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# Towards a new approach for scientific and technological planning

## 1. Introduction

This essay proposes a theoretical basis and suggests guidelines for scientific and technological planning in underdeveloped countries, particularly those of Latin America. The paper is based on a report prepared by the author at the University of Pennsylvania and presented to the Department of Scientific Affairs of the Organization of American States (Sagasti, 1972). The ideas and concepts put forward are derived from a critical appraisal of current planning methods, from a conceptual model of the nation as a system, from an analysis of the Latin American situation in science and technology, and from recent developments in planning theory. The second section is devoted to an examination of the concept of planning, the third defines the principles on which to base a planning methodology for science and technology, the fourth proposes a framework consisting of five categories to group planning decisions, and the fifth contains a summary.

## 2. The concept of planning used in the essay

In the broadest sense, *planning* is anticipatory decision making. It consists in exerting choices in situations which have not yet occurred but which are envisioned to occur, which are interrelated and interdependent, and which are not known with certainty. Planning is essentially rationalist and interventionist in its approach, it implies that by making commitments in advance and by taking action at present it will be possible to influence future events. Planning seeks to control these future events to a greater degree, to orient them in the appropriate direction in order to obtain desired results, and to foresee their possible consequences.

Planning, and the anticipatory decisions that constitute it, are primarily concerned with the generation, identification and evaluation of alternatives.

*Soc. sci. inform. 12 (2), pp. 67-95.*

Policy-making can be distinguished from planning because it involves establishing criteria for generating, identifying and choosing among alternatives. Therefore, *planning* can be defined as the collection of activities which, taking the principles and criteria established by policy-making, generate, identify and select among alternatives through a process of anticipatory decision making. Thus *policy-making* can be considered as the part of the planning process whose task is to set principles and criteria for anticipatory decision making.

A *planning methodology* refers to the procedures followed in arriving at the commitments made in advance by the planner, and to the way in which actual decisions are made. The anticipatory decisions included within the scope of planning are concerned with the structure and functioning of the system to which planning is addressed and also with changes in its environment. A *plan* consists of statements spelling out the anticipatory decisions taken, their interrelations, and the criteria employed in making them.

Traditional or orthodox planning has usually been concerned with the allocation of resources and the definition of activities to be performed by the system, particularly in the short and medium terms. Conventional approaches to planning generally take the institutional infrastructure and the environment of the system as fixed constraints which are not acted upon. They also leave aside the long-range problems of designing desired futures for the system, or treat them by extrapolating short and medium-range planning methods.

The conventional approach to planning puts great emphasis on the preparation of plans, which become the "final product" of planning. Plans are considered a collection of statements describing and justifying a series of activities to be carried out during a fixed period, and to which resources are allocated. This view of planning suffers from several deficiencies.

First, by focusing efforts on the preparation of a plan, producing documents becomes the central concern of planners. The documents are usually obsolete by the time they are published, discussed, and approved; however, after their approval these plans frequently acquire a life of their own, in spite of their inadequacies. The rapid tempo of change prevailing in underdeveloped countries makes this approach to planning self-defeating.

Second, the importance attached to the preparation of a set of documents separates the functions of plan preparation and plan implementation almost completely. The planners' task becomes that of generating documents which are then given to those in charge of their implementation.

Third, planning tasks are defined on the basis of a fixed period, the time horizon of the plan, which becomes a fundamental category of analysis. Different types of planning decisions, which generally involve different time horizons, are forced into the same time frame ("five year" plans for example), and planning decisions become fixed parameters to be reviewed only at the time of preparing the next "plan". The failure of economic development planning in Latin America (Inter-American Economic and Social Council, 1969) during the 1960s can be attributed in part to this conventional view of planning which emphasizes the plan as a collection of documents [1].



The approach adopted here considers that *the value of planning does not lie in the generation of plans as such, but in the process of producing them.* The main benefits that decision makers obtain from planning derive from their participation in the planning process, and not from the use they may give to the documents describing the "plan". The learning process that takes place during the preparation of the plan becomes far more important than the plan itself.

