SOME PROBLEMS IN THE ORGANISATION OF PLANNING IN MULTI-DIVISIONAL ORGANISATIONS: THE TENNESSEE VALLEY AUTHORITY AS A CASE ILLUSTRATION

Cyril Davies

August 1976 WP-76-26

2361
Laxenburg
Austria

International Institute for Applied Systems Analysis

Cyril Davies /bb
April 1976

SOME PROBLEMS IN THE ORGANISATION OF PLANNING IN MULTI-DIVISIONAL ORGANIZATIONS: THE TENNESSEE VALLEY AUTHORITY AS A CASE ILLUSTRATION

1. INTRODUCTION

This paper is concerned with the organisation of planning activities in large organisation. Planning is an essential activity that must be carried out by all organisations if they are to continue to exist in the real, unstatic world. However, the organisation of planning may take many different forms, from the use of large centralised planning units to a largely informal, unspecialised activity carried out at many organisational levels.

The main thesis of this paper is that there exist particular definable and qualitatively measurable factors that determine in any particular case the organisation of planning that will be most suitable. The centre of interest here is on problems which are peculiar to divisionalized structures, in which each division has a planning function which feeds into a planning function for the corporate whole. It is hypothesised that where the situations facing each of the divisions would lead naturally to the adoption of different forms of planning, pressures exist forcing them towards similar forms. In this circumstance one or more of the divisions will find itself with a poorly adapted system. At the corporate level difficult trade-offs will need to be made between maladaptation in one part of the organisation as against some other part.

Much of the paper is concerned with discussion of a theoretical nature characterising different ways of organising planning and the factors determining the suitability of one mode rather than another. However, the ideas are tested against the experiences gained from study of the Tennessee Valley Authority. The field work on the TVA was carried out by a team of IIASA scientists during 1975. The study was a wide ranging one covering management practices, strategy formulation, planning, use of models, environmental management and organisation structure. The information used here draws especially on the findings of study related to organisation structure and planning. [1]

In some papers on planning a somewhat narrow view has been taken. Planning has been equated with the formal procedures and methods followed in producing a 'plan' - a document which outlines allocation of resources between activities for a defined period ahead. This approach has sometimes supported statements to the effect that in particular organisations planning does not exist, or is hardly developed. According to the approach adopted here such statements arise because of a confusion between the essential function of planning and a particular way of organising that function.

We assume here that continued survival is a fundamental objective of almost all organisations. (Possibly, exceptions may be found where an organisation is set up to deal with some transient problem and does not intend to survive longer than the solution of that problem.) However, since no organisations can expect to exist in an unchanging world where their resources and demands for their outputs remain constant, organisations need to examine and choose between future options and take decisions consistent with that chosen option. The planning function is the process of searching for possible future alternatives which meet the organisations objectives, and elaborating these to support necessary current decisions about the future. Where a future alternative involves many different activities, the process of planning must take a holistic view, and consider the interactions of these activities one upon the other. This is integration and it is an essential part of the planning process. Planning may be carried out formally or informally, use or not use special techniques and may or may not be carried out by a specialised department.

In essence we are viewing planning not as an organisational form, but as an organisational function. This view follows the cybernetic model of organisation proposed by Beer [2], although we do not here follow Beer in adopting this model as a unique model for viable organisation. Also we include in the process of planning the formation of planning links between divisions of a corporation rather than distinguishing this as a coordination function. Section 3 of this paper identifies two completely contrasting ways of organising the planning function.

A basic proposition of the paper is that the organisation of planning most suited to a case depends upon two factors, referred to as technology and environment. These factors, whilst defined in many different ways, have been prominent in recent work on organisation structure. Whilst environment of an organisation has generally been related to planning, technology has not. Section 2 of this paper provides an explanation of how we are using the terms. Because our interest is with multi-divisional structures the environment is broken down into the external-to-the-corporation environment (which is what is generally meant by environment in organisation studies) and the corporate environment, i.e. the environment of any one division which is composed purely of other divisions. Some new conceptual ideas are presented for understanding the corporate environment.

To the extent that technology and environment can be taken to influence structure and procedures than for multi-divisional structures we have to recognise the possibility of a new problem. Where technology and environment vary over parts of a corporate structure, they may require varying organisational responses which could threaten the integrity of the corporate structure as a whole. Section 4 elaborates this. It seems that this aspect has remained generally unrecognised in the literature. An important exception is work by Lawrence and Lorsch [3], but they were dealing with a rather different situation to that described here.

By drawing on the ideas contained in the discussion of planning, technology and environment some specific propositions are proposed and are tested against the experience of the Tennessee Valley Authority. However, problems met transcend this particular case. For example, they seem equally relevant to cases arising in the field of regional development where one is dealing with a multi-organisation rather than elements of a single organisation, and they indicate gaps in scientific knowledge about organisation performance. These matters are discussed in the final section of this paper.

