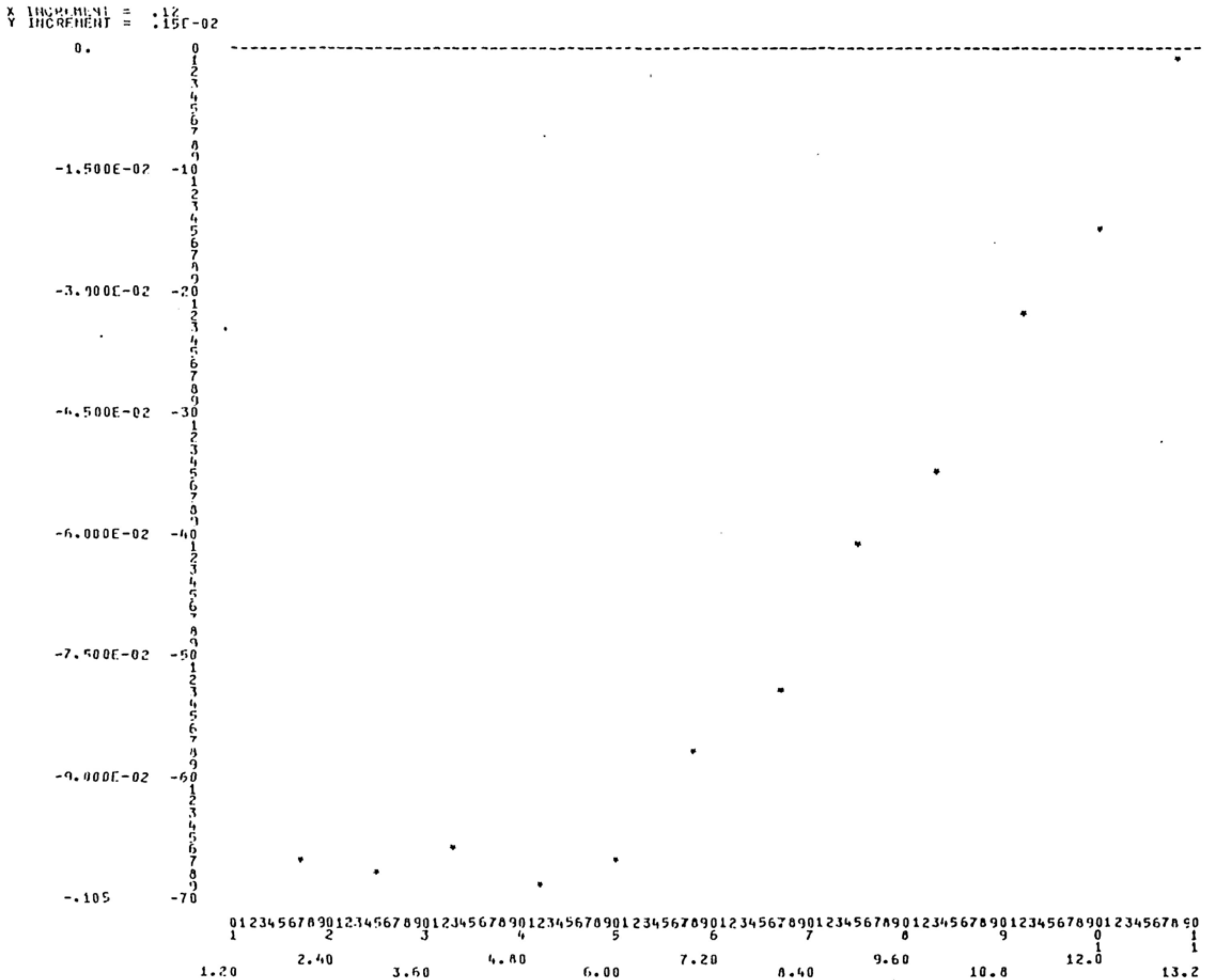
16

```
THE SENSITIVITY TEST RUN NUMBER      0

THE SPECIAL RESOURCE IS                  0
TOTAL RESOURCES ARE KEPT CONSTANT AT  1000000.00
THE RECOVERY PERIOD IS     12

STANDARD DELAY PERIOD(S) FOR
     ENGINEERING  3
     MARKETING    4
     MANAGEMENT   0
     R&D          3
     INT RES      6
```

