

MULTI-ORGANIZATIONAL STRATEGIES:
AN ANALYTIC FRAMEWORK AND CASE ILLUSTRATIONS

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ABSTRACT

Last November the Management and Technology Area had its Status Report on the results of its research activities during 1976. The present Research Memorandum is the report that the internal 'Organizations Group' of Management and Technology presented.

Two different case studies are reported. The first one is concerned with the Impacts of Oil Development Off-shore of the North East Coast of Scotland. While presenting some of the findings specific to Scotland, our main intention with this part of the paper is to convey the methodology we have developed to study the organizational dimension of large development programs. This methodology is used in the second part, the Bratsk-Ilimsk Territorial Production Complex case study, to do the analysis of a particular policy issue today under the attention of Soviet policy makers, namely the need for new management mechanisms to support the present evolution of Territorial Production Complexes.

MULTI-ORGANIZATIONAL STRATEGIES

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INTRODUCTION

The two papers which make up this report introduce and illustrate the use of an analytic framework which has been developed to support organizational strategies for the planning and management of multi-sectoral programs. The programs discussed here are both examples of regional development, but the issues addressed have a direct relevance to programs of many other types.

Many of the problems with which societies are confronted today transcend the scope of existing institutional capabilities. The energy crisis, or problems of pollution, or providing food for growing populations, as well as regional development are recognisably problems of this type. Approaches to their solution have generally been conceived in terms of 'programs.' Many types of input are combined in the process of program substantiation, some of which, such as technical inputs differ significantly according to the nature of the program. By contrast, management issues of planning and implementation arise irrespective of the particular problem area addressed.

Despite the universality of this organizational dimension, scientific support for multi-organizational strategies has been very limited. In comparison with the inputs of the technical disciplines, there is a marked absence of systemic analysis of organizational issues in many cases. Reasons for this can be readily seen. Programs generally involve the interactions of many organizations whereas much research in the 'organizational sciences' focusses on problems within single organizations. Organizational strategy more obviously than technical strategy is dependent on societal values. In addition, of course, organization has to reflect the particularities of the specific program under consideration. Theoretical approaches general enough to meet these needs yet also directly capable of supporting a policy process have not been available up to now. The two papers contained here attempt to demonstrate progress which has been made towards this end within IIASA.

The papers represent summaries of more extensive studies within the Management and Technology Research Area and were presented at an internal IIASA Status Report in November, 1976. Within the larger tasks of the M & T Area the authors have been focussing upon organizational issues. The first paper relating to Scotland reports on a limited study initiated by the authors and originally conceived as addressing only organizational issues.

Recently the study has been extended by other IIASA scientists to include environmental factors. The paper on the Soviet case relates to a much larger study within the M & T Area which involved from the outset considerations of development strategy, use of mathematical models and environmental issues as well as planning and management. In the Soviet study we had the benefit of substantial interaction with Soviet scientists. It is more realistic to view this study as contributing to a particular policy issue which is current in the Soviet Union, although the role of IIASA was not one which required or allowed any direct inputs to Soviet decision makers.

The difference in the status of the two studies is reflected in their presentation in the accompanying papers. The narrower scope of the Scottish case and the definition of program objectives by the researchers rather than policy makers precludes its use as input to an on-going policy process. Instead, in the very abbreviated form reported here we use this case to introduce the basic elements of our analytic framework and to illustrate the use of that framework in approaching policy issues. Our intent is to provide a feel for the types of new insights to be gained from such an analysis and the nature of its use in generating policy alternatives.

In the Soviet case the elements of the framework are used more directly in the mode of policy assessment. The organizational issues identified are of current concern in the Soviet Union. The policy alternatives we examine have been suggested by different groups within the Soviet Union and thus we can assume that on the basis of political and other considerations each is more or less a feasible alternative. We focus our attention, then, on the degree to which each satisfies the organizational challenges posed by the program.

The brevity of the two papers precludes their representing in any way a comprehensive report of either study. The aim of the original presentations and of this report, is to provide an overview of the progress which has been made in providing scientific support to policy making in this area. For each of the case studies and for the methodological approach documentation is, or will shortly be, available. [1,2,3]

SCOTLAND: AN ORGANIZATIONAL ANALYSIS OF THE IMPACTS
AND OPPORTUNITIES OF NORTH SEA OIL

The aim of this discussion is to demonstrate the application of a framework for analyzing the organizational dimension of complex programs. With the Scottish case we hope to illustrate the potential of the framework for generating policy alternatives designed to facilitate the achievement of program objectives. Our aim in this discussion is methodological, rather than conclusive with respect to Scotland. The methodology is oriented to support policy-makers in their efforts to make organizations effective in the implementation of complex, multi-sectoral programs. In this and the Bratsk case which follows, we focus particularly upon regional programs.

The Setting

Before turning to a discussion of the framework itself, let us draw a general picture of the setting to which it will be applied. Scotland, as you know, is one of the four countries which comprise the United Kingdom. For purposes of this case it represents the region under attention.

For many years Scotland's economic situation has been declining; the region around Glasgow which includes much of the population and industry of Scotland is one of the most severely affected. Much of its basic industry is outdated; the rate of unemployment has been double the U.K. average for decades; and in general, it has not been capable of sustaining a growth economy. The discovery of major oil deposits off the north-east coast of Scotland in 1970 presented new opportunities for a better economic future.

Capitalizing upon these new opportunities meant the incursion of significant side effects, many undesirable. In several areas of Scotland, UK policy to exploit the oil resources rapidly has meant important environmental and social impacts. Figure 1 identifies some of these areas. Our observations, in conjunction with the published opinions of other researchers, lead to the identification of two management challenges which arise for Scotland in the context of this rapid exploitation of oil resources off its north-east coast.

The challenges can be phrased in terms of the time horizons for which they are relevant. The short-term challenge focusses upon the immediate impacts to local communities posed by the oil exploitation. Demands for immediate onshore support of exploration and platform construction are faced most often by small settlements in the north-east with no industrial tradition. Traditionally they have been primarily agricultural and fishing communities. Demands for infrastructure, and lucrative new job opportunities, are resulting in major upheavals in the lives of these communities, both socially and economically. The new activities threaten the quality of life in these impacted