2. TECHNOLOGY AND ENVIRONMENT

2.1. Technology - Since the publication of Woodward's pioneering studies [4] showing that organisational structure in

a sample of industrial firms was best explained by considering the nature of the work process, many studies have sought to relate technology to structure. This work has been both concerned with extending the concept of technology beyond a narrow technological concept based on workflow, and with producing more easily definable and measurable concepts of technology. Perrow [5] was largely influential in extending the concept and applying it outside of the industrial sphere. He did this by relating technology to the level of routiness an employee meets in his job. Complex technology then becomes associated with lack of routines or uncertainty in a process, be it administrative or industrial. The concept of technology used here adopts this general approach but we follow Woodward in viewing technology as the property of a system rather than as operating on an individual level (re-Perrow).

According to the view taken here a process follows a simple technology when pre-programmed rules govern the relationships of the elements of the process one to another and when rules also exist to deal with exception situations. A complex technology allows the application of no such rules, or to the extent that such rules occur they are invalidated by an abundance of exception situations. In short, individuals in a complex technology will find themselves with low routiness, high uncertainty and perhaps spending much time searching for appropriate actions.

There is an explicit equation here of the technology of a process with its modelability. The ultimate in simple technology is where the whole process is modelable; for the extreme complex technology no part of it is. The interesting implication here is that technology is not an absolute measure but depends on the state of knowledge of the process. As understanding of a process increases so its technology (if this understanding is applied) becomes more simple. Landing man on the moon using wholly automated systems is a very simple technology task; where a human pilot has to be involved, the technology is considerably more complex.

2.2. Environment - In some sense our concept of technology characterises the internal space of an organisation. To characterise the external space we immediately become concerned with

environment. For the division of an organisation (or more generally a sub-system) there are two different relevant environments - the corporate environment (including other sub-systems of the same system), and the external-to-the-corporation environment. These two environments are worth considereing seperately because of the differences in degrees of control that can be exercised over them. The rules operating in the corporate environment are defined largely by the centre.

2.2.1. External environment - As with technology the influence of environment on organization has been the object of many studies but there is no generally accepted typology of organisational environments. A recent review article [6] drawing on recently published works suggests a typology which distinguishes 64 types of organisational environment. These 64 arise from a combination of 16 general environmental characteristics with 4 environmental movement characteristics. The 16 environmental characteristics are made up of combinations of the four binary categories: complex/non-complex, routine/non-routine, organised/disorganised, directly affecting/indirectly affecting. An enquiry into the nature of these categories suggests that they can all be contained within a reasonably wide definition of complex/non-complex. Here we characterise a complex environment as one that can take many states, each different state requiring a particular organisational response. Hence the organisation needs to maintain some significant level of effort monitoring its environment. Using this general notation of complexity the various other concepts referred to are not seperate dimensions, rather they characterise the sorts of conditions that may be expected in complex or non-complex environments. For example, we may expect that where the environment is non-routine (in the sense that it adopts states which cannot be dealt with by routine procedures of the organisation), where it is disorganised (in the sense that the entities with which the organisation must interact are nor organised into a few groups), and where the environment is indirect (in the sense that the organisation has reduced possibility for control over it), then we would expect to find a complex environment. Hence, this

reference is more useful in the guide it gives on how to go about recognising complexity rather than in producing dimensions of environment.

The concept of movement in an environment does, however, seem distinguished from the concept of complexity. Complexity refers to the number of states the environment may adopt and very high complexity may be accomodated by a high level of monitoring. However, movement is concerned with the way over time the environment switches between states. Where this is very rapid and very unpredictable monitoring the present may not be sufficient, although it may be necessary to sensitise the organisation to when change has occured. In this case highly flexible organisation response may be called for.

As we found with technology, we find with environment that its characterisation is not an absolute measure but is related to the availability of models. The number of perceived independent states of an environment is reduced as more advanced models structure relationships between them. An apparantly highly unpredictable environment may be easily managed through use of forecasting models.

2.2.2. Corporate Environment - Complexity is an appropriate dimension for characterising the corporate environment surrounding an organisational unit. It is then a measure of the number of other units in the larger organisation whose actions and outputs affect that unit, and the number of different states each of the other units can adopt. However, unlike the external environment the complexity of the corporate environment is dependent on corporate policy. The organisational sub-units of the system can develop links with one another to reduce environmental complexity. Such links may arise either spontaneously or as a response to corporate policy.