17



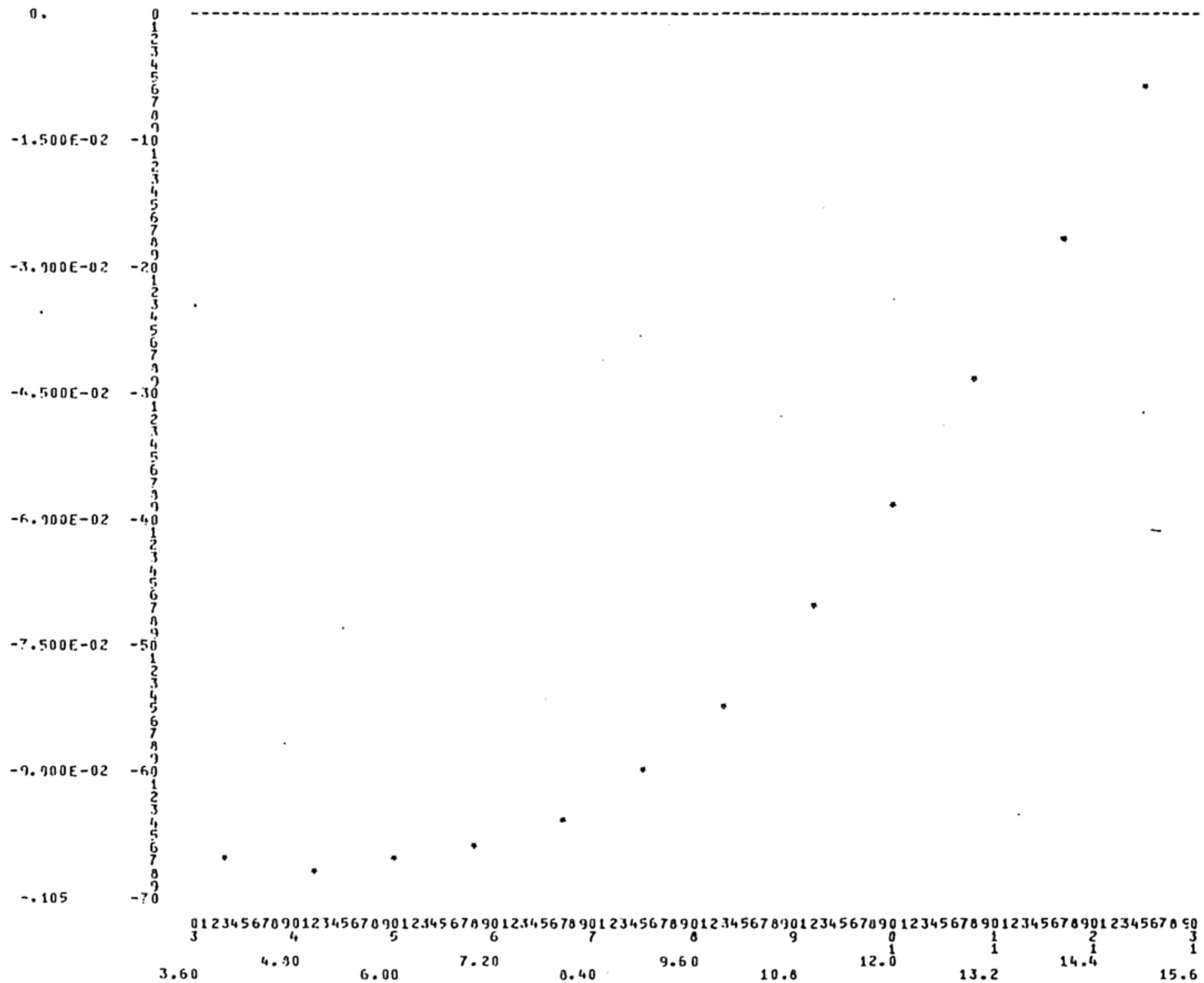
VALUES OF THE RATE OF RETURN OF COMP.DIV 1

2	3	4	5	6	7	8	9	10	11	12	13
-.101	-.102	-.099	-.104	-.101	-.087	-.080	-.061	-.053	-.033	-.023	-.002

THE RATIO OF IC IS .100

18

X INCREMENT = .12
Y INCREMENT = .15E-02



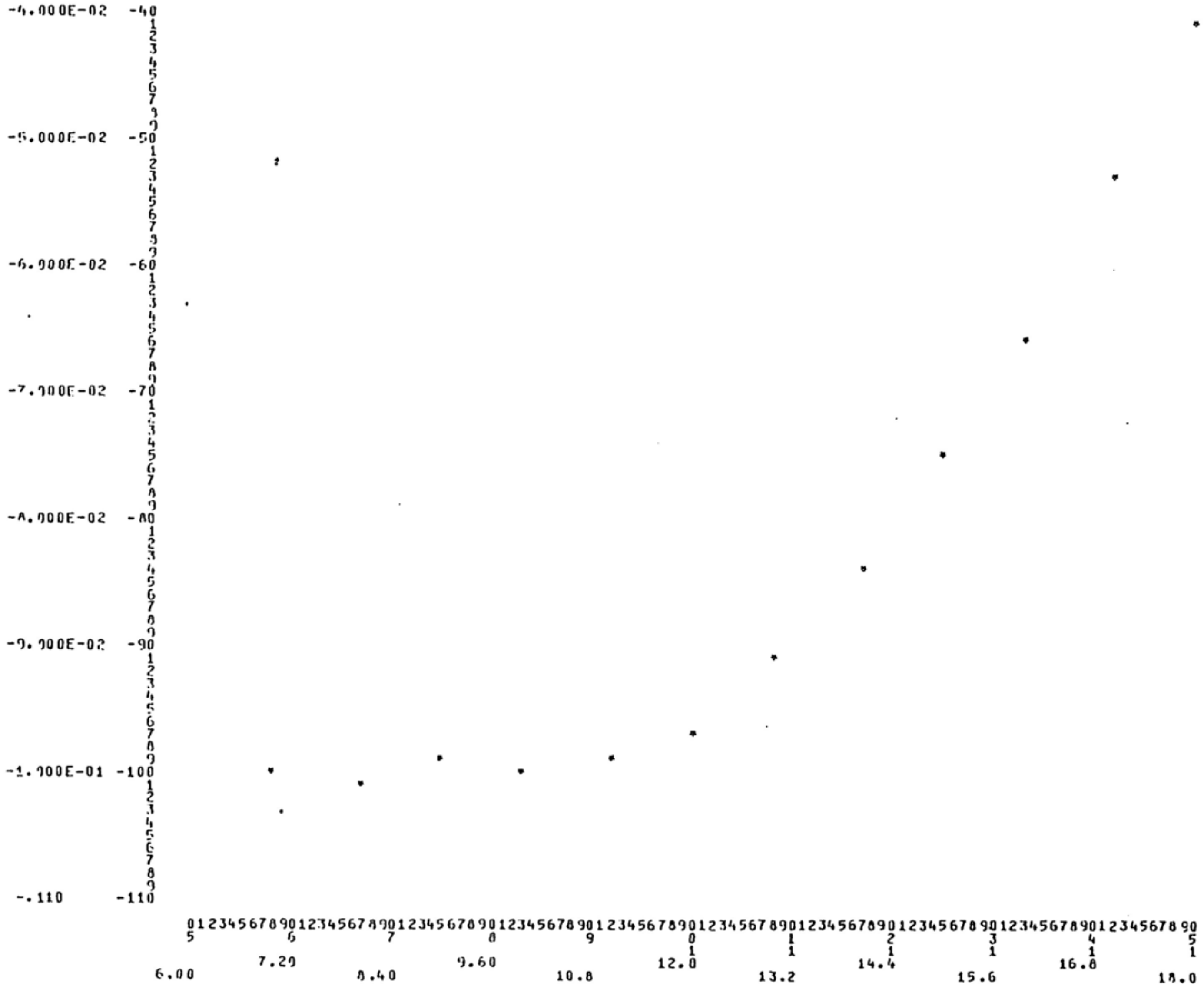
VALUES OF THE RATE OF RETURN OF COMP.DIV 3