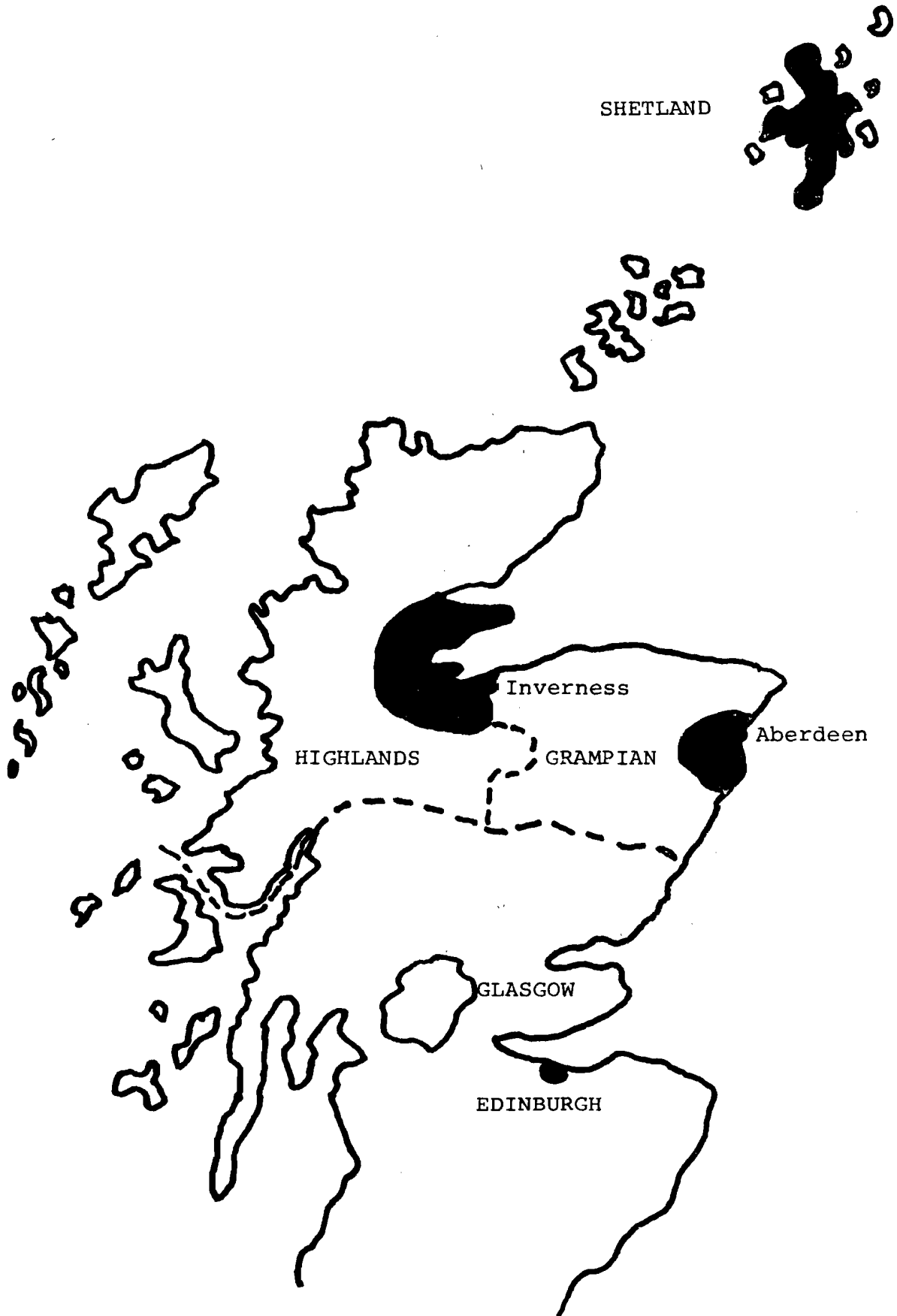


Figure 1: Some Areas with High Impacts from Oil Development

communities, while at the same time facilitating current U.K. policy of rapid oil exploitation.

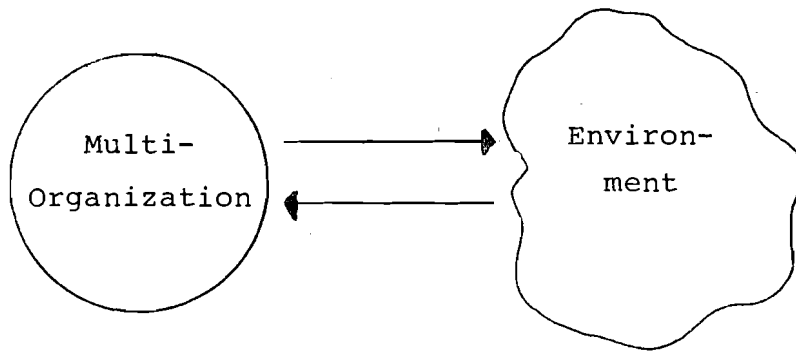
The long-term challenge focusses upon the opportunities oil presents for the future economic development of Scotland. The oil impact, in economic terms is basically an impulse function. For the moment it is creating jobs and economic activity; yet much of this activity will last only as long as exploration and construction activities continue. A decade hence, by the end of the 1980's, the direct economic benefits of oil to the general economy of Scotland will be substantially lower. The long-term challenge, then, is to capitalize upon oil development for the long-term development of the Scottish economy.

The Framework

These challenges, although specific to Scotland, have their parallels in other cases of program implementation. From our point of view a very important characteristic of such challenges is that they involve and affect many different organizations in the setting, and the way these organizations inter-relate. We will turn now to a brief description of the analytic framework with which we approach the responses of multi-organizational systems to challenges of this nature.

Of the many organizations which might in some way or another be associated with the program we define our relevant organizational system as consisting of those organizations whose objectives are derived, at least in part, from the statement of program objectives. The most elemental part of the framework is the recognition that this system is in interaction with an environment - a systemic environment - consisting of those factors external to it, a change in the complexity of which requires some response by the system. If the system is to survive in its environment, the interaction between system and environment must be balanced in one way or another. That is, the system must be able to respond in an appropriate way to each change in state of the environmental factors. This is a statement of Ashby's Law of Requisite Variety. [4]

Figure 2 illustrates the concept of system-environment interaction. The relevant system environment is defined by the system objectives. The particular objectives that a system wishes to achieve define the set of outside factors which must be taken into account. When new program objectives are defined they tend to result in an increase in the complexity (or number of states) of the environment to which the system must relate. It is this increase in environmental complexity which poses the new challenges to the system. If the objectives are to be achieved organizational responses are required which increase the ability of the system to meet the new complexity of the environment. A reformulation of Ashby's law for our framework says that the complexity of the organizational response should be at least as high as the complexity of the challenges if there is an intention to control them.



Law of Requisite Variety:

Response = Challenge

Figure 2: System Environment Interaction

The set of organizations, the multi-organization, which defines the system under consideration, has a structure, be it formal or informal. We identify this structure by studying the nature of the goals of different member organizations in the context of the development. In this manner we cluster the organizations into a system structured by levels, each embedded within the other.

In this case, where the program is one of regional development we can define a national (or general) system level which defines the boundaries or general objectives of the regional program. At this level are organizations whose focus considers trade-offs between regional development and other potentially competing activities. These organizations might, for example, consider industrial, economic and energy policies simultaneously with regional development problems. Once these trade-offs are worked out and goals defined, the goals are then handed to the set of organizations whose responsibilities are specific to the regional program, and which form the regional (or program) system.

This system level considers only trade-offs internal to the regional development objectives among various activities, thereby defining sub-goals. In their turn to implement the sub-goals, these are handed to a set of organizations concerned with specific activities, the regional (or program) sub-systems.

We recognize this goal definition process as iterative and continuous between system levels.

The identification of these systemic levels is the first step in recognizing the pattern of organization in a particular setting. An implication of this systemic definition of organization is that the challenges we have identified earlier can be addressed by any one of the levels or by actions taken by any mix of organizations at the various levels. Political and other objectives of the society in which the system is embedded have an important influence in the location and mix of responses by system levels. The idea of system challenge and response at several levels is illustrated in Figure 3.

We can take as an example different societal modes of goal definition. For each mode implications differ for the level at which the response to challenges will occur. In the case where definition of overall program goals by a national system is in great detail the implications are twofold. First, the national system would need to develop the capacity to generate these very detailed goals, and second, the discretion of the regional system level is limited by the detail, and therefore requires relatively low complexity to handle them. This is in marked contrast to the case where a national system passes goals to a regional system which are more broadly defined. In this case it is the regional system which must develop the capacity to define the implications of the goals and their definitions. To summarise this notion in other words, it is the specificity of the goal definition which defines the distribution of discretion or capacity among system levels.

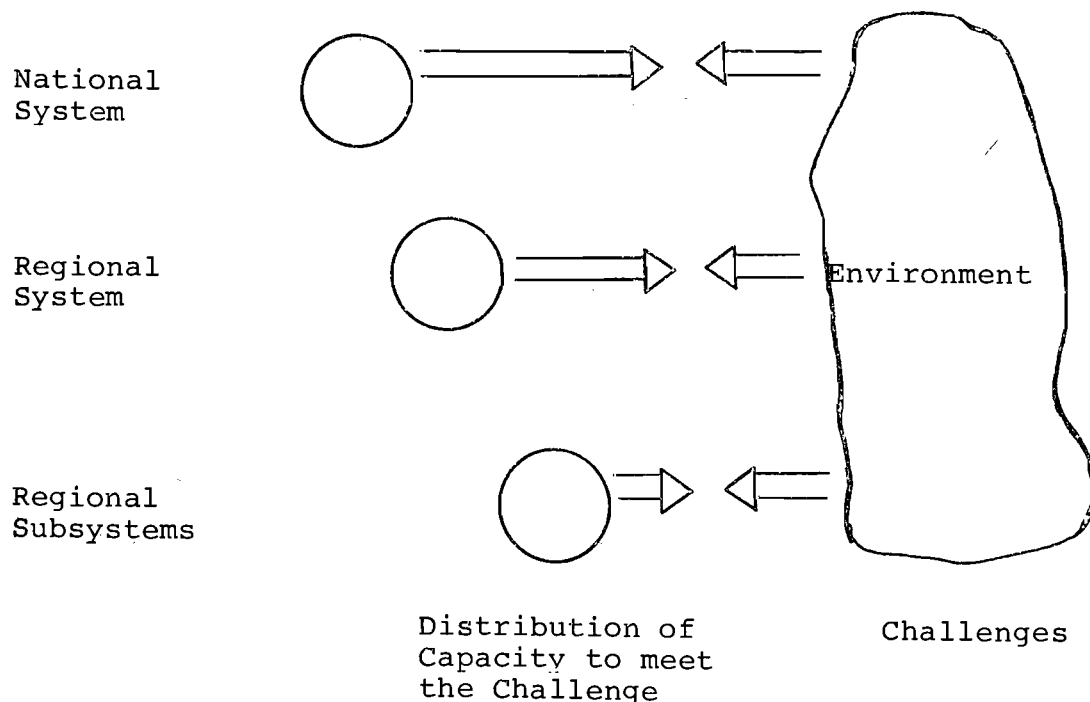


Figure 3: Distribution of Discretion among System Levels

The management capacity of each one of these systemic levels can be expressed in terms of the functional roles played by each organization within it. The capacity of a system level is generated by the functions embodied in the many organizations which comprise that systemic level. This functional capacity is specific to objectives and occurs at each systemic level. We define five functions which are sufficient to describe all system behavior and which are necessary functions if the system is to achieve its objectives. These functions occur at each systemic level. [5].