When one unit, say unit 1, considers forming links with another (unit 2) there are two competing factors that have to be taken into account, from the point of view of that unit. First, forming links will lead to a reduction in the complexity of the corporate environment. If changes in state of unit 2, significantly affect the ability of unit 1 to achieve its objectives

then this reduction of environmental complexity will be highly favourable to unit 1. However, against this gain there may have to be balanced costs if such links lead to a loss of autonomy of unit 1, in particular a loss of flexibility in responding to changes in the external environment. If changes in the external environment of unit 1 are more critical for its achievement of objectives than changes in the state of unit 2, the cost of linkages may be greater than the benefits. Considerations of this type determine the extent to which unit 1 seeks to form linkages to reduce the complexity of its corporate environment. However, the extent to which it will be able to form links in practice, in a situation unconstrained by corporate policy, depends upon the cost/benefit balancing from the point of view of the other units 2.....n, with which it may seek to form links. In this respect the environment may be characterised according to whether it is highly balanced or highly unbalanced. A balanced environment is one in which the unit is able to form links to the extent it desires to. An unbalanced one is where the value trade-offs on linkages made by other units do not correspond to that of unit 1, so that it cannot form as extensive links as it wants. We assume that in an unconstrained situation links are formed only where they are perceived as beneficial by both units being linked. This dimension of balance is added to the dimensions of complexity and change to characterise the corporate environment.

3. CHARACTERISATION OF PLANNING SYSTEMS

The way in which planning is organised can be characterised on a spectrum which at one extreme has what we designate as top-down analytic systems and at the other extreme bottom-up synthetic. The terms refer to the nature of project generation in the case. Typical organisation for these extreme types differ in use of models, use of specialised planning departments and often on the formality of the planning process.

3.1. Top-down Analytic Systems - Top-down analytic systems are ones in which future activity options are generated in a central planning unit and are described initially at a high level of aggregation. A large part of the planning activity is concerned with the elaboration of an option by breaking it down into activities for the different operational units of the organisation - this is

the significance of the term analytic. A strength of this mode of planning is the high degree of integration between sub-activities it allows (since they are all elaborations of a single aggregate set). This may be crucial when activities are very highly inter-dependent. However to achieve this integration it is necessary that the interactions between activities be well understood. Without this understanding the splitting down of aggregate activities into components cannot be supported. An illustration of this is found in economic planning. Through the use of input-output type models a very high degree of integration becomes in principle possible using top-down planning systems. Without such models the degree of integration that the system potentially allows cannot be achieved. Understanding the interactions of a process, and its behaviour with changing inputs is, according to our terminology, a characteristic of simple technology. So top-down/analytic systems are most suited to simple technology.

A potential weakness of such systems is a lack of responsiveness to environment. This is because in many situations a central planning unit may be limited in the signals it can handle from the environment. This is but a simple application of the Law of Requisite Variety [7]. In practice therefore top-down systems may be most suited to fairly simple environments.

3.2. Bottom-Up Synthetic Systems - Bottom-up/synthetic systems are ones in which future options are generated at the lowest levels of the organization. These pass up the organization to a planning unit that will generally be smaller than in comparable systems in which a top-down system operates. The planning process is one of adding together (synthesising) and integrating at each stage proposals from lower down. Because the initial proposals may have been generated taking into account very different sets of local needs the process of integration may be a difficult one to manage. Even where interactions between activities are well understood that system does not allow easy application of models or rules for integration. Thus where interactions are extensive and understood this difficulty may operate decisively against bottom-up systems. However where

interactions are not well understood, that is the technology is complex, bottom-up systems may have the advantage. This is because the system pushes questions of integration down to operational levels of an organization where intuitive understanding of complex interactions is likely to be better than in a central unit.

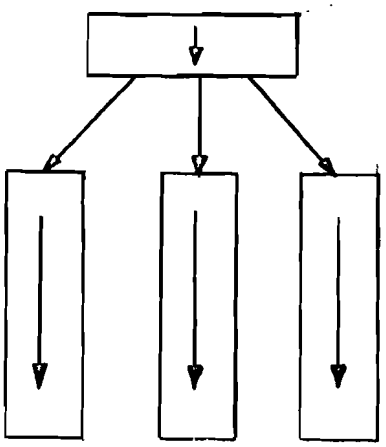
The major advantage of this system of planning is the responsiveness it allows to complex environments. The capacity to monitor environment is not here limited to the capacity of any one unit, but can draw upon all of the employees of the organization.