4	5	6	7	8	9	10	11	12	13	14	15
-.100	-.102	-.100	-.100	-.096	-.090	-.082	-.071	-.058	-.044	-.027	-.009

THE RATIO OF IC IS .050

X INCREMENT = .12
Y INCREMENT = .10E-02

19



VALUES OF THE RATE OF RETURN OF COMP.DIV 2

7	8	9	10	11	12	13	14	15	16	17	18
-.100	-.101	-.099	-.100	-.099	-.097	-.091	-.084	-.075	-.066	-.053	-.041

THE RATIO OF IC IS .100

20

TOTAL DEMAND OF RESOURCE UNITS DURING MONTH N.:

	1	2	3	4	5	6	7	8	9	10	11	12
ENG.RES....	0	400.	400.	600.	7411.	7411.	8733.	15144.	15544.	16867.	16867.	23278.
MAN.RES....	0	400.	706.	1412.	2992.	4479.	6365.	8158.	10350.	12848.	15821.	18794.
MARK.RES...	0	0	0	0	0	139.	278.	764.	1389.	2014.	3333.	4653.
RES&DEV.RES	0	0	0	0	222.	444.	889.	1556.	2222.	3111.	4000.	5111.
INT.COM.RES	0	0	0	0	0	0	0	16667.	16667.	25000.	41667.	41667.

	13	14	15	16	17	18	19	20	21	22	23	24
ENG.RES....	24800.	17989.	17989.	23278.	16867.	15867.	16867.	23278.	16867.	16867.	16867.	23278.
MAN.RES....	22167.	21373.	24345.	16827.	16127.	19100.	18400.	21373.	20673.	13155.	16127.	19100.
MARK.RES...	6111.	6667.	8333.	6875.	7083.	8403.	3472.	4444.	4306.	2153.	3472.	4792.
RES&DEV.RES	6444.	5556.	6667.	5778.	4667.	5556.	4444.	5556.	4444.	3333.	4222.	5333.
INT.COM.RES	58333.	41667.	58333.	58333.	41667.	41667.	41667.	41667.	25000.	25000.	41667.	41667.

	25	26	27	28	29	30	31	32	33	34	35	36
ENG.RES....	17989.	17989.	17999.	23278.	16867.	16867.	16867.	23278.	16867.	16867.	16867.	23278.
MAN.RES....	18400.	21373.	24345.	16827.	16127.	19100.	18400.	21373.	20673.	13155.	16127.	19100.
MARK.RES...	5000.	6667.	8333.	6875.	7083.	8403.	3472.	4444.	4306.	2153.	3472.	4792.
RES&DEV.RES	4444.	5556.	6667.	5778.	4667.	5556.	4444.	5556.	4444.	3333.	4222.	5333.
INT.COM.RES	41667.	41667.	58333.	58333.	41667.	41667.	41667.	41667.	25000.	25000.	41667.	41667.

	37	38	39	40	41	42	43	44	45	46	47	48
ENG.RES....	17989.	17989.	17999.	23078.	16267.	16267.	14944.	14944.	8133.	6811.	6811.	6811.
MAN.RES....	18400.	21373.	24345.	16427.	14453.	16245.	13965.	15452.	12865.	3155.	3461.	3767.
MARK.RES...	5000.	6667.	8333.	6875.	7083.	8403.	3472.	4097.	3472.	833.	972.	1111.
RES&DEV.RES	4444.	5556.	6667.	5778.	4667.	5556.	4222.	4889.	3333.	1556.	1778.	2000.
INT.COM.RES	41667.	41667.	58333.	58333.	41667.	41667.	41667.	41667.	25000.	16667.	16667.	16667.