A Policy Function exercises discretion to choose between alternative strategies for objective achievement. Once selected those form the objectives for subsystems. In this choice policy is supported by a process of generation and substantiation of alternatives - an Intelligence Function.

A Control Function - "manages" the subsystems by providing resources and monitoring their performance against the objectives. Generally the activities of subsystems will be interdependent. A Coordination Function provides for direct information exchange between subsystems so that they can take into account their effects upon each other. Finally there is a need for the selected activities to be implemented - an Implementation Function. At any system level this is provided directly by the subsystems embedded in that level. (These five functions can, in turn, be recognized within the subsystems themselves.) Together they define the "functional capacity" of each systemic level with respect to a particular objective. The functions and the concept of recursive levels provide the analytic framework, with a capability for focus at any level of resolution, as illustrated in Figure 4.

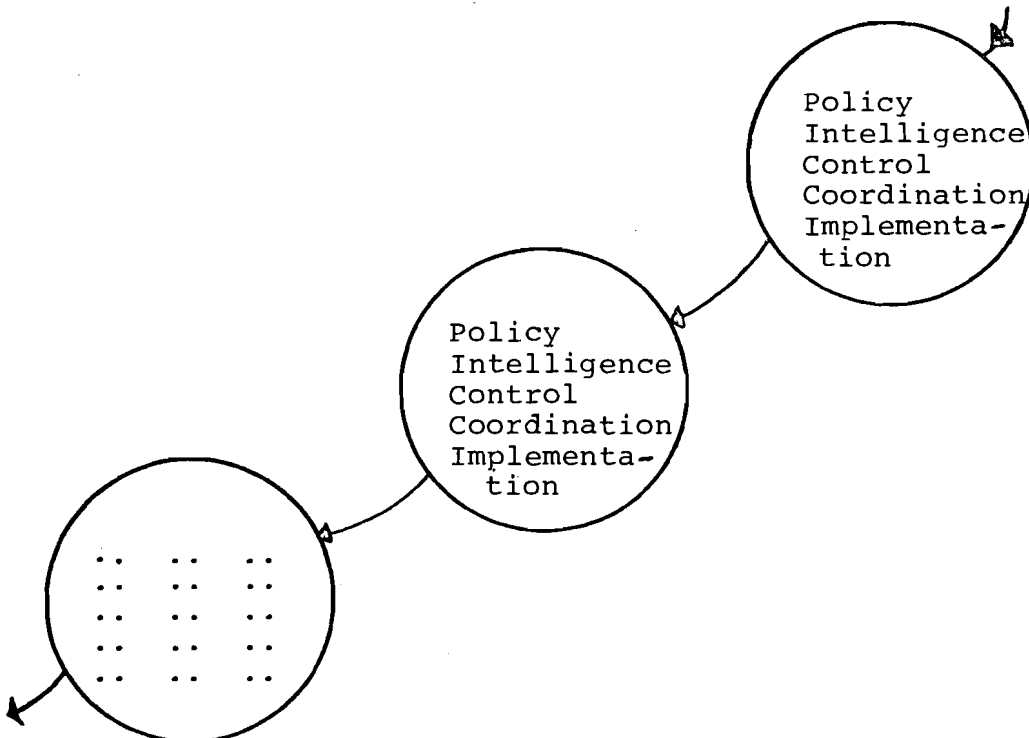


Figure 4: Functional Capacity of a System

To summarize our discussion of the framework, we may now consolidate these various elements into a more general picture of the analytic process. It is the increase of environmental complexity associated with program objectives which poses new challenges to the system. This new complexity may be met at any of the system levels under consideration.

Each level of the system is concerned with only a part of the total system environment. The environmental factors with which any level is concerned follow from the nature of the objectives that level receives, and the nature of the objectives it sets to its subsystems. Thus it is by examining the process of objective setting that we can determine the environmental complexity that each level must meet. Put another way, it is the process of objective setting - a process greatly influenced by societal values - which defines the demands upon, or the distribution of the challenges among system levels.

If the program objectives are to be fully achieved we postulate that the organizational capacity at each level should be sufficient to meet those demands. We note that an appropriate distribution of organizational capacity between levels is not a necessary consequence following from the objective setting process. A level may set highly elaborated objectives to a subsystem without, in fact, having a commensurate level of intelligence or control capacity to support those objectives. Our analysis proceeds, therefore, to compare the new environmental complexity at each level (resulting from the objective-setting process) with the complexity of the response. Figure 5 illustrates this process. If matching does not occur, we would postulate a lack of responsiveness of the system to its environment, leading to ineffectiveness. Such a case might lead to a reconsideration of objectives which permits a different distribution of challenges among levels.

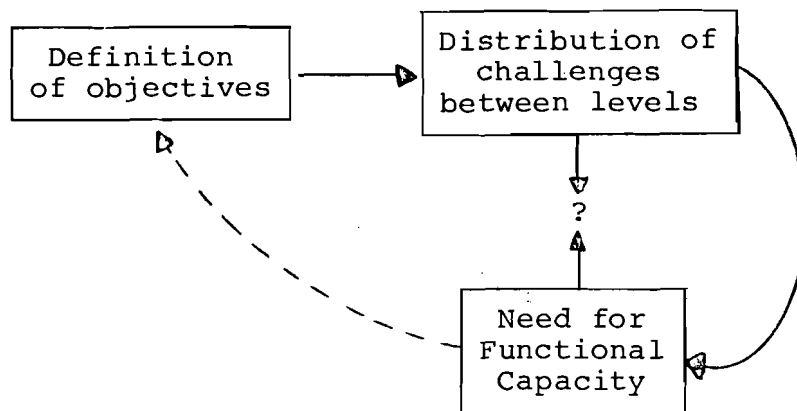


Figure 5: The Framework Summary

In this context, our inquiry could permit a detailed understanding of the overall response of a system. The policy output of such an inquiry may be either a set of alternative strategies to facilitate that response, or an assessment of alternative organizational policies which may already be under consideration.

The Long Term Challenge - Scottish Economic Development

With the discussion of the framework in hand, we can now return to a fuller consideration of the challenges. Because it sets the parameters within which short-term responses can most effectively be designed, we will consider the long-term challenge first.

Our first task is to define the system of organization which is the object of our interest. Scotland has a mixed economy, and thus the set of potential organizations includes both governmental and private groups. However, as it is the governmental system which is intervening in the setting to influence the activities of organizations toward the fulfillment of objectives, it is that system on which we focus. We will focus our attention, therefore, on analyzing the capacity of this governmental system to respond effectively to the challenge of facilitating Scottish economic development and capitalizing on the opportunities presented by oil exploitation for the long-term.

Having defined the system, our second task is the allocation of organizations to their appropriate system levels. We recognize first the UK government as the expression of the national system. UK government is composed of many different departments, one of which is the Scottish Office. The Scottish Office is also in charge of implementing general governmental policies in Scotland, and comprises the major actor in the regional system. In systemic terms, therefore, the Scottish Office has a dual role, as part of both the national and regional systems. In its turn, the Scottish Office is overseeing in Scotland the activities of local authorities and what is termed in the U.K., the "industrial program." The system of local government has long and well established traditions in the U.K. The "industrial program" is a set of policies retaining to industrial development managed by a variety of organizations. These four groups of governmental organizations make up the organizational system on which we focus.

Each of the three system levels, in turn, is interacting with an environment. Oil companies, private industry, and many other organizations are relevant for the UK government in its concern for Scotland. For the Scottish Office, industry within the region, and other productive activities are the relevant environment. In particular we recognize that the oil activities are affecting local authorities, and the industrial program must interact with a variety of enterprises which compose its relevant environment.

Resulting from these considerations Figure 6 shows the system composition and the relevant environment to each level.