The discussion on environmental characteristics used the two concepts of complexity and change; complexity refers to the number of states the environment might adopt, and change to the way it shifts between states. Of course all environmentswhose complexity is greater than unity change but differences occur in the rates with which they move between states. The movement in a simple environment may be greater than in a complex one. High, unpredictable change rates cause problems whatever planning system one uses. Ultimately an organization may be forced into highly robust strategies which have the effect of reducing the change characteristics of the environment. This is because when we think of organizational environment we consider not everything in the environment but only things whose change of state affect the organization. As soon as a strategy is designed which is unaffected by the movement of some rapidly changing element in the environment, that element is no longer considered as part of the environment. To the extent that such strategies reduce the complexity of the environment they favour moves towards top-down systems. However the complexity of the environment of a robust strategy may still be very high. The alternative to this is for the organization to adopt a highly opportunistic approach in which planning to achieve objectives is abandoned in favour of developing a very fast response to current opportunities. However this is possible only with organization objectives of a very special nature.

In all this discussion it is recognized that the description

of both top/down and bottom/up systems, an extreme type is presented which will not be found in practice. All real systems will embody iterations and information flow both up and down. So that in bottom/up systems, some filters will be specified from the centre outlined the type of projects which are consonant with the organizations objectives. In top/down systems the central generation of a plan will be supported by information from operating levels. However real systems can be classified according to the type to which they predominantly correspond.

3.3. Planning in Multi-divisional Organizations - The comments on planning so far are related to any autonomous unit. The focus on planning in this paper is on particular problems of planning in a multi-divisional organization. The characteristic of the planning environment of one division of such an organization is that part of its environment is formed by other units in the same corporation. If the corporation is to have meaning as an entity then some degree of integration between divisions is required; links must be formed across the corporate environment. Using the designation of planning systems as top/down or bottom/up, four situations can be distinguished.



1a

Figure 1 Possible Configuration of Planning in Multi-divisional Organizations

Here a central top/down system is used at the corporate level. From the point of view of planning the whole organization exists as a single body; planning is effectively not divisionalized and the nature of the corporate environment of any one division need not be considered.

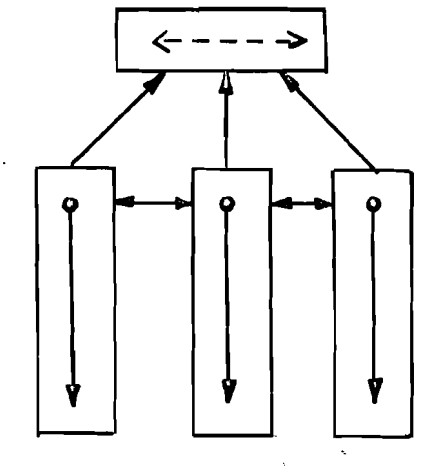


Figure 1b

Top/down systems are used within divisions but the integration between divisions is handled at the divisional level. In essence viewed from the corporate level the system is bottom/up. This is a rather unlikely model to occur in practice; it combines the disadvantages of top/down systems (namely, difficulties in responding to complex environment) without the advantages of ease of integration at the corporate level. Nevertheless it is a possible model and if the corporate level does not play an integrating role then each division must take account of its corporate environment in generating its own choices for the future. Links between divisions are thus required for planning purposes and these appropriately occur between the planning units. Whether such links will occur spontaneously to a degree that reflects the corporate trade-off between overall integration and divisional flexibility depends on whether the corporate environments are balanced in the sense used above (Section 2.2.b). When environments are balanced

the appropriate level of linkages will arise without the support of formal mechanisms. When this is not so the corporate interest requires that links be formalized.

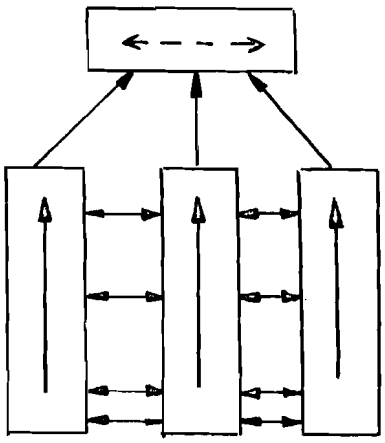


Figure 1c

In this case all of the divisions of the corporation follow bottom/up modes of planning. A corporate office may have some role in integrating planning proposals coming up from the divisions but the nature of the planning mode requires that the bulk of integration occurs lower down. In this case, as in the last one, a division must take account of the corporate environment, and planning links between divisions will be necessary. Here the links need to operate at many levels - since there is no single level that has responsibility for planning. Whether or not the necessary links will arise and be supported informally depends again on the extent of balance in the corporate environment. If the environment is unbalanced then formal mechanisms laid down at the corporate level will play an essential role in achieving integration across divisions.