In the view of planning adopted here, the time horizon becomes a flexible concept. Anticipatory decisions are not referred to a rigid and pre-defined time frame : different types of decision have different time horizons. These anticipatory decisions are continuously in the making; they are reassessed and revised whenever it becomes necessary to do so. Therefore, rather than using rigid time interval (expressed in years, months or weeks) for differentiating between long, medium and short-range planning, I shall define the long-range as that time horizon beyond which the present existing situation does not condition to any significant extent the behavior of the system. The short-range would be defined as the time horizon for which the present situation and the dynamics that led to it determine the behavior of the system to a large extent. The medium-range would be defined as the time horizon for which present conditions have a significant influence on the behavior of the system, but do not determine it.

Ozbekhan's conceptualization of planning (Ozbekhan, 1969) is also closely related to the one used in this research :

"Planning [...] is a future-directed decision continuum that can be visualized as a three-level structure and as a multiphased process. The structure is made up of different typologies of decisions. The process consists of various functional relations that tie decisions into a complex network of action flows and control mechanisms" (p. 135).

Although I shall propose a different typology of decisions than the one Ozbekhan develops, the similarities between the two approaches to planning outweigh the differences. Furthermore, Ozbekhan's (1969) concept of "willed future" and Ackoff's (1971) concept of the "ideal system", shaped only by stylistic constraints, provide the main theoretical basis for the category of stylistic planning.

The present approach to scientific and technological planning is also conditioned by, and coincident with, that of Emery (1967) and Emery and Trist (1965). Their typology of organizational environments and their description of the fourth type, that of turbulent fields, provide a way of conceptualizing interactions among systems which helped in clarifying the concept of contextual planning. The work of Friend and Jessop (1969), being closely related to that of Emery and Trist, also proved useful in this respect.

1. Of course the lack of a real political will to make planning work was perhaps the perhaps the most important factor in this failure.

The approach to planning taken in this work is also derived from earlier work done by the author in the field of scientific and technological planning (Sagasti, 1970*a*; 1970*b*), where the characteristics of an idealized planning methodology were suggested and their implications examined. These led to some of the principles to be discussed in the following section. Some of the abstract and theoretical concepts related to this planning approach are also discussed in other papers (Sagasti, 1971*a*; 1971*b*).

In short, the work of Ackoff (1966; 1968; 1970; 1971), Emery (1967), Ozbekhan (1969; 1971), Beer (1966), Emery and Trist (1965), Friend and Jessop (1969), and also that of Friedmann (1967), Harris (1970), and Vickers (1965), provided the elements for organizing the theoretical basis of my approach to planning. This background on planning theory, combined with the critique of current methods for scientific and technological planning (Sagasti, 1970*b*), with the conceptual model of the nation as a system (Sagasti, 1970*a*) and the analysis of the Latin America situation (Sagasti, 1972) led to the framework and the methods for scientific and technological planning which will be discussed in the following sections.

### 3. Principles for scientific and technological planning in underdeveloped countries

Five principles for scientific and technological planning in underdeveloped countries have been identified. Each will be listed and discussed in turn. These principles are derived primarily from the work of Ackoff (1971), and Waldo (1969), and they have been examined in the light of the empirical context of the Latin American situation in science and technology.

1) *Planning for the development of science and technology should be continuous*

Planning is a process consisting of decisions made in a set of interrelated and anticipated choice situations. The anticipatory decisions should be modified in the light of new information regarding changes in the system and its environment. In consequence, planning has no natural beginning or end-point and the preparation of documents containing the "plan" becomes a by-product of the planning activity, rather than the main justification for it. This implies that all types of anticipatory decisions will be continuously in the making, conditioning each other and interacting in a continuous fashion. It is not possible to stipulate that one type of planning activity precedes the others in a rigid sequential way, they should all take place simultaneously with anticipatory decisions made in one area feeding information into the others.

2) *Planning for scientific and technological development should be participative*

Effective planning cannot be done *for* a system or organization, it has to be carried out *with* it. This principle suggests that the involvement of the scientific community, the users of research, the government, and those engaged in systems related to the scientific and technological one, is critical for success in planning. The scientific community in particular is primarily interested in maintaining freedom of research and usually resists interventionist measures. Therefore, efforts should be made to incorporate in the planning process the largest possible number of scientists, professionals, and technicians.