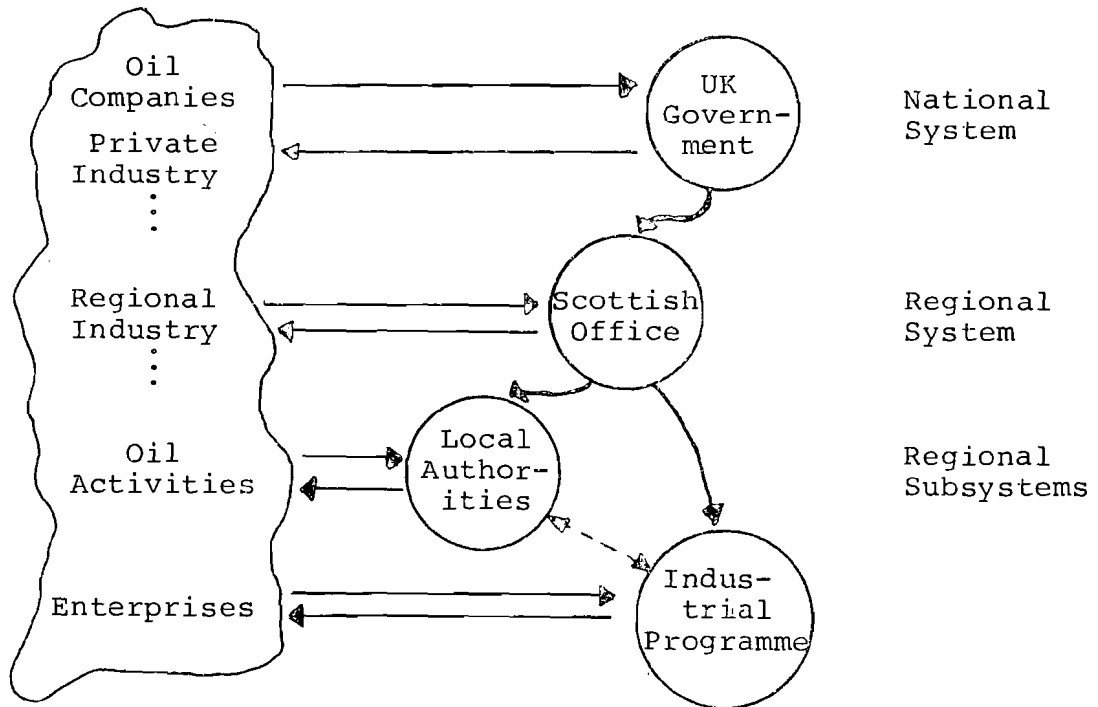
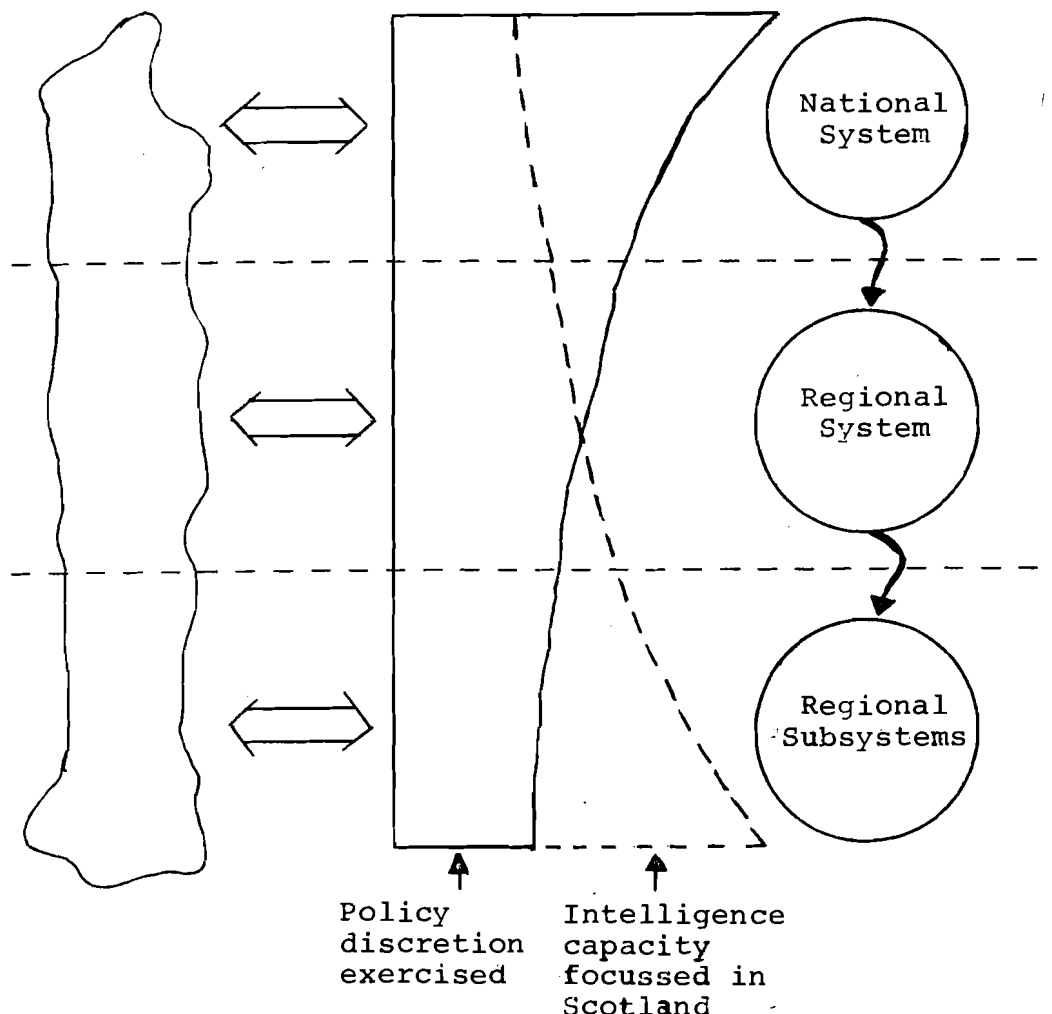


Figure 6: The Organizational System and its Relevant Environment for the Long-Term Challenge

Were our object a full analysis of the capacity of the system to respond to the long-term challenge, we would now turn to a consideration of the organizational support for each of the functions at the three system levels. For the purposes of this short discussion let us direct attention to the policy and intelligence functions only. Our implicit assumption here is that the most effective policy is likely to be defined where the policy function is matched by the support of its intelligence function. (An assessment of policy implementation would take into account a full consideration of all functions.) In the present simplified mode we will assume that where policies are enacted without sufficient intelligence support they may not lead to system objective achievement, and where a limited policy discretion is supported by a greater intelligence function it can be said that there is unused capacity in the system.

In the context of the long-term challenge, we observe the actual policy response of the system, and match this against a (crude) assessment of its intelligence capacity. Figure 7 illustrates in a purely schematic way the outputs of this comparison. Specifically, we find the national system, while defining economic, energy, industrial and regional policies, *is de facto* reducing the degrees of freedom of the regional system, and addressing a large part of the variety of the environment. In its turn, the regional system and subsystems are participating in the responding to the challenge by defining environment and infrastructure policies, and

Figure 7: Schematic Matching of Response and Demand



influencing industrial policies. (This is represented by the continuous line in Figure 7.)

Our assessment of the capacity of the system levels with respect to this challenge differs from our observation of the response. While there is a great deal of intelligence potential in the national system, it is not specifically focussed on policies for Scotland as a region. It appears that there may be insufficient intelligence capacity in the national system to support the level of policy definition which we observe. On the other hand, in some areas it appears that there is a greater degree of intelligence capacity in the regional system, than the discretion permitted by national policy definition. (The broken line in Figure 7.) In sum, we find an apparent mismatch between the actual policy response of the system, and the capacity of the respective system levels. Our interpretation of this situation suggests that the response to the challenge is inappropriate and at the moment, unsatisfactory.

Lets take an example to illustrate the point in more detail. Our example concerns U.K. "regional policy", which was defined by central government to support depressed regions, using unemployment as its indicator of need for support. The mechanisms for support include industrial grants for new productive activity and employment bonuses for all new jobs created in depressed areas.

Several observations can be made. First we note that the decision rule is defined so that the regional system has limited discretion in the allocation of support. The national system through its policy formulation is addressing most of its environmental complexity. Second, we may characterise the national decision rule as lacking in requisite variety to handle the environment it faces. What does this mean? It means that there are many relevant dimensions of regional activity which are beyond the scope of this decision rule, but which affect significantly the desired outcome. In the context of oil development its lack of variety can be illustrated.

The north-east region of Scotland is an area incurring a great deal of economic impact from oil activity; it is a very attractive location for industrial activity, and is being developed rapidly at the moment by private entrepreneurs. However, at the same time, under the regional policy, these industries, who would come to Aberdeen city today at their own expense, are receiving grants from the government. The policy is inflexible in adjusting to the situation where Aberdeen has ceased to be a depressed region, and now represents a natural growth pole for industry in Scotland.