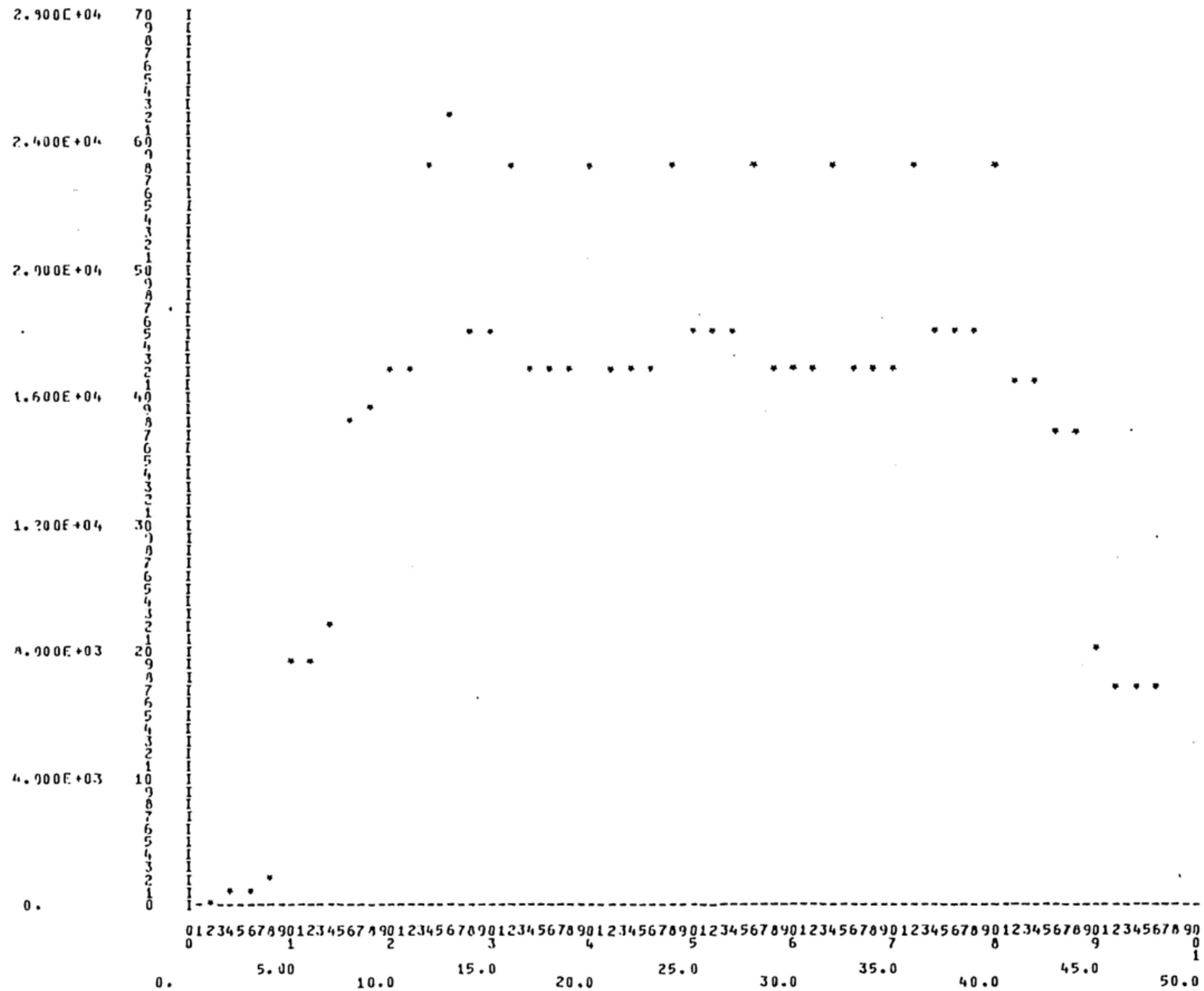
ENGINEERING RESOURCES

MONTH	DIVISION 1	DIVISION 2	DIVISION 3	TOTAL
1	0	0	0	0
2	400.0	0	0	400.0
3	400.0	0	0	400.0
4	400.0	0	200.0	600.0
5	7211.1	0	200.0	7411.1
6	7211.1	0	200.0	7411.1
7	7211.1	200.0	1322.2	8733.3
8	13622.2	200.0	1322.2	15144.4
9	14022.2	200.0	1322.2	15544.4
10	14022.2	1322.2	1522.2	16866.7
11	14022.2	1322.2	1522.2	16866.7
12	20433.3	1322.2	1522.2	23277.8
13	20833.3	1322.2	2644.4	24800.0
14	14022.2	1322.2	2644.4	17988.9
15	14022.2	1322.2	2644.4	17988.9
16	20433.3	1322.2	1522.2	23277.8
17	14022.2	1322.2	1522.2	16866.7
18	14022.2	1322.2	1522.2	16866.7
19	14022.2	200.0	2644.4	16866.7
20	20433.3	200.0	2644.4	23277.8
21	14022.2	200.0	2644.4	16866.7
22	14022.2	1322.2	1522.2	16866.7
23	14022.2	1322.2	1522.2	16866.7
24	20433.3	1322.2	1522.2	23277.8
25	14022.2	1322.2	2644.4	17988.9
26	14022.2	1322.2	2644.4	17988.9
27	14022.2	1322.2	2644.4	17988.9
28	20433.3	1322.2	1522.2	23277.8
29	14022.2	1322.2	1522.2	16866.7
30	14022.2	1322.2	1522.2	16866.7
31	14022.2	200.0	2644.4	16866.7
32	20433.3	200.0	2644.4	23277.8
33	14022.2	200.0	2644.4	16866.7
34	14022.2	1322.2	1522.2	16866.7
35	14022.2	1322.2	1522.2	16866.7
36	20433.3	1322.2	1522.2	23277.8
37	14022.2	1322.2	2644.4	17988.9
38	14022.2	1322.2	2644.4	17988.9
39	14022.2	1322.2	2644.4	17988.9
40	20433.3	1322.2	1322.2	23077.8
41	13622.2	1322.2	1322.2	16266.7
42	13622.2	1322.2	1322.2	16266.7
43	13622.2	0	1322.2	14944.4
44	13622.2	0	1322.2	14944.4
45	6811.1	0	1322.2	8133.3
46	6811.1	0	0	6811.1
47	6811.1	0	0	6811.1