This principle also postulates that excessively centralized planning procedures which would attempt to define in detail desired futures, institutional structures, patterns of interaction with other systems, activities to be carried out and the allocation of resources, would not be effective. The planning methodology should establish a proper balance between central guidance and individual initiative. Underdeveloped countries lack the governmental machinery to perform these planning tasks in a centralized fashion; even if they had it, such an approach would succeed, but probably at the cost of threatening the freedom and independence which are required for creativity in science and technology.

However, this does not imply an abandonment of planning. The principle of participative planning seeks to establish a balance between the approach which is limited to gathering and coordinating individual initiatives, and that which attempts to control in detail the behaviour of the scientific and technological system. Given the relatively low level of development of the institutions performing scientific and technological activities in underdeveloped countries this principle would encourage institutional development. It would provide guidance and general direction, while at the same time promoting individual initiative within an established frame of reference.

3) *Planning for scientific and technological development should be integrated with other planning activities*

This principle refers to the need for integrating scientific and technological planning with other planning activities within the nation. This requires broadening the perspective of the planning process by including the system's environment, formed by the other systems that are interrelated with it, within the scope of the planning efforts. In particular, an analysis of the Latin American situation pointed out the need for integrating economic planning, educational planning, and scientific and technological planning in order to resolve the divergences between individual and collective rationality and the contradictions that are highlighted in Sagasti (1972, chap. 4 and 6).

4) *Planning for scientific and technological development should be coordinated and internally coherent*

The scientific and technological system is formed by organizational units at different levels performing different functions. These units generate

plans which need to be coordinated and made compatible with each other. This principle puts emphasis on designing the appropriate institutional infrastructure and defining the channels of communications among the organizations involved in planning, in such a way that the planning process would become capable of responding to the needs of the different units in the system. Coordinated planning is therefore concerned with attaining coherence within the system by making compatible the plans of individual units at the same and different levels.

5) *Planning for the development of science and technology should be experimental and adaptive*

Relatively little is known about the factors and conditions affecting the behaviour and performance of the scientific and technological system, particularly in underdeveloped countries. Therefore, planning for the development of science and technology will be unavoidably experimental and steps should be taken to allow interpretation of the anticipatory and actual decisions to be made within an experimental design framework.

In addition to the uncertainties arising from the lack of knowledge about the behaviour of the scientific and technological system and its constitutive units, there are the uncertainties associated with changes in the system and its environment. These uncertainties regarding the future choice situations to which anticipatory decisions refer, require that the planning process be flexible and adaptive in order to respond to new developments in the system and/or its environment. In short, the planning process should be experimental, flexible, and adaptive. The planning methods associated with it should be capable of making planning a cumulative learning process.

A final remark on principles for scientific and technological planning in underdeveloped countries refers to the need for avoiding rigidity in planning methods. A methodology for planning science and technology should be applicable under a variety of circumstances that may change continuously. Hence the importance of providing a frame of reference within which planning procedures, methods, and models could be placed as they are modified and augmented in order to conform to evolving situations.

## 4. The categories of anticipatory decisions involved in scientific and technological planning

As long as anticipatory decisions are the building blocks of planning, the development of planning methods should consider explicitly the different types of anticipatory decisions that have to be made, for these may require different types of planning procedures. Five general categories of decisions can be identified in the process of planning for scientific and technological development : first, the definition of long-term ideals and the desired future image of the system; second, decisions regarding the pattern of interactions with related systems and their decision areas; third, decisions about the institutional infrastructure of the system; fourth, determining the scope and nature of the activities to be performed by the system; and fifth, decisions on the allocation of all types of resources. These five anticipatory decision categories are the domain of stylistic, contextual, institutional, activity, and resource planning respectively.

The interactions among these categories of decisions can be summarized by saying that resources are allocated to *activities* through *institutions*, taking into account the *context* in order to approach the *desired future*.