Our third observation is that this is a situation where there appears to be capacity in the regional system which could augment the intelligence support for the policy presently being defined in the national system, and thus increase the complexity of the decision rule. Either the regional system could be granted greater discretion in these areas, or the national system could incorporate regional intelligence capacity in defining a more flexible, or complex policy. We use this example to demonstrate the meaning of a "mismatch" between capacity and response.

Short-Term Challenge: Ameliorating Local Impacts while
Facilitating Oil Development

We now turn to the short-term challenge. Since the oil discoveries in 1970 the variety of oil activities and impacts on local communities has increased substantially. The initial strategy to meet this challenge depended upon existing organizational procedures and mechanisms. No significant changes in policies at the national or regional levels were contemplated and for a time the strategy appeared sufficient. However, as planning applications and demands for infrastructure increased, important strains were recognized by the system, the Scottish Office and local authorities in particular.

As a result of these strains, which included a dramatic delay and inquiry into a key planning application for a platform construction site, several changes have occurred which, taken together, may be viewed as a response strategy. There has been an increase in the role of the Regional System - the Scottish Office - in meeting the new complexity. Increased policy discretion at this level has two elements. The first moved new discretion from the National to the Regional level. An example of this is the removal of U.K. government cost normatives for local authorities as they responded to infrastructure demands incurred by the oil development.

The second element shifted discretion to the Regional System from the local authority subsystem. While most development applications would be decided by local authorities independently, for important oil-related applications, that discretion is now importantly influenced by, or removed to, the Scottish Office. Several mechanisms have been used for this, from the issuing of planning guidelines to local authorities, to a direct Scottish Office role when particularly controversial applications are involved.

To support its increased role several mechanisms have been introduced to increase functional capacity. These have included coordinative committees both inside and outside government, outside intelligence support and new initiatives within the Scottish Office regarding spatial planning. Without discussing the detail of these responses here, we note that on the whole observers agree that the challenge has been fairly successfully met.

Conclusions

As we said earlier, the object of this discussion is the demonstration of an analytic approach rather than the presentation of particular findings with respect to the Scottish response to oil development. Thus, we use our observations of response to the two challenges only as illustrative of the process of contrasting demands on a system level and its response.

From this short discussion of Scotland we can observe two different matches in capacity to response. Apparently the short-term challenge has been met by re-allocations of discretion which resulted in a relatively effective match between the capacity of each system level and the complexity of its environment. The situation in response to the longer-term challenge is less clear. There appears to be a mismatch between the level of policy discretion being exercised and the intelligence function supporting that policy in both the national and regional system levels. Remedies for this situation might be either to increase the discretion of the regional system, as was the case in the environmental and infrastructure policy areas, or to increase the Scottish focus in U.K. intelligence, and policy functions.

Taken to a greater level of detail, this type of analysis could generate more specific organizational proposals for achieving a better match between policy and intelligence support that presently exists. Clearly, this analysis is not intended for that purpose. Particularly in our case study of Scotland, where we have researched from the position of observers totally outside the system, such an intent would be presumptuous.

The process demonstrated here, however, can be applied both in the generation of these more detailed policy proposals, or for the assessment of proposals under consideration by policy makers. By reformulating a problem in the context of our analytic framework we find ourselves capable of a systematic examination of the organization of a system in terms which permit assessment of the implications for its capability to implement particular program objectives.

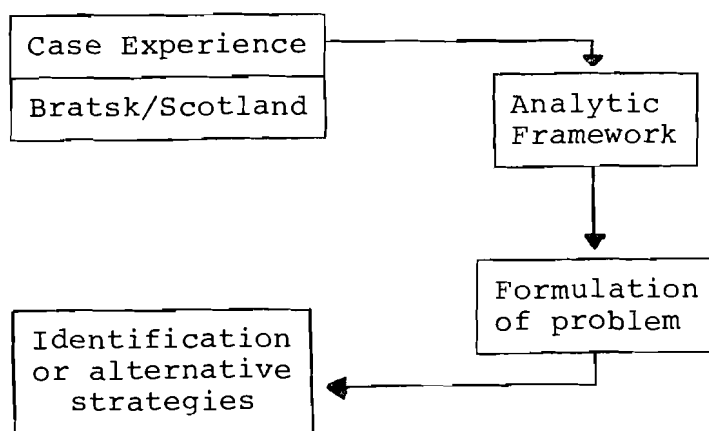


Figure 7: Organizational Analysis

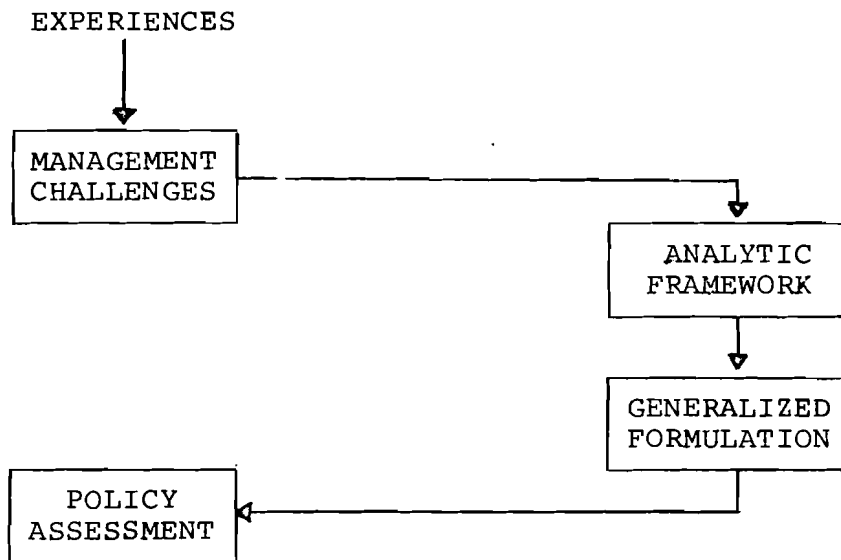
In the Bratsk case which follows, we focus more on an assessment of the potential of alternative new strategies under discussion by policy makers.

BRATSK-ILIMSK: THE ORGANIZATIONAL IMPLICATIONS OF THE CONCEPT OF TERRITORIAL PRODUCTION COMPLEX

The purpose of this discussion, is to provide an example of the type of insight organizational analysis can provide as input to an ongoing policy discussion. The discussion we address focusses upon a number of policy proposals in the Soviet Union to improve the planning and management processes presently supporting the development of Territorial Production Complexes (TPC).

The process of our organizational analysis follows several steps (see Figure 1). First we will examine the experiences of a TPC which is typical for Siberia, Bratsk-Ilimsk. We then organize those experiences according to a set of management challenges which we have derived from definition of TPC. The experiences are then examined in terms of our analytic framework so that the challenges can be reformulated in a more generalized manner which ultimately permits the assessment of the policy proposals now under discussion.

Figure 1: Organizational Analysis



The written version of this report, Chapter 2 of the Management and Technology Field Study in Bratsk, addresses all of these dimensions (see Figure 2) [1]. It explores the management implications of the concept of a territorial production complex; it examines the specific experiences of the Bratsk-Ilimsk TPC in the context of the Soviet planning system; it presents

the context of the Soviet planning system; it presents the systemic framework which is the foundation of our organizational analysis; and it outlines the management implications of each of the major proposals currently under discussion. Its object is to provide policy-makers with the process and criteria for choosing among various policy options.