48	6811.1	0	0	6811.1	37

THE MAXIMUM RESOURCE USED IS 24800.00 AT PERIOD 13

X INCREMENT = .50
Y INCREMENT = .40E+03



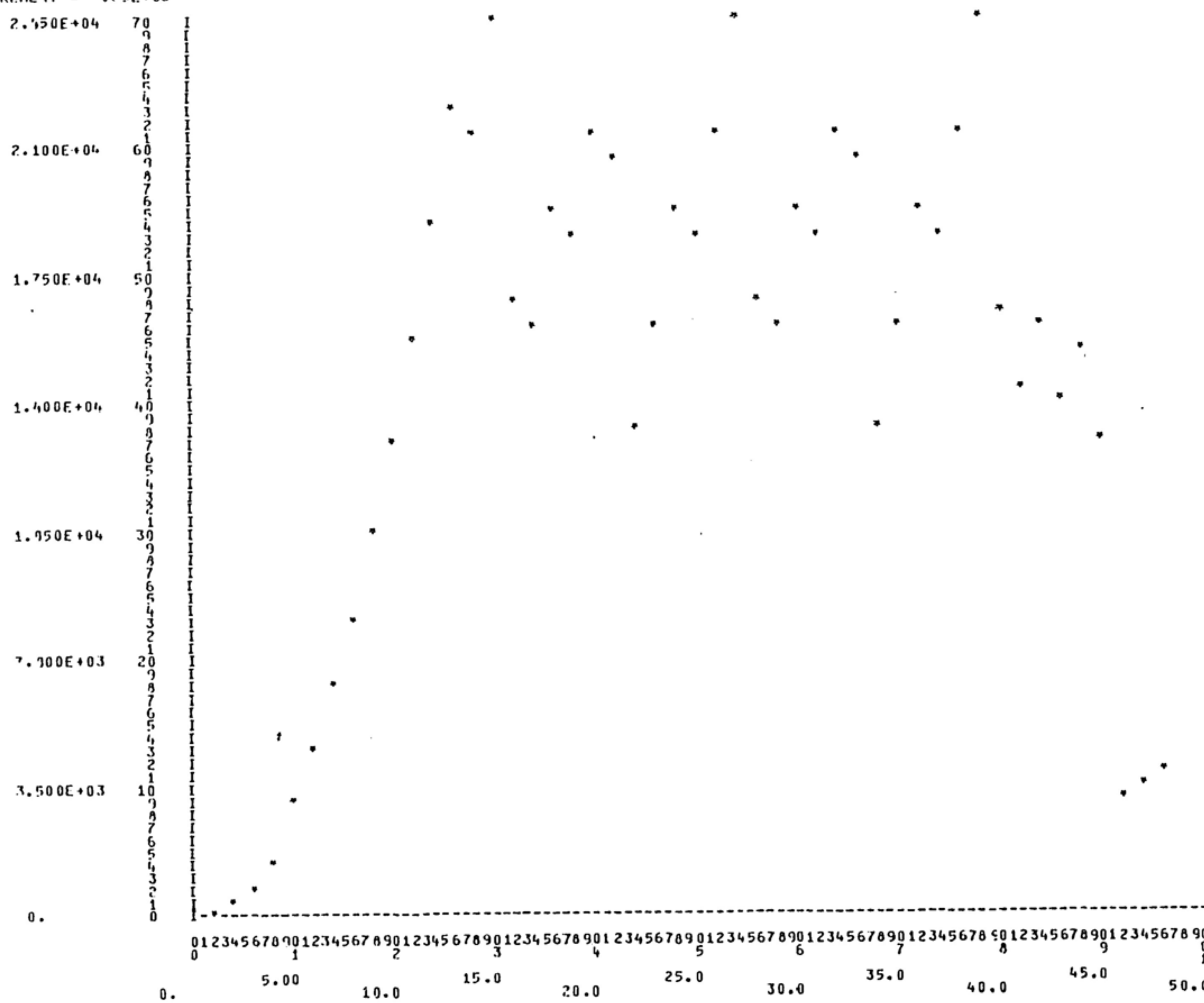
MANAGEMENT RESOURCES

MONTH	DIVISION 1	DIVISION 2	DIVISION 3	TOTAL
1	0	0	0	0
2	400.0	0	0	400.0
3	706.1	0	0	706.1
4	1012.1	0	400.0	1412.1
5	1718.2	0	1274.2	2992.4
6	2330.3	0	2148.5	4478.8
7	2942.4	400.0	3022.7	6365.2
8	3554.5	706.1	3897.0	8157.6
9	4566.7	1012.1	4771.2	10350.0
10	5484.8	1318.2	6045.5	12848.5
11	6403.0	1624.2	7793.9	15821.2
12	7321.2	1930.3	9542.4	18793.9
13	8639.4	2236.4	11290.9	22166.7
14	5790.9	2542.4	13039.4	21372.7
15	6709.1	2848.5	14787.9	24345.5
16	7627.3	3154.5	6045.5	16827.3
17	4872.7	3460.6	7793.9	16127.3
18	5790.9	3766.7	9542.4	19100.0
19	6709.1	400.0	11290.9	18400.0
20	7627.3	706.1	13039.4	21372.7
21	4872.7	1012.1	14787.9	20672.7
22	5790.9	1318.2	6045.5	13154.5
23	6709.1	1624.2	7793.9	16127.3
24	7627.3	1930.3	9542.4	19100.0
25	4872.7	2236.4	11290.9	18400.0
26	5790.9	2542.4	13039.4	21372.7
27	6709.1	2848.5	14787.9	24345.5
28	7627.3	3154.5	6045.5	16827.3
29	4872.7	3460.6	7793.9	16127.3
30	5790.9	3766.7	9542.4	19100.0
31	6709.1	400.0	11290.9	18400.0
32	7627.3	706.1	13039.4	21372.7
33	4872.7	1012.1	14787.9	20672.7
34	5790.9	1318.2	6045.5	13154.5
35	6709.1	1624.2	7793.9	16127.3
36	7627.3	1930.3	9542.4	19100.0
37	4872.7	2236.4	11290.9	18400.0
38	5790.9	2542.4	13039.4	21372.7
39	6709.1	2848.5	14787.9	24345.5
40	7627.3	3154.5	5645.5	16427.3
41	4472.7	3460.6	6519.7	14453.0
42	5084.8	3766.7	7393.9	16245.5
43	5697.0	0	8268.2	13965.2
44	6309.1	0	9142.4	15451.5
45	2848.5	0	10016.7	12865.2
46	3154.5	0	0	3154.5
47	3460.6	0	0	3460.6
48	3766.7	0	0	3766.7