However, even if a conceptual and operational separation of these five types of planning activities is possible, it must be emphasized that they are not independent and that they cannot be dealt with separately and individually. A planning methodology which would simultaneously identify the combination of activities, the institutional structure and the allocation of resources that optimize the performance of the system making it approach its ideal, is what planners would like to have at their disposal. Unfortunately, it is rather unlikely that such a methodology could be developed in the near future, and the most viable alternative appears to be the development of iterative planning procedures which would take each category of decisions in turn, defining a provisional plan to be revised once anticipatory decisions have been made in the other areas.

The five categories for scientific and technological planning can be regarded as a framework within which to order the tasks involved in planning for scientific and technological development. Current planning methods refer only to the categories of activity and resource planning; there are no methods specifically designed for anticipatory decision making in any of the three other categories. An analysis of the Latin American situation (Sagasti, 1972) shows that the contextual and institutional categories are of particular importance for science and technology, and recent developments in planning theory (*cf.* Ackoff, 1971; Ozbekhan, 1969) suggest that the category of stylistic planning is of fundamental importance orienting planning activities as a whole.

The different characteristics of anticipatory decisions in each of the five categories impose the need for developing different planning paradigms, conceived as the collection of points of view, habits of thought, methods and models, for the five different categories of planning activities. Planning concepts, procedures and methods which are appropriate for one planning category cannot be expected to be equally appropriate and applicable for any of the other categories which differ in almost every respect. For example, resource planning procedures and the resource perspective of planning cannot be applied effectively for institutional, contextual, and stylistic planning. The particular problems of resource distribution and allocation have little in

common with those of institutional building, those of coordinating policies and plans, and those of designing the ideal desired future. Hence, it becomes necessary to discard old thinking habits when moving from one category of planning to another. These remarks can be put forward in the form of an additional principle : *Planning for scientific and technological development should consider the different categories of planning decisions that have to be made and develop methods appropriate for each.*

The different characteristics of the five types of anticipatory decisions described above, suggest that they may fall within the domain of different planning organizations. Assuming the existence of a central agency in charge of scientific and technological planning, stylistic planning would then be performed by the planning agency and the interest groups which are in some way or another affected by the anticipatory decisions to be taken. Contextual planning would be a task to be performed by the planning agency in conjunction with planning agencies in other related systems. Institutional, activity, and resource planning would be carried out by the planning agency and the other institutions and organizations acting within the boundaries of the scientific and technological system.

The relationships between the different categories of planning and the three time dimensions of long, medium and short-range planning can be outlined as follows : stylistic planning is essentially a long-range planning activity, and the dimensions of medium and short-range are not relevant to it. Contextual, institutional, and activity planning are seen to be primarily medium-range planning activities, although the identification of ideal patterns of interaction, institutional structures, and patterns of activities would be included within stylistic planning and hence become part of a long-range planinng exercise. The dimension of short-term planning appears to be less important for these three planning categories. Finally, resource planning involves the three time dimensions considered, although it is primarily oriented to short-range planning. Occasionally long and medium-term resource commitments have to be made, but by and large resource planning is concerned with short-range considerations through the budgetary process. Summarizing, we may say that the short-range is the dominant time dimension for resource planning, that the medium-range is the dominant time dimension for activity, institutional, and contextual planning, and that the long-range is the dominant time dimension for stylistic planning.

The main characteristics of the five types of planning activities are summarized in Table 1. The conditioning factors, the areas where emphasis is placed, the type of process and the procedures involved, the organizations responsible for carrying them and the dominant time horizon, are specified for each of the five types or categories of planning activity.

It is also possible to relate the five principles for scientific and technological planning identified in the preceding section with the five planning categories of stylistic, contextual, institutional, activity, and resource planning. The