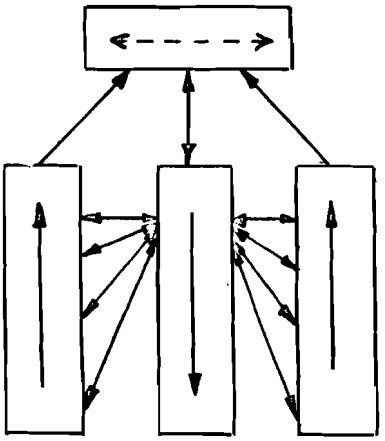


Figure 1d

This case is a mixed situation in which some of the divisions operate top/down planning modes while others operate bottom/up. It is a case which is of great interest here. A central thesis of this paper is that while it may reflect the different needs of the various divisions, in practice it is subject to overwhelming difficulties of implementation. Viewed from the corporate level there are two main resons for this. Firstly, to the extent that links must occur between divisions across the corporate environment, they need to connect a planning office in one division to several levels not especially identified with planning in another. However the temporal dimension of planning, its perceived purpose, and the outlooks of the people involved ('planners' on the one hand - scientists, managers, administrators on the other) are likely to be so different that these links cannot be satisfactorily specified or supported.

Secondly, at the corporate level, there may be difficulties in designing a planning interface that is satisfactory for dealing with divisional plans generated in such radically different ways. The corporate input to a top/down divisional system may be quite different to the input to a bottom/up system. Of course two separate interfaces could be created, but if divisional proposals interact, the effect of this is just to push the interface problem elsewhere.

There is a further anticipated problem, behavioral in nature. The mode of planning used in an organization may be an important factor governing the corporate self-image. There is a tempting (but not always justified) equation of bottom/up systems with an informal, decentralized style. Top/down systems sometimes suggest the opposite. At the corporate level a strong identification may exist with one or other of these styles. This corporate self-image may be an important factor in choice of planning system. It would naturally tend to favour a particular mode used more or less uniformly across divisions.

4. PLANNING, TECHNOLOGY AND ENVIRONMENT

The ideas presented in the previous sections are brought together and summarized in Tables 1 and 2.

We can go now to examine the case of the Tennessee Valley Authority. Data from this case will alow a test to be made of four of the propositions contained in the tables. These are:

1) Bottom/up planning is well adapted to complex technology in a complex environment
2) Bottom/up planning is not well adapted to simple technology in a simple environment
3) Informal links for planning coordination are adapted only to balanced environments
4) Factors operate against the operation of several modes of planning within a corporation.

Table 1 Divisional Preferences

Type of System	Environment		Technology	
	Complex	Simple	Complex	Simple
Top-down	Difficulty in monitoring environment	Good	Difficult to achieve integration	Good
Bottom-up	Good	Redundancy in information flows	Integration aided by process understanding at low level	Difficulty in achieving high integration

Table 2 Corporate View

Corporate level	Divisional Planning Systems		
	Bottom-up	Top-down	Mixed
Corporate planning	Limited function possible	Central corporate planning desirable	Difficulties in establishing mode and interface
Links between divisions	Depends on 'balance' Formal means where balance is low	Not necessary if central corporate planning operates	Difficult to define and implement

5. TENNESSEE VALLEY AUTHORITY

5.1. Corporate Stucture - The TVA is a federal agency created in 1933 by an Act of Congress. Its early objectives were to improve the quality of life in the Tennessee Valley region through harnessing the powers of an uncontrolled river system - the primary activity was dam construction to provide flood control, navigation and hydro-generation of electricity. Improvement of local agriculture was also a main concern. The TVA has remained a multi-purpose agency; though its power generation activities now employ a very large percentage of its staff and over 90% of its investment, it is concerned also with environmental quality, agriculture, support for local communities and other such things.

To manage such diversified activities the TVA has adopted a divisionalised corporate stucture. At the centre is a three-man board concerned with policy, and under it an office of the General Manager. This office contains a planning and budget staff, and is supported by service divisions (personnel, purchasing and so on). A full description of the structure is given in the paper by Tomb [1a]. Figure 2 shows the current organisation chart.

The major planning effort in the TVA is delegated to the operational divisions. The planning cycle used in the TVA is described by Tomlinson[1b]. It embodies three main elements leading to the submission of a programme to Congress for approval.

The first element of the cycle is the production of a "Situation Assessment" by each of the divisions. This is supposed to be a wide-ranging assessment of the problems and opportunities facing the division. The divisional environment, both external and corporate, is reviewed here. In producing this document staff at all levels in the divisions are involved. It is a procedure capable of monitoring a highly complex environment.

Situation Assessments are reviewed by the corporate planning staff. Any modifications in the divisional pictures of problems and opportunities required by corporate interests are fed in here. The next stage is the production by the divisions of a summary planning document covering the period 5-10 years ahead. This plan is based upon the Situation Assessment.