Figure 2: Chapter 2

- Planning and Management Implications of TPC Concept
 - . System of Planning in the Soviet Union
 - . BITPC as Object of Planning
 - . Primary Organizational Actors and Their Roles in the Management of BITPC
- Systemic Interpretation of TPC
- Future Management Alternatives for TPC

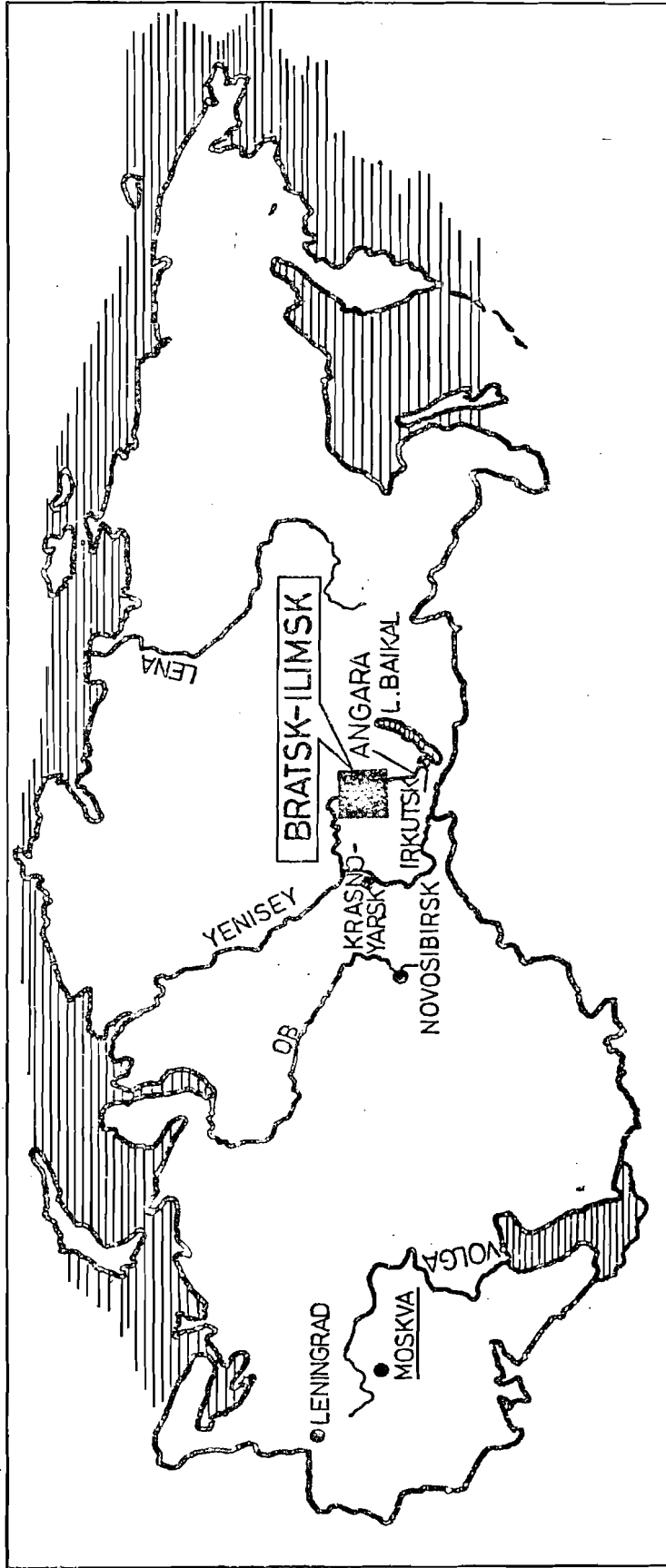
In this short discussion, we will focus primarily on the first and last of these. We will explore the experiences of Bratsk in light of a set of management challenges which we derive from TPC as a development strategy. Then, drawing upon our analysis we will focus the current Soviet proposals in the context of their ability to support the development of future TPCs in Siberia.

The territorial production complex on which we focus is at Bratsk-Ilimsk in Siberia. (See Figure 3). Bratsk was one of a series of TPC's conceived as a strategy for exploiting the vast hydro-power and mineral resources of this part of Siberia. The Bratsk and Ust-Ilimsk hydro-power stations are components of a five-dam cascade system designed to capture the power potential of the Angara-Yenesei river system. The strategy couples each dam with a matrix of complementary, energy-intensive industries and support settlements. Conceived in the context of an electrification strategy during the 1920's, the Bratsk dam was begun in 1954 and completed in 1967; the dam at Ust-Ilimsk is now under construction. We will focus on the major elements of this development strategy today using the experience of Bratsk-Ilimsk to increase the level of detail of our understanding of the nature of the planning and management processes involved.

The Concept and Challenges of TPC

Let us turn now to the implications of the TPC concept as a strategy. The concept of territorial production complex has been evolving for some forty years. Originally conceived in the 1930's it has grown in comprehensiveness and complexity as the demands of national economic growth have evolved during these years. We understand it now as a development strategy aimed at the exploitation of virgin territories, or frontier lands.

Figure 4. BRATSK - ILMISK TERRITORIAL PRODUCTION COMPLEX IN THE USSR

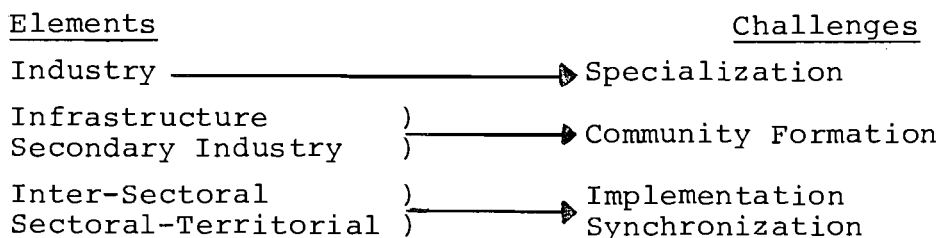


The core element of the TPC is a set of industrial nodes. In the Bratsk-Ilimsk TPC, we find three nodes: Bratsk, Ust Ilimsk and Nizne-Ilimsk. The nodes are comprised of a set of complementary industries which are defined through a process focussed on national economic objectives. Processes for defining industries of national specialization, as they are termed, are well developed and have been the mainstay of the planning system in the Soviet Union for many years. The special challenge of selecting industries for TPCs is the determination of industries which will be efficient in conjunction with a matrix of other industries. This is the challenge of defining specialization in "complex" interaction, where we find that industries which might not otherwise appear efficient in serving national objectives, may turn out to be efficient when coupled with appropriate other industries or resources.

The second and third elements of TPC are of equal importance in the frontier context. The provision of social and technical infrastructure and secondary industries to support the working population present the second of what we are terming management challenges. The challenge is essentially the construction of complete, and to whatever degree possible, self-supporting settlement communities. We define communities to include housing, schools, shops, medical facilities, industries and agricultural support. It is not simply a question of providing adequate shelter for workers, but one of creating communities which have the capacity to grow and to adapt to the changing needs of the population which has immigrated there.

The fourth and fifth elements of TPC development refer primarily to the implementation or construction phase. The matrix of industrial development depends upon synchronized construction of sectoral industries, industries which, in the Soviet system, are often sub-ordinated to different Ministries at the national level. The challenge is to have the completion of the power station synchronized with the aluminium or timber complex which will consume the energy. Likewise the efficiency of the industrial development is dependent upon the simultaneous completion of at least the basic elements of social and technical infrastructure. Roads, housing and other basic facilities must be available in a timely manner. In the Soviet Union, this implies closer and more exact coordination between sectoral agencies with responsibility for industrial development and territorial authorities who usually have primary responsibility for infrastructure and settlements.

Figure 4: An Evolving Development Strategy



This then, is the set of management challenges we derive from the definition of a territorial production complex as a strategy for the development of frontier lands. We can now consider each in more detail using the experiences of Bratsk-Ilimsk. (See Figure 4).

Challenge 1: Sectoral Specialization

We begin with the challenge of sectoral specialization in the context of complex interaction. Specialization industries are defined during the planning process in the Soviet Union and so we must consider what the challenge means in the context of the planning system. First, it requires a methodology for evaluating investments in complex interaction so that policy-makers can choose among various industrial strategies for a particular TPC. Then, in addition to the organizational procedures already existing in the planning system, we define the need for the capability, a process or an agency which can take an overview across sectoral lines and make decisions for the TPC as a whole regarding long-term investments.

The planning system in the Soviet Union focusses on many time frames, only three of which are of interest to us: long-term, i.e. fifteen years, medium-term, i.e. five years, and short-term, i.e. annual plans. For each time horizon there is a pre-planning phase where alternative strategies are researched. These provide support for the planning cycle itself. The actual planning process is iterative and involves organizations throughout sectoral and territorial administrative structures. Investment decisions of the sort required to define TPC development are taken on the basis of the alternatives generated during the pre-planning stage.

For usual sectoral development the respective ministries with their vast research support, the State Committee for Science and Technology and the Academy of Science generate alternatives for policy decisions. A somewhat different process occurs for TPCs.

For Bratsk in its early stages a combination of the usual sectoral attention and special comprehensive planning occurred. Gridroprojekt, under the auspices of the Ministry of Power, prepared the initial plans for major industries and the complex in the mid-1950's. Long-term perspectives for this project were prepared under the direction of the Committee for the Study of Productive Forces, and somewhat later, by the East Siberian Commission which was operative from 1962-1970. These were the primary coordinative agencies specifically focussing on Bratsk; they drew upon the support of many research institutes. The commissions were, however, ad hoc, and although they are often appointed for specially identified projects of national significance, the commissions are short-lived and thus may not provide the continuity required for long-term planning.