Table 1. *Characteristics of the different categories of planning*

| | *Stylistic* | *Contextual* | *Institutional* | *Activity* | *Resource* |
|---|---|---|---|---|---|
| Conditioned by | Value systems and preferences (stylistic constraints)<br>Long-term possibilities | Environmental constraints<br>Interdependencies with other systems | Institutional constraints and possibilities for development<br>Organizational ecology | Existing and potential capabilities<br>Dynamics of processes | Availability of resources<br>Possibilities for directing allocations |
| Emphasis on | Alternative futures<br>Desired image (willed future)<br>Clarification of values | Convergence of different policies and plans<br>Attaining overall coherence in plans and policies | Establishing appropriate organizational structure (channels and clusters) | Defining areas for concentration of activities<br>Evaluation of past performance | Influencing resource allocation |
| Type of process | Exploratory<br>Consultative<br>Multiple-loop | Coordinating<br>Negotiative | Structuring and texturing (setting the organizational fabric) | Diagnosing<br>Target-setting<br>Balancing<br>Learning | Allocative and distributive<br>Experimental |
| Procedures followed | Establishing ideal standards<br>Proposing broad directions<br>Establishing dialogue with interest groups | Making explicit relevant implicit policies<br>Resolving contradictions<br>Use of indirect instruments for implementing plans and policies | Institution building and renewal (creation and modification of institutions)<br>Defining performance measures<br>Setting the "rules of the game" | Establishing objectives<br>Defining orientation<br>Setting operational procedures | Acquiring and distributing resources<br>Establishing priorities for resource allocation<br>Defining specific aims and goals<br>Generating a data base |
| Made by | Planning agency and interest groups | Planning agency and agencies in other systems | Planning agency and other organizations in the system | Planning agency and other organizations in the system | Planning agency and other organizations in the system |
| Dominant time horizon | Long-range | Medium-range | Medium-range | Medium-range | Short-range |

five principles apply to the planning process as a whole, and hence to each of the five categories. Table 2 summarizes these relationships.

I shall now describe in further detail the nature and characteristics of the five categories of planning which have been identified and are offered as a framework for scientific and technological planning in underdeveloped countries.

1) *Stylistic planning*

The general objectives of stylistic planning are to project a desired future image of the scientific and technological system as an ideal to be approached, and to engage the participation of the interest groups affected by planning, exposing their values and preferences in the process. The stylistic plan is turned into an instrument to promote dialogue and participation, rather than being the justification of the planning activity. The main outcome of the process becomes a common view of the future and a perspective shared by those participating in the process, rather than the statements contained in the documents describing the plan.

Trist (1968), commenting on Crozier's analysis of French economic planning, has emphasized that the learning process that takes place during the preparation of a plan is far more important than the plan itself. Recent suggestions by Caroll (1971) point out that this learning process and the involvement generated by participatory forms of planning, particularly in technological matters, need not to be confined to the immediately interested parties, such as the government and scientist, but also spread to ordinary citizens. Therefore, participation and dialogue with all interested parties to identify the "style" in which the system would evolve, while at the same time initiating a learning process, becomes the main concern of this planning category.

Stylistic planning is an exploratory multiple-loop process conditioned primarily by value structures and preferences, this is what Ackoff (1970) calls "stylistic constraints", it puts emphasis on the specification of alternative futures and the definition of a desired image or a "willed future" (Ozbekhan, 1969).

The ideal future image of the system to be designed in stylistic planning must include statements on the patterns of interdependence with other related system. For example, it should specify the possible contributions of science and technology to economic and educational development, and to the use of natural resources. It should also contain a description of the ideal institutional infrastructure for the system, the structure of activities to be performed, and the ideal pattern of resource acquisition and allocation.

The image of the desired future would be put forward in terms of "scenarios" consisting of qualitative statements about the characteristics of the system and its interrelations with the environment at a certain future time. The scenarios would be complemented by proposals regarding the general strategy