After corporate review the summary plan is elaborated by the divisions into detailed 5-year budget submissions.

It is, however, not possible to understand the true nature of this process without inquiring into the capacity of the corporate planning unit to review at each of these stages. The office concerned with review has very few staff, and accepts its lack of capacity to achieve real integration. Its review of Situation Assessments is limited to reading them and identyfying gross conflicts of interest. No formal procedures are used for recognising less evident or potential interactions. At the corporate level the Situation Assessment procedure has been justified in terms of the benefits it conveys on the divisions in having to make this wide ranging review. The marked absence of planning capacity has led Tomlinson to characterise the whole process as 'a magnificent body without a brain.' (1b)

It seems clear that in our classification of corporate planning systems described above (3.3) the TVA sees itself clearly as Case 3: bottom-up planning in divisions with the integrating load undertaken at divisional level. This implies planning links are necessary between divisions, and it is recognised at the corporate level. To achieve this a system of 'self-coordination' has been adopted. This system requires that when one division is including in its plans an activity that has an effect on another division, the plan should be discussed between divisions, and conflicts resolved at that level. However, no rules are laid down for this. It is up to the initiating division to decide where the interactions occur, and no sanctions appear to operate if it does not 'self-coordinate.' Hence as it appears to operate the policy of 'self-coordination' cannot be viewed as a formal procedure supporting links between divisions. Links will be formed where both of the agencies involved see it in their interest, and will not in other cases. In such circumstances corporate need for integration will only occur where the corporate environment perceived by divisions is balanced.

5.2. Planning in Divisions - We have indicated that the corporate preference is for bottom-up divisional planning, and integration between divisions occuring informally. The field-study on the TVA allowed the possibility for two divisions to

assess how far this occured in practice and how well the mode of planning was suited to their needs. The divisions studied were the Division of Forestry, Fisheries and Wildlife Development and the Office of Power. They were selected because of the contrasts they provide in many of the characteristics of interest to us. Fuller organisational descriptions of these divisions is given in the Paper by Davies (1c).

5.2.1 The Division of Forestry, Fisheries and Wildlife Development

Nature of Workload and Environment

The broad objectives of this division are to develop wildlife, fisheries, forests and recreation for the benefit of the region. It has close relationships with state, federal and other bodies and its means of implementaion are primarily through demonstrational and educational means.

The technology of the workload in our terminology can be characterised as complex. Many divisional staff seem to be working in areas where new situations constantly arise and which require decisions to which no readily available rules can be applied. Staff with a range of scientific and other skills work in the division and many of the seperate tasks require inputs from these different skills. However, in complex natural resource systems there are few models which adequately describe the problems, and which can structure the relationships of the different types of contributions.

The external environment is similarly complex. The division's activities relate directly to the quality of the life of people in the region. Hence it needs to be aware of the needs, expectations and preferences of the Valley communities. The relevant environment also contains many special interest groups concerned with fishing and forest management, and other research groups. Few models are available to effectively reduce the number of states the environment can take. Community values in particular are difficult to predict.

In discussion above (2.2.1) on environments, three factors were taken to militate towards complex environment - unorganised, unroutine and indirectly affected. While to an extent the environment does consist of organised groups, there appear to be

many such groups and the interests of individual members of the community must be remembered. Changes of state in the environment cannot generally be dealt with by a routine response, and the division has only indirect means - education and demonstration - to influence the state of the environment. We, thus, find in the environment of the division all the factors that support a view of complexity.

We find a complex corporate environment also, programmes of the division affect and are affected by the programmes of other divisions. The corporate environment is conveniently divided into two parts.

In one part the interaction occurs because of complementary responsibilities in the general area of environmental (in the wide sense) quality. In this area development and investigative studies by the division often depend upon skills and interests found in other divisions (for example, concerned with environmental protection, water quality, agriculture). Hence, the interaction is very high and by forming links benefits may be significant. The other side of the coin is a loss of autonomy by forming links. There seems reason to believe that this is not very important. While the division needs to remain responsive to a complex environment, where projects interact with other divisions they are facing largely a similar environment and would need to react in a similar way. Also the other divisions involved appear of roughly similar size and influence so no undue loss of autonomy would result from influence differentials.

The conditions seem such that the division would favour a high level of links with these other divisions. While no detailed study of these other divisions was possible, the situation from their point of view should be essentially similar. This part of the corporate environment seems therefore to be balanced and favourable to planning links.