A more common mechanism for focussing planning attention upon a particular project is the production of a general scheme for that project. In the early years of Bratsk, the role of such a scheme was handled by the Gidroprojekt plans. These initial plans provided the basis on which goals for successively more detailed and shorter term planning were later elaborated. At the present time, however, we find in the comments of scientists engaged in TPC modelling research that general schemes tend not to exist for these projects. In fact, there is some disagreement and discussion about the status of general schemes for TPCs today.

While efforts have been made to incorporate such projects in the five-year plan itself, these are recent efforts and we have indications that some projects are going ahead without the benefit of the careful attention which the planning system can focus on a given project. The example most easily at hand involves another industrial node at Boguchany where it is not clear today whether this node will form a part of the Bratsk-Ilimsk TPC or the basis of yet another TPC.

Thus, although we find many efforts in research being focussed upon the development of methodologies which permit evaluation of alternative investment schemes for TPCs, it is not so clear where in the planning system, particularly in the pre-planning phase, the mechanisms exist to focus policy attention which can take into account intersectoral considerations. The result could be that the benefits of complex interaction will be significantly reduced in the ensuing development.

Challenge 2: Complex Community Formation

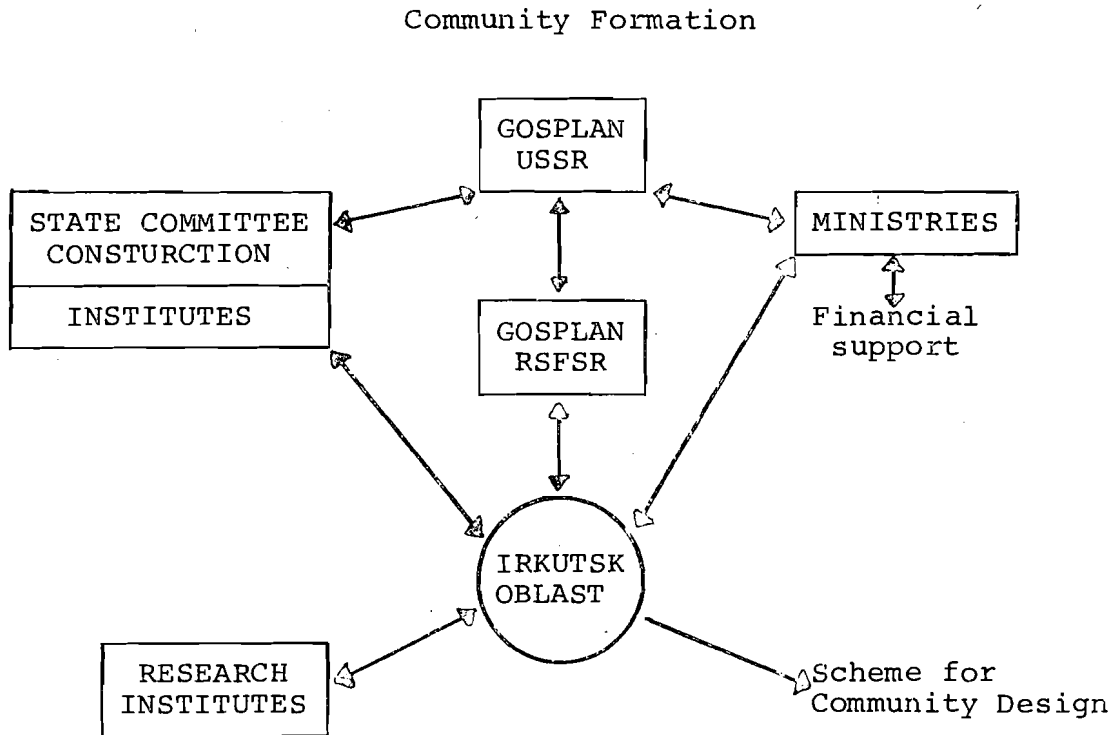
The second challenge we have identified is that of designing and forming complex settlement communities in the wilderness. We have defined this as a problem of creating self-supporting communities which have the capacity to adapt to the changing needs of the population. We can imagine that there are two key elements in the planning for such communities. The first is the creation of comprehensive development schemes, and the second is securing the financial support.

The local territorial authority, Irkutsk Oblast* planning department, plays the major coordinative role in the formulation of plans for Bratsk and other TPCs in its territory. (See Figure 5.) Supported by research institutes at the national level, most notably Giprogor the town planning institute, and by the local research institutes, the Obplan coordinates the preparation of general schemes for community development during the pre-planning

* The territorial administrative structure has several levels: city, district, region (oblast), republic. For the Bratsk-Ilimsk TPC, the city of Bratsk is embedded in a district which is located in the Irkutsk Oblast (includes the area to the west of Lake Baikal) which is a part of the Russian Federation (republic).

phase. It coordinates the efforts of sectoral ministries, as well as those of the Russian Federation, the greater territory in which the Oblast is located. Plans are prepared within the framework and standards set by the State Planning Committee, Gosplan, and the State Committee for Construction.

Figure 5: Primary Organizational Interation



The process appears to locate policy responsibility for the design at the local level. It is not clear, however, to what extent these national standards limit the flexibility of regional agencies in meeting the special needs of the local community.

The second element is the financial support required for the construction of the communities. In particular this means the definition of a process by which costs can be distributed among ministries and territorial authorities. While the Oblast has a large degree of policy discretion with respect to physical plans, the financing has been attached to specific industrial projects as a percentage of costs. Thus, national ministries appear to control the finances. We found the Oblast, then, with responsibility for planning but without the corollary authority to adjust expenditures as changes arose in industrial development. We understand changes are being made in these financial procedures for the current five-year period.

Challenge 3: Synchronization of Implementation

The third challenge we have defined is that of synchronizing the implementation of TPC projects. The challenge here involves

the day-to-day phasing of the activities of multiple sectors and of sectors with territories. Particularly in the harsh Siberian setting, we translate this challenge into the requirement for some comprehensive control capability for implementation of these projects. There are two primary types of mechanisms for achieving this control in the Soviet Union.

The first is the planning process itself, particularly in its annual planning cycles. Adjustments within the five-year plan can be made on an annual basis, and if major redirection is necessary it can be accommodated. Such major changes, however, must have the approval of the State Committee for Planning, Gosplan, USSR.

The second set of mechanisms for synchronization are those organizations of the TPC itself which have responsibility for implementation activities. The most important of these in BITPC is Bratskgesstroi, the construction organization. Bratskgesstroi was created during the 1950's as an all-purpose construction organization.

Although formally subordinated to, and originally the construction agency for, the Ministry of Power, it handles construction for all projects within the TPC. Thus, with the exception of the railroad, which was built by another organization, Bratskgesstroi handles the construction of most industrial projects, social and technical infrastructure. In addition, it takes on many roles in community service, such as the allocation of housing and the management of trading shops. We consider it as a major innovation in TPC formation.

With respect to the timing of industrial construction projects, Bratskgesstroi's annual planning process is the primary coordinative mechanism. Working with the enterprises on the TPC, through its own ministry and through the ministries of customer enterprises, competing demands for material and human resources are reconciled.

With respect to housing construction in Bratsk, Bratskgesstroi works closely with the Director of Housing and the City Soviet. The Director of Housing is another organizational innovation created as a response to the extra demands of TPC development. Its major role is in working with design institutes to prepare housing plans for the city.

Finally, we find the Board of Directors, an informal organization whose members are the heads of the major enterprises of Bratsk, and whose chairman is the Chairman of Bratskgesstroi. These 40 people meet on a regular basis and provide an informal coordinative capability.