THE MAXIMUM RESOURCE USED IS 24345.45 AT PERIOD 15

24

X INCREMENT = .50
Y INCREMENT = .35E+03

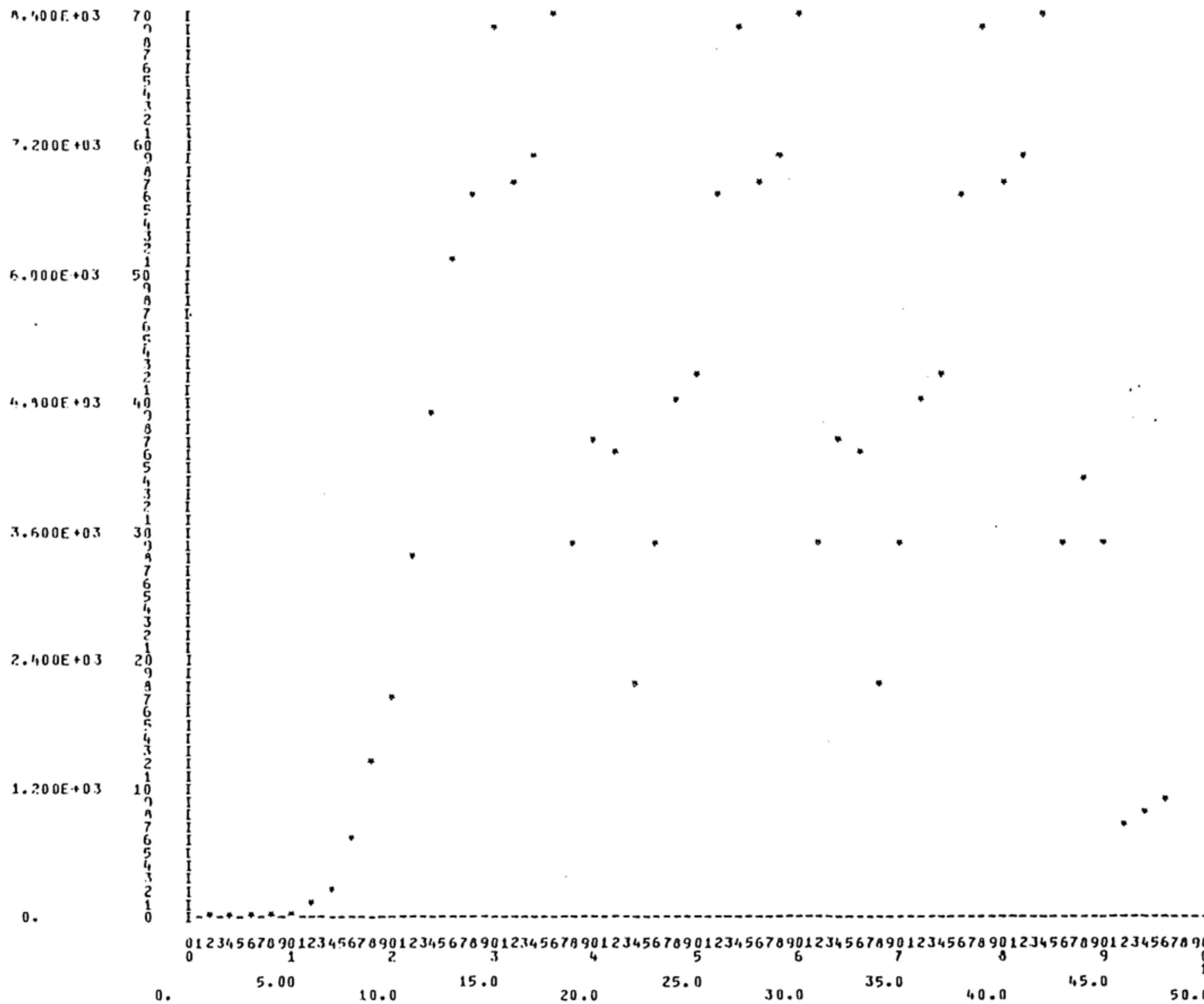


MARKETING RESOURCES

MONTH	DIVISION 1	DIVISION 2	DIVISION 3	TOTAL
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0
4	0	0	0	0
5	0	0	0	0
6	138.9	0	0	138.9
7	277.8	0	0	277.8
8	416.7	0	347.2	763.9
9	694.4	0	694.4	1388.9
10	972.2	0	1041.7	2013.9
11	1250.0	694.4	1388.9	3333.3
12	1527.8	1388.9	1736.1	4652.8
13	1944.4	2083.3	2083.3	6111.1
14	1111.1	2777.8	2777.8	6666.7
15	1388.9	3472.2	3472.2	8333.3
16	1666.7	4166.7	1041.7	6875.0
17	833.3	4861.1	1388.9	7083.3
18	1111.1	5555.6	1736.1	8402.8
19	1388.9	0	2083.3	3472.2
20	1666.7	0	2777.8	4444.4
21	833.3	0	3472.2	4305.6
22	1111.1	0	1041.7	2152.8
23	1388.9	694.4	1388.9	3472.2
24	1666.7	1388.9	1736.1	4791.7
25	833.3	2083.3	2083.3	5000.0
26	1111.1	2777.8	2777.8	6666.7
27	1388.9	3472.2	3472.2	8333.3
28	1666.7	4166.7	1041.7	6875.0
29	833.3	4861.1	1388.9	7083.3
30	1111.1	5555.6	1736.1	8402.8
31	1388.9	0	2083.3	3472.2
32	1666.7	0	2777.8	4444.4
33	833.3	0	3472.2	4305.6
34	1111.1	0	1041.7	2152.8
35	1388.9	694.4	1388.9	3472.2
36	1666.7	1388.9	1736.1	4791.7
37	833.3	2083.3	2083.3	5000.0
38	1111.1	2777.8	2777.8	6666.7
39	1388.9	3472.2	3472.2	8333.3
40	1666.7	4166.7	1041.7	6875.0
41	833.3	4861.1	1388.9	7083.3
42	1111.1	5555.6	1736.1	8402.8
43	1388.9	0	2083.3	3472.2
44	1666.7	0	2430.6	4097.2
45	694.4	0	2777.8	3472.2
46	833.3	0	0	833.3
47	972.2	0	0	972.2
48	1111.1	0	0	1111.1