The second part of the corporate environment is that composed of the Office of Power. A substantial portion of the staff of the division are employed on work which is of direct interest to, and charged to, the Power programme. Major examples of this are monitoring of fish stocks in water reservoirs

around power stations and responsibility for supervising land reclamation by coal suppliers who use strip-mining methods. These activities clearly affect the power programme (see below) but they are defined by corporate policy and the plans of the Office of Power do not neccessarily affect the division in carrying out these projects. Hence the interaction between th activities is not reciprocal. Also through forming links the division may lose autonomy since the Office of Power is by far the larger unit and is also the 'paying agency.'

We therefore have a situation in which the environment seems to be highly unbalanced. We would expect the division wants to form fewer links than the Office of Power wants to form with it. However, in a situation where no rules exist requiring such links to be formed, they will not be formed and we would not expect to detect disatisfactions within this division.

Planning in Practice - From discussions with senior divisional management down to some heads of individual projects a strong impression of satisfaction with the planning system was received. The Situation Assessment procedure was viewed as being highly appropriate to the needs of the division. In its own manual on planning procedures emphasis is laid on the needs for employees at all levels to be involved, and also for employees to seek opinions from outside of the TVA. The manual justifies this in terms of the diverse nature of its activities. Indeed prior to the system being institutionalised on a TVA-wide basis, the division was itself adopting a similar procedure.

In its links with other divisions similar satisfaction was expressed. Close links are maintained with other divisions operating in the 'environmental' areas. At times these extend to inter-divisional projects, although interestingly no formal procedures exist for setting up such projects. Their management is handled informally. With respect to the Office of Power some concern was expressed about the percentage of the division's activities which are funded by the power programme and the adoption, sometimes, of a narrow view by the Office of Power on what the scope of these activities should be.

Generally the absence of 'bureaucratic' procedures in the TVA was welcomed. The highly informal mode of planning was seen as adequate and appropriate to the division's needs.

5.2.2. The Office of Power: Nature of Workload and Enyironment

The Office of Power is a multi-divisional unit concerned with the power programme. It is responsible both for generation and transmission of electricity, and for planning new capacity to meet future demand. A primary objective is to ensure that power is sold at the lowest possible rate.

Although a power system is very complicated from the engineering point of view, in our sense of the word it is not a complex technology. Most of the operating decisions that must be made and some aspects of planning are routine in nature. Rules will have been established to deal with the range of contingencies which are likely to occur. Like other large power utilities the Office of Power is characterised by its high use of computer based models many of which can be used directly in decision-making. Such models can be used to integrate much of the work of different parts of the Office. Hence, human discretion in dealing with uncertainty or new situations is far less evident than in the previous case.

The Office's main interaction with its external environment arises through provision of electricity. The TVA does not itself supply end users but distributes to local distribution companies. This environment consists of a limited number of organised groups which the Office of Power directly affects, and it is a routine interaction. These characteristics we have noted as being suggestive of a simple environment.

Although the Office does need in its planning to consider future demands for electricity, and there are many millions of individual users who may all act differently, in reality adequate models exist to forecast future demands.

The corporate environment of TVA takes in almost all of the other divisions. For some activities, e.g. station construction and control of water release for hydrogeneration the interactions are so primary that formal links do exist relating to planning and operation with the responsible divsions.

However, with many other divisions the relationship is one in which these other divisions are undertaking development or investigative work which in the present or future will constrain the area in which the Office of Power can freely

operate. In one way or another these activities all relate to the quality of the physical environment. They are charged to the power programme and their outputs can possibly increase costs of power generation but the projects are generated and controlled largely by the other divisions. The Division of Forestry, Fisheries and Wildlife Development is one of these. Following a similar argument to that applied to this case one can expect that the Office of Power finds itself in an unbalanced corporate environment in which linkages will not arise spontaneously to the extent that it would wish.

Planning in Practice - At the time this Office was visited it was suffering through problems due to the rise in price of coal, problems with the introduction of nuclear capacity and much reduced future demand forecasts - all of which directly or indirectly act to increase the cost of a unit of electricity generated. It was, therefore, to be expected that it would be especially sensitive to added problems that it perceived as arising through having to follow TVA procedures. Its links with other divisions provide one example of this. Self-coordination was felt not to be working and worries were expressed that insufficient balancing occured between TVA power objectives and some of its environmental ones. Other divisions were said at times to generate projects which added unneccessarily to power costs, and that these projects go ahead without sufficient opportunity for the Office to comment. The Situation Assessment produced at this time contained instances of this. In fact some moves have been taken to strengthen 'self-coordinaion' as it relates to this type of project. Other divisions are now required to submit projects charged to the power programme. However, it is still not clear what sanctions could be used against divisions which do not comply. Nor do conflict resolution mechanisms seem to have been built-in to the strengthened procedure.