Table 2. *Relationships between planning principles and planning categories*

| | *Stylistic* | *Contextual* | *Institutional* | *Activity* | *Resource* |
|---|---|---|---|---|---|
| Continuous planning | Futures are designed continuously through modular studies covering different aspects of the ideal future system. | Patterns of interaction with other systems are reassessed on a continuous fashion. | Although particular institutional structures cannot be changed continuously, they should be reviewed periodically. | Priorities for research activities should be modified whenever necessary. | Acquisition and allocation of resources takes place continuously. |
| Participative planning | Interest groups participate in the process. Their values are uncovered in designing the desired future. | Planners in other systems in the environment participate in designing patterns of interaction. | The design of institutional structures includes the participation of those who will be part of them. | Priorities are defined with the participation of the scientific community. | Resources allocated by planning agency consider inputs by those who will use them (research contracts, grants and fellowships). |
| Integrated planning | The ideal image specifies desired interrelations with other systems. | Patterns of interaction with other systems in the environment are the central concern. | Institutions should be designed to link the system with its environment in an appropriate fashion. | Priorities are fixed taking into account the needs of other systems. | A large portion of resources are allocated by other systems in the environment. The system should influence their allocation. |
| Coordinated planning | The ideal image specifies the role played by the different units which belong to the system. | The units in the system should be coordinated so as to allow implementation of the designed patterns of interaction with the environment. | The institutional infrastructure of the system should be designed to allow coordination of the component units of the system. | Activities performed by different units in the system should be coordinated to avoid duplication and leaving gaps. | Resources allocated by different units in the system should be coordinated and evaluated through uniform budgetary procedures. |
| Experimental and adaptive planning | Designed futures are flexible and should be modified in response to changes in values and preferences. | Patterns of interaction need not to be considered fixed, but should be modified according to changes in the system or its environment. | Institutions should not be given "tenure" and made permanent, they should be responsive to changes and capable of learning. | New fields for scientific and technological activities emerge because of unexpected changes, priorities should be modified accordingly. | Decisions on resource allocation should be viewed and interpreted in an experimental context. |

to follow in order to approach the ideal state they describe. The statements need not to be quantitative or supported by detailed projections, initially they should be impressionistic descriptions of the scientific and technological system in year 19--. As the interactions in the continuous process of stylistic planning evolve, these scenarios would be refined and brought on focus more clearly to take into account possible developments in the system and external limitations. A good description of the construction and use of scenarios suitable for stylistic planning is found in (Management and Behavioral Science Center, 1970).

The planning horizon to which stylistic planning refers is the long-range, a span of time long enough so that the present situation and its dynamics do not condition to any significant extent the future situation. This does not imply, however, that questions of possibility and feasibility are completely discarded.

The concern for the design of ideal future systems is not a recent one. In addition to traditional utopian thinking (Plato, St. Augustine, St. Thomas More, etc.), the design of ideal systems has been advocated on the basis of its contributions to actual decision making at the practical level. Perhaps one of the most coherent early descriptions of the possible use of ideal schemes for taking action has been given by Kropotkin in 1873 (Kropotkin, 1970). In an essay titled "Must we occupy ourselves with an examination of the ideal of a future system?", he said :

"I believe that we must. In the first place, in the ideal we can express our hopes, aspirations and goals, regardless of practical limitations, regardless of the degree of realization which we may attain; for this degree of realization is determined purely by external causes.

In the second place, the ideal can make clear how much we are inflected with old prejudices and inclinations. If some aspects of everyday life seem to us so sacred that we dare not touch them even in an analysis of the ideal, then how great will our daring be in the actual abolishment of these everyday features? In other words, although daring in thought is not at all a guarantee of daring in practice, mental timidity in constructing an ideal is certainly a criterion of mental timidity in practice" (p. 47).

Kropotkin stresses the benefits of freeing the imagination from questions of feasibility in order to uncover latent value structures and preferences. In a different vein, both Ackoff (1970) and Ozbekhan (1969) have emphasized the same benefits that can be derived from such an exercise in utopian thinking. Ackoff proposes the construction of scenarios which are bounded only by stylistic constraints, and Ozbekhan suggests the design of a willed future embodying only preference and value considerations. However, we feel that ideal future images, to be of real benefit in stylistic planning, must be tempered in some way by the concept of what it is possible to achieve.

The view of the future implicit in stylistic planning is purposeful and interventionist. It involves the design of a future rather than the extrapolation of current trends and existing conditions, or the projection of most likely developments based on extrapolations and the potential reactive responses to them. The extrapolated view of the future can be conceptualized in terms



of the statement "if present trends continue and no action is taken, then the future *will* look like this". The most likely or "surprise free" view of the future agrees with the statement "given current trends, and the fact that this or that action will probably be taken in reaction, then the future *is most likely* to look like this". Good examples of extrapolated and most likely projections are found in Kahn and Wiener (1967), Wiener (1971) and Sagasti and Ackoff (1971).