THE MAXIMUM RESOURCE USED IS 8402.78 AT PERIOD 18

X INCREMENT = [illegible]
Y INCREMENT = .12E+03



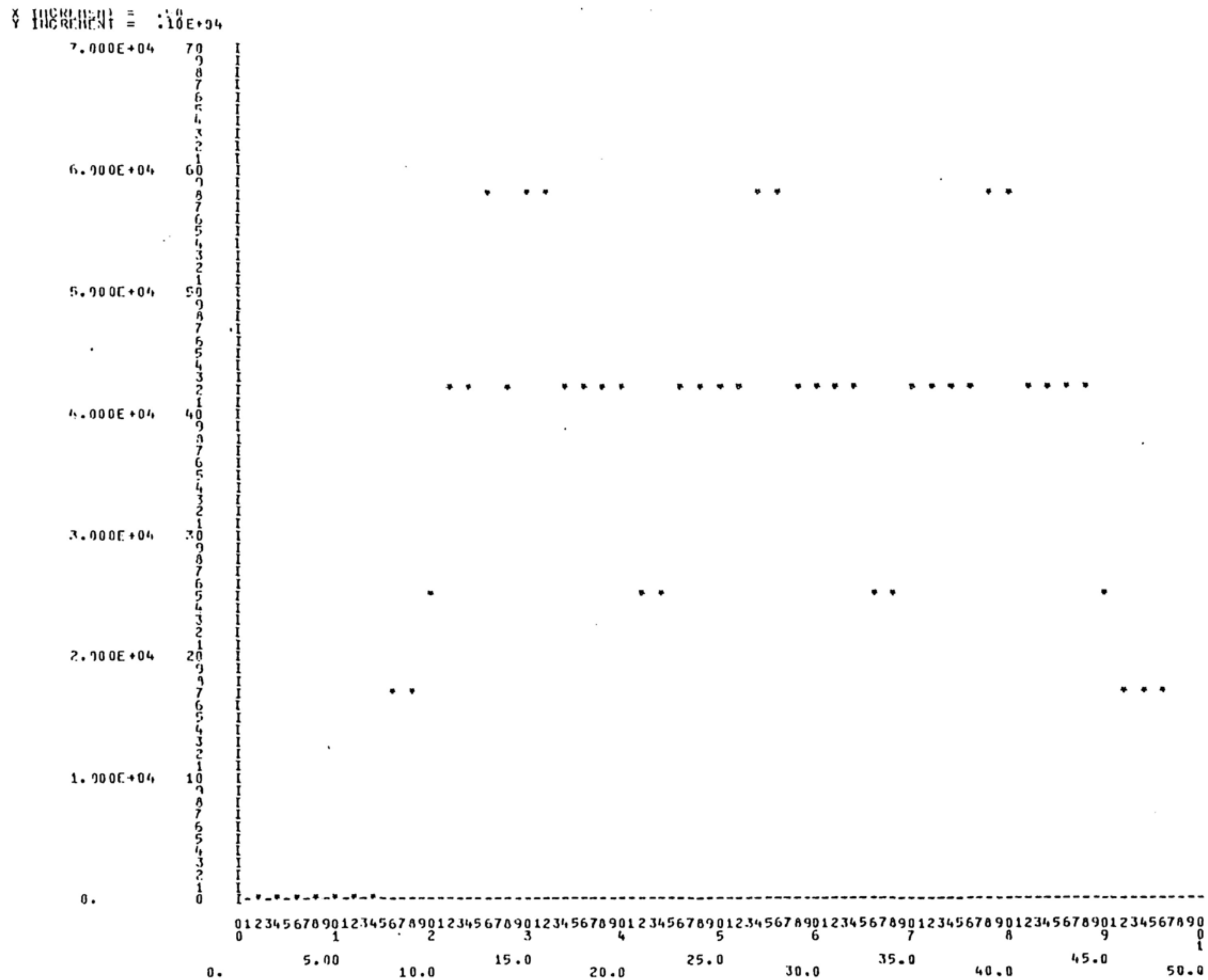
2J

INTERMEDIATE COMMODITY RESOURCES

MONTH	DIVISION 1	DIVISION 2	DIVISION 3	TOTAL
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0
4	0	0	0	0
5	0	0	0	0
6	0	0	0	0
7	0	0	0	0
8	16666.7	0	0	16666.7
9	16666.7	0	0	16666.7
10	16666.7	0	8333.3	25000.0
11	33333.3	0	8333.3	41666.7
12	33333.3	0	8333.3	41666.7
13	33333.3	16666.7	8333.3	58333.3
14	16666.7	16666.7	8333.3	41666.7
15	33333.3	16666.7	8333.3	58333.3
16	33333.3	16666.7	8333.3	58333.3
17	16666.7	16666.7	8333.3	41666.7
18	16666.7	16666.7	8333.3	41666.7
19	33333.3	0	8333.3	41666.7
20	33333.3	0	8333.3	41666.7
21	16666.7	0	8333.3	25000.0
22	16666.7	0	8333.3	25000.0
23	33333.3	0	8333.3	41666.7
24	33333.3	0	8333.3	41666.7
25	16666.7	16666.7	8333.3	41666.7
26	16666.7	16666.7	8333.3	41666.7
27	33333.3	16666.7	8333.3	58333.3
28	33333.3	16666.7	8333.3	58333.3
29	16666.7	16666.7	8333.3	41666.7
30	16666.7	16666.7	8333.3	41666.7
31	33333.3	0	8333.3	41666.7
32	33333.3	0	8333.3	41666.7
33	16666.7	0	8333.3	25000.0
34	16666.7	0	8333.3	25000.0
35	33333.3	0	8333.3	41666.7
36	33333.3	0	8333.3	41666.7
37	16666.7	16666.7	8333.3	41666.7
38	16666.7	16666.7	8333.3	41666.7
39	33333.3	16666.7	8333.3	58333.3
40	33333.3	16666.7	8333.3	58333.3
41	16666.7	16666.7	8333.3	41666.7
42	16666.7	16666.7	8333.3	41666.7
43	33333.3	0	8333.3	41666.7
44	33333.3	0	8333.3	41666.7
45	16666.7	0	8333.3	25000.0
46	16666.7	0	0	16666.7
47	16666.7	0	0	16666.7
48	16666.7	0	0	16666.7

THE MAXIMUM RESOURCE USED IS 58333.33 AT PERIOD 13

26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2.000E+04
1.000E+04
0.
0.
5.00
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
50.0