These three organizations contribute to a comprehensive control capability in the implementation of TPC projects. We must note, however, that none of these agencies has sole

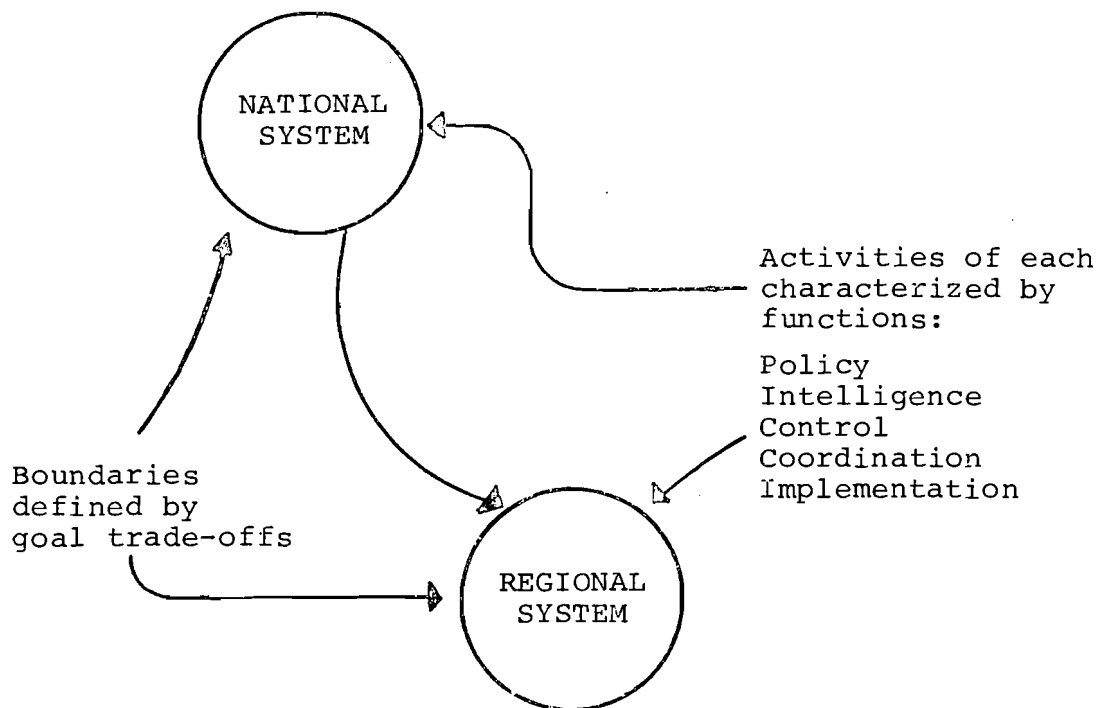
authority in the short-term to make changes which affect longer-term plans. Any changes which affect either annual or five-year plans must be submitted to the highest levels of national authority for approval. Thus the flexibility of these local systems in adapting to changes imposed by the physical or organizational environment is somewhat limited.

Reformation of Challenges According to the Analytic Framework

We now have a few examples to illustrate the nature of the additional challenges posed by TPC as a development strategy. We would like to summarize them now in a way which increases our ability to understand the implications of the various management proposals now under discussion in the Soviet Union. These proposals are the ones mentioned earlier, which have been put forward by the Soviet scientists and policy-makers in an effort to improve the ability of the Soviet system to deal with the particular additional requirements of TPC development.

Our analytic framework provides the basis for making the transition from the specific experiences of Bratsk to criteria which can be used by policy-makers in a wider context. As it has been described in more detail earlier, only a few of the elements are repeated here so that we can generalize our understanding of the Bratsk case. The framework defines organizational systems and subsystems by the nature of their goals, and characterizes the activities of all levels of the system by five functional categories. In this case study we define two systemic levels, the national and the regional, and characterize each by the five functions. (See Figure 6.)

Figure 6: Simplified Framework Elements



As an example of the nature of goal structuring to define system boundaries we can use the first two of the management challenges. Choice of industries of national specialization for the nodes which will be the core of a TPC are a goal set of the national system in the Soviet Union. This goal provides the parameters within which the regional system defines the nature of the settlement community which will support these industries. Of course, the systems interact extensively in defining both industries of national specialization and settlement needs, but the notion which is important here is that the goals of one system set the parameters for the activities of a subsystem.

The framework further postulates that the activities of each of these levels of the organizational system can be described using five functions. To repeat briefly, the functions we use are: policy, intelligence, control, coordination and implementation. Four, are self-explanatory: policy, control, coordination and implementation refer to those activities commonly conceived of as choosing among strategic objectives, monitoring performance against those objectives, and coordinating and implementing system activities. Intelligence refers to a policy support activity, usually research or planning, which generates the alternatives from which policy-makers can choose their strategic objectives. We use the term intelligence, rather than planning here, because the term planning has a special connotation in the Soviet Union. Their planning process, in fact, incorporates several of the other functions.

Returning now to the management challenges, we can describe them somewhat more fully. For the challenge of definition of industries of national specialization the policy and intelligence functions are carried out by the national system, with the support of many other agencies. (See Figure 7).

The management challenge of community formation is an objective for the regional system set in the context of a national policy. The policy and intelligence functions for settlement design are carried out at the regional level, by a variety of agencies within the parameters set by the national system, e.g., planning standards and the five-year plan.

Figure 7: Systemic/Functional Response to Challenge

Industrial Specialization	Policy) Intelligence)	National
Community Formation	Policy) Intelligence)	Regional
Implementation Synchronization	Control) Coordination)	and National Regional

The third management challenge, that of synchronizing implementation, can be characterized as a control and coordination function. In the instance of inter-sectoral coordination it is carried out primarily by the national system and also by the regional system. In the instance of coordination between sectoral and territorial projects, it is carried out by both the national and regional systems.

Using the elements of the analytic framework we will briefly illustrate the implications of each of the three types of proposals now under discussion in the Soviet Union. Using the framework we can identify the dimensions of TPC development that each addresses and thereby assess the impacts each might have on the current planning and management process for TPC.

Implications of Current Soviet Policy Proposals

We have identified three types of proposals from our interview in the field study. They are put forward by different groups within the Soviet Union, and we feel they are representative of the main dimensions of the current discussion.

The first type of proposal is to increase the capability of the national level of the planning system to focus specifically on TPCs. The second type of proposal is the creation of a local operation agency. The third type of proposal suggests the creation of a comprehensive agency at the regional level.

We analyze their impact on the challenges that we have defined in terms of the functions they support by systemic level. The matrix in Figure 8 provides the dimensions from the framework which are necessary for the analysis: the proposals, and the functions mentioned earlier, and the challenges and system level which appear within the boxes.

The first proposal addresses the challenge of definition of industries of national specialization, by proposing an increase in the policy and intelligence functions of the national system with respect to TPCs. The second proposal primarily addresses the challenge of synchronization. It affects the synchronization of both goals of industrial development and settlement formation by suggesting an increase in the control and coordination capabilities at the regional systemic level. The third proposal appears to address all three challenges. It appears to locate policy, intelligence, control and coordinative capacity for both national and regional objectives in a regional agency. Reformulating the proposals in this manner, using the elements of the framework provides us with the basis for analyzing the implications of each proposal.

Figure 8: Summary of Proposal Dimensions

Proposals \ Functions	Policy	Intelligence	Control	Coordination	Implementation
1. National Level of Planning System	Spec (N)	Spec (N)			
2. Local Operational Level			Syn (R)	Syn (R)	
3. Local Comprehensive Agency	CF (R)	Spec CF (R)	Syn CF (R)	Syn CF (R)	

Challenges:

Spec = Specialization
 CF = Community Formation
 Syn = Synchronization

N = Functions of the National Level
 R = Functions of the Regional Level

By increasing the policy and intelligence functions of the national system with respect to industrial specialization, the first proposal puts a great deal of emphasis on the development of territorial models. It might also increase the capability of the national system to include local variety in the specification of standards for community formation. It does not address the challenge of synchronization.

The second type of proposal increases local control and coordinative capacity for territorial projects. One of the implications of this proposal is that it increases the demands upon the national system for control. How? In this process the local agency would be preparing plans for inter-sectoral projects which fulfil national objectives. Any trade-off would thereby affect industries involved in national policy and would need to be sorted out at that higher level of authority. The creation of such an agency would present an additional set of plans for review and increase demands on the national system. It is quite possible that the process of reviewing TPC activities which might be catalyzed by such an agency would prove quite useful.

The third type of proposal appears to have addressed all three challenges. An agency of the regional system specifically focussing on the comprehensive needs of the TPC would provide better information to the national system for its policy deliberations on specialization industries. It creates the demands for an

increased level of national control as did the operational agency in the second type of proposal. More fundamentally, such an agency would result in the formal definition of a new level of planning and might stimulate all the perturbation which accompanies a major systemic change of this sort.

Conclusions

In sum, each of the proposals we have discussed represents an improvement in the capability of the present system. They might be adopted alone or in combination. Proposals 1 and 2, for example, are quite complementary in theory. Of course, as they are put forward by two distinct groups they may represent very different political strategies.

Having now illustrated the nature of TPC as a development strategy in the context of the Bratsk-Ilimsk development, we hope you have a better sense of the special challenges posed by this unique strategy. However, in addition to providing a sense of this Siberian experience, we have addressed this discussion to the illustration of an analytic process focussed on policy assessment. We hope to have demonstrated here that the somewhat different and subtle impacts of specific management proposals can be clarified for policy-makers.

By reformulating the specific experiences of Bratsk, using our analytic framework, we have structured a more generalized understanding and criteria within which policy alternatives can be assessed. We intend to have illustrated a process here which, by its formulation can be utilized in a wide variety of settings to analyze the organizational dimensions of many different program activities.

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