The stylistic view of the future adopts a wishful and purposeful stance; it seeks to design the future as we would like it to be, to concrete aspirations in the form of an ideal future state, and then to devise a strategy for reaching its given present conditions. *Initially* the questions of feasibility and possibility should be avoided for the reasons that Kropotkin suggests, namely, they should not interfere with the vision of the future which could bring new ideas and would embody preferences and values; but these questions need to be introduced when modifying the desired image and devising a strategy for attaining it. At later stages the extrapolated and most likely futures should play the role of "reference projections" with which to compare the desired future. From this comparison, Ackoff's "planning gap" emerges, and the planners are confronted with the void between the projected and desired futures which has to be filled in through purposeful action.

The questions of feasibility and actual possibilities introduce a balancing force for the utopian thinking involved in the design of desired future. In stylistic planning for science and technology this is done in two ways : through the preparation of a diagnosis of the existing situation, its dynamics, and its possibilities for future development; and through the use of technological forecasting to examine the feasibility of attaining particular aspects of the desired future image, ascertaining whether the levels of effort required are commensurate with potentialities.

The injection of a measure of reality into the stylistic planning process is designed to avoid the temptation to embrace the concepts and statements contained in a purely wishful desired future, elaborating on them and then assuming the desired image to be an accomplished fact. Fayerwheather (cited in Gross, 1967) has called this tendency "projectismo" and identified it as a characteristic of much planning in Mexico. Gross (1967) suggests that this is a feature common to planning in many underdeveloped countries where "dreams are easy to concoct but the conflicts and obstacles to achievement are tremendous" (p. 195). According to him

"[...] projectismo is based upon utopian commitments to a desired situation that are simply impossible to obtain. In this latter case, the elaboration of presumed methods of attaining the unattainable may serve to make the plan more plausible, even though not a bit more feasible. Yet the fact that a plan may be utopian need not prevent its reaching the stage of central decision and commitment. National political leaders often make 'pie in the sky' promises as the only way to distract attention from current suffering".

Therefore, by introducing a diagnosis of the existing and potential capabilities in science and technology and incorporating technological forecasting

within the scope of stylistic planning for science and technology, it may be possible to avoid the pitfalls which are associated with purely utopian and wishful thinking in the design of a desired future image. The appendix to this paper suggests further ideas on the methodology for stylistic planning.

There are reasons that suggest that the process of building a planning capability, particularly in science and technology, should give priority to stylistic planning. Stylistic planning is relatively more independent from the other types of planning activity. Being a long-range planning exercise, it affects resource, activity, institutional, and contextual planning more than they affect it. Furthermore, planners, policy makers and other interest groups find it easier to agree on long-term ideal conceptualizations, than on short-term problems of resource allocation or medium-term problems of defining activities, building institutions, and coordination with other systems. Stylistic planning may thus provide a basis for agreement which would be otherwise difficult to obtain.

2) *Contextual planning*

The second category of planning decisions refers to the pattern of interaction between the scientific and technological system and its interrelated systems in the environment. Contextual planning is concerned with attaining coherence among these interacting systems, and with exploring the possibility of using indirect instruments and mechanisms for implementing planning decisions. It is conditioned by environmental constraints and lays emphasis on the convergence of policies and plans put forward by different systems, primarily through coordination and negotiation processes. The procedures it follows involve making explicit the consequences of other systems' policies and plans, the resolution of contradictions that may appear among them, and the analysis of possible ways of implementing scientific and technological plans through measures taken in other systems.

Interactions with the environment of the scientific and technological system are the main focus of contextual planning. The environment can be defined as those systems and their components which affect the behaviour and performance of the scientific and technological system, but over which it has no possibility of exerting direct control. However, this does not imply that the system cannot influence the behaviour of its environment. The negotiation and coordination processes referred to in the preceding paragraph are the means through which the behaviour of other systems in the environment can be influenced without having direct control over them. Because of their importance for contextual planning, the characteristics of the environment merit further analysis.