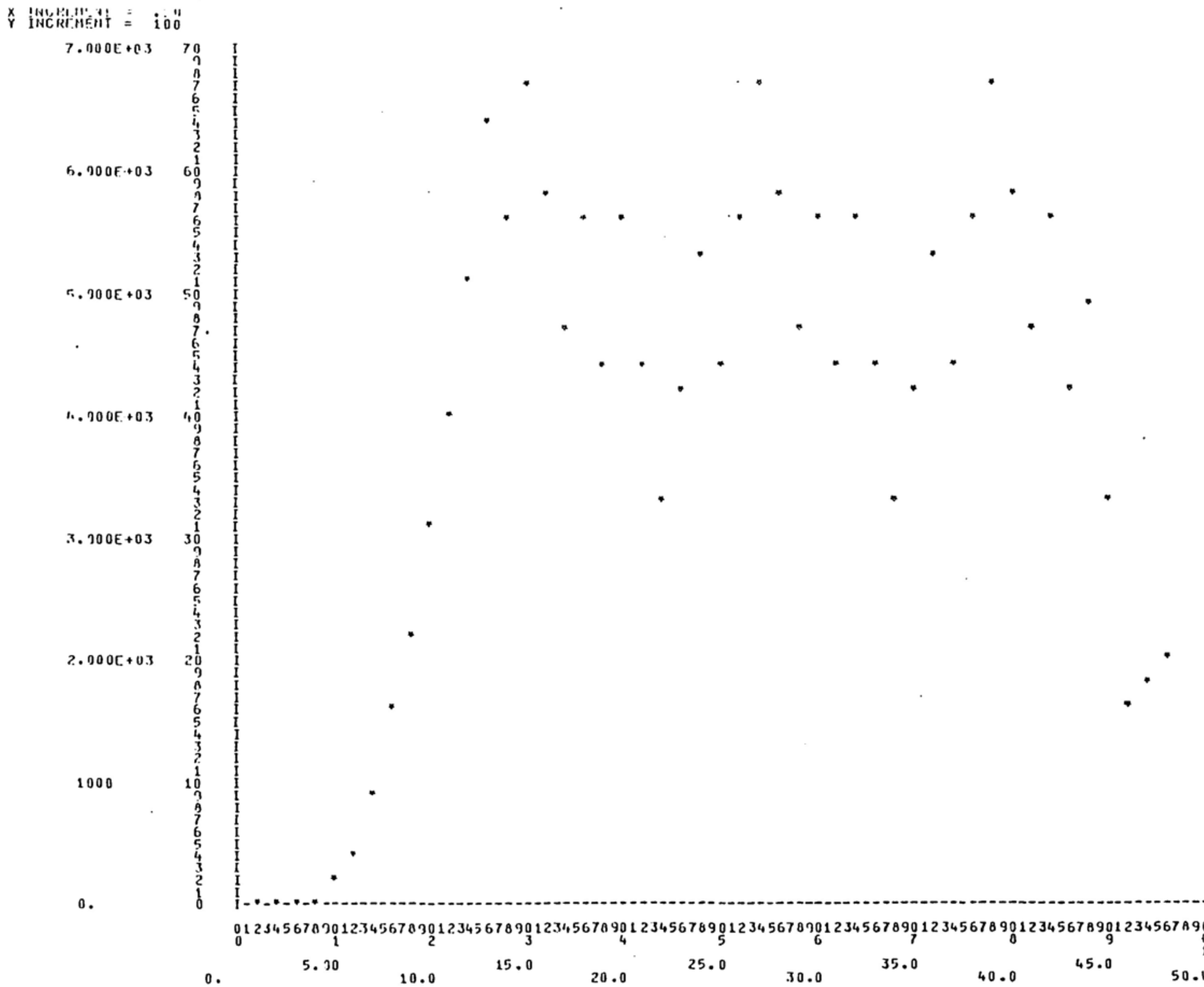
29

RESEARCH & DEVELOPMENT RESOURCES

MONTH	DIVISION 1	DIVISION 2	DIVISION 3	TOTAL
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0
4	0	0	0	0
5	222.2	0	0	222.2
6	444.4	0	0	444.4
7	666.7	0	222.2	888.9
8	1111.1	0	444.4	1555.6
9	1555.6	0	666.7	2222.2
10	2000.0	222.2	888.9	3111.1
11	2444.4	444.4	1111.1	4000.0
12	3111.1	666.7	1333.3	5111.1
13	3777.8	888.9	1777.8	6444.4
14	2222.2	1111.1	2222.2	5555.6
15	2666.7	1333.3	2666.7	6666.7
16	3333.3	1555.6	888.9	5777.8
17	1777.8	1777.8	1111.1	4666.7
18	2222.2	2000.0	1333.3	5555.6
19	2666.7	0	1777.8	4444.4
20	3333.3	0	2222.2	5555.6
21	1777.8	0	2666.7	4444.4
22	2222.2	222.2	888.9	3333.3
23	2666.7	444.4	1111.1	4222.2
24	3333.3	666.7	1333.3	5333.3
25	1777.8	888.9	1777.8	4444.4
26	2222.2	1111.1	2222.2	5555.6
27	2666.7	1333.3	2666.7	6666.7
28	3333.3	1555.6	888.9	5777.8
29	1777.8	1777.8	1111.1	4666.7
30	2222.2	2000.0	1333.3	5555.6
31	2666.7	0	1777.8	4444.4
32	3333.3	0	2222.2	5555.6
33	1777.8	0	2666.7	4444.4
34	2222.2	222.2	888.9	3333.3
35	2666.7	444.4	1111.1	4222.2
36	3333.3	666.7	1333.3	5333.3
37	1777.8	888.9	1777.8	4444.4
38	2222.2	1111.1	2222.2	5555.6
39	2666.7	1333.3	2666.7	6666.7
40	3333.3	1555.6	888.9	5777.8
41	1777.8	1777.8	1111.1	4666.7
42	2222.2	2000.0	1333.3	5555.6
43	2666.7	0	1555.6	4222.2
44	3111.1	0	1777.8	4888.9
45	1333.3	0	2000.0	3333.3
46	1555.6	0	0	1555.6
47	1777.8	0	0	1777.8
48	2000.0	0	0	2000.0

THE MAXIMUM RESOURCE USED IS 6666.67 AT PERIOD 15

(b)



Y INCREMENT = 100
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3.000E+03
2.000E+03
1000
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0.
5.00
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
50.0

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