In its internal planning the Office follows through an essentially bottom-up procedure. No central planning unit exists and although model systems are being developed which would allow central planning to operate there were no current plans to form such a unit. However, some problems are recognised with the bottom-up procedure. A Situation Assessment is

produced and many levels in the Office are asked to contribute. But we were told that the results of extensive participation are somewhat disappointing and produce relatively little. Some disaffection with the procedure by employees was mentioned but we were not able to confirm this. It was said that despite the bottom-up procedures much of the substance of the plan of the Office was generated at a senior level.

We find in the Office a curious contrast between form and substance. The form of planning is bottom-up, the substance seems to be largely top-down. And we find also some resistance to adopting forms which make the top-down mode more explicit and perhaps more efficient, for example, through setting up of a central planning unit.

5.3. Conclusions of TVA

The empirical evidence from TVA, although largely unstructured and qualitative, seems to support fully the propositions made in Section 4.

The bottom-up system is meeting the needs of the complex technology and environment of the Division of Forestry, Fisheries and Wildlife Development, but not of the much simpler environment and technology of the Office of Power. Moreover the unbalanced corporate environment the Office of Power finds itself in has left it unable to achieve a satisfactory integration of its plans with those of other divisions. Curiously, despite the perceived lack of appropriateness of the planning system it uses, we found no plans to re-organise the form of planning although developments in the modelling field would support this. No tangible reasons could be found for this reluctance - it was said to be not how TVA operates. In fact the ideas we have developed in Section 3.3 are essentially consistent with this; there is a need for some degree of corporate wide consistency.

However, given such a need it is reasonable to speculate on why the corporate system should be so different from one which meets the needs of the Office which forms such a large part of the total operation.

One reason may be that central planning systems are not universally accepted as legitimate in the US setting. While

a private power utility may not be bound by this, a federal multi-purpose agency in a somewhat sensitive political position may have to.

Another reason could be the view held by top management of the corporation of what TVA is essentially about. There is certainly a strong reaction against the proposition that TVA has become just another power producer. The design of systems clearly most suited to its non-power activities could be an unconscious rejection of this proposition which is so much supported by a narrow look at, say, sources of the TVA funds.

Yet another reason could be that TVA policy makers perceive the costs (in efficiency, adaptation, staff motivation) of 'under-centralising' and much less than the costs of 'over-centralising'. Since not all needs can be met by one system, the system used may be thought of as the best compromise. The present state of knowledge in organisation science does not allow us to test this hypothesis - a gap that will be discussed in the overall conclusions to this paper.

6. Conclusions

The work carried out has indicated the usefullness of using the concepts of technology, environmental complexity and balance in understanding the organization of planning systems. For organizations having a fairly uniform technology and environment these concepts could be of value in organization design. However where technology and environment are not uniform across the organization's activities we have found some support for the proposition that the form used involves a complex trade-off. Organization science cannot contribute to this trade-off until it progresses beyond qualitative analysis to provide some measure of the costs involved with different types of mal-adaptation - in this case 'overcentralization' of planning as against 'under-centralization'. Such measures do not appear to be in sight.

The discussion here has been limited to a fairly simple organizational system, where the subsystems are divisions within a corporate structure. For many important problems no such simple organizational system exists. In cases of energy system management, environmental management and regional development (to list some important examples) the organizational subsystems will generally not belong to one corporate structure, and no single body may have overall planning responsibility. We are then faced not only with subsystem-system interfaces, but with interfaces between different elements at the same system level. However despite the added difficulties this presents for analysis the ideas presented in this paper would appear to be equally relevant. The application of them particularly to the regional development context forms a part of current IIASA research concerned with organization for integrated regional development. [8,9,10]

References

1. Report on the Study of the Tennessee Valley Authority IIASA - to be published

1a. Tomb, J. "Organization Structure of TVA"

1b. Davies, C. "Case Studies of Two TVA Divisions"

1c. Tomlinson, R. "Planning in the TVA"

2. Beer, S. "Brain of the Firm" Allan Lane 1972

3. Laurence, P.R. and Lorsch, J.W. "Organization and Environment" Harvard 1967

4. Woodward, J. "Industrial Organization, Theory and Practice" Oxford 1965

5. Perrow, C. "A Framework for the Comparative Analysis of Organization", American Social Review 1967

6. Jurkovich, R. "A Core Typology of Organizational Environments" Administrative Science Quarterly 1974

7. Ashby, W.R. "Introduction to Cybernetics", Wiley 1956

8. Davies, C., Demb, A., Espejo, R. "An Overview of Organizational Research in Regional Development" IIASA WP-76-14

9. Espejo, R. "A Method to Study the Organizational Dimension of Regional Programs" IIASA WP-76-14

10. Davies, C. "A Force Field Approach to Assessing Organization for Regional Development" IIASA WP-76-15