Eric Trist in his contribution to a United Nations report on administrative capabilities for development (1969), proposes a differentiation between the task and contextual environments of a system or organization :



"It is necessary to distinguish between the immediate, operational or task environment and the more remote general or contextual environment. The task environment consists of all organizations, groups and people with whom the organization has specific relations, on both the input and output sides, even though it may not be aware of their complete range. The contextual environment consists of the relations which the entities included in the task environment have to each other and to other systems not directly entering the world of the organization's own transactions. Events in the contextual environment may at any time obtrude into this world, constructively or destructively, predictably or unpredictably" (p. 44).

For a system to deal effectively with its environment it is not sufficient to pay attention to the task environment, which is formed by the organizations, institutions, interest groups, and clients, having direct linkages with the system. It is also necessary to assess the potential influence of the contextual environment, seeking to anticipate changes which may affect the behaviour of the system. For the scientific and technological system, the relations between different components of the economic system, those between the physico-ecological and the economic systems, those between the educational and economic systems, etc., would constitute the contextual environment.

In planning patterns of interaction it may be the case that some aspects and components of the contextual environment, particularly those which intrude and affect the system's behaviour and performance, need to be made part of the task environment by establishing direct links between them and the system. This may be thought of as a process of enlarging the scope and the influence of both actual and anticipatory decision making for the scientific and technological system.

The characteristics of the environment and of the policies made by the systems it contains, constitute in fact a set of implicit policies for science and technology. Government economic and educational policies, in particular, contain an array of consequences or implicit policies which regulate the behaviour of the scientific and technological system in an indirect way. These implicit science and technology policies must be made explicit if planning for scientific and technological development is to be effective. The process of making them explicit is likely to uncover contradictions and inconsistencies between overt objectives and policies and those forced on the system by its environment. The ways in which these contradictions are resolved will have a decisive influence on the future developments of science and technology [2].

The process of uncovering implicit policies and exposing contradictions is likely to lead to value conflicts. Contradictory policies are not made congruent simply by showing discordances and divergencies. These value conflicts must be resolved through coordination or negotiation; extreme cases may even require an open fight in order to determine the values and objectives which will prevail in the conflict. Once these conflicts are exposed in context-

2. Given the importance of these contradictions for contextual planning, some aspects of the theory of dialectic materialism, which has a long tradition in handling contradictions, become relevant for contextual planning.

ual planning, policy makers and planners will have to make choices overtly and with full knowledge of the value conflicts involved.

Therefore, contextual planning is concerned with the interdependencies between the system and its environment. It examines the implicit policies which are the consequences of actual and anticipatory decisions taken in other systems, it identifies contradictions and points out the ways of resolving them, and it also considers the possibility of using indirect instruments for implementing the system's policies and plans. Contextual planning constitutes primarily a medium-range activity; the existing situation, particularly with regard to the task and contextual environment, conditions the anticipatory decisions that will be taken, but do not determine them to a large extent.

3) *Institutional planning*

The anticipatory decisions on institutional structure, which are the subject of institutional planning, refer to the organizational network through which activities are to be carried out and resources channeled, and to the rules and regulations which govern the behaviour of the different units comprising the institutional infrastructure. Institutional planning is conditioned primarily by organizational constraints and the possibilities for institutional development; this is, the organizational ecology of the scientific and technological system. It emphasizes the establishment of organizational and institutional channels and clusters, through a process of structuring and texturing which defines the organizational fabric of the system. The procedures followed in this type of planning activity include institution building and renewal, which refer to the creation and modification of institutions, setting the codes of behaviour or "rules of the game", and defining the performance measures for organizations in the scientific and technological system.

The development of an institutional infrastructure for the scientific and technological system is a necessary condition for the development of science and technology in underdeveloped countries. René Maheu, Unesco's Director General, emphasized the importance of the network of institutions in an address to a meeting of Southeast Asian Countries (Maheu, 1965) :

"The scientifically advanced nations know well — and this is precisely the secret of their technological pre-eminence — that the social and economic benefits derived from oriented or applied research depend on the existence and efficiency of what is known as the country's 'operational network' of scientific and technological research institutions" (p. 10).

This network of institutions is generally well developed in advanced countries, and therefore they have seldom dealt with it explicitly. Planners in developed nations take the institutional structure for granted and address themselves to the problems of priorities or resource allocation. The fact that institutional structures are more developed in advanced countries has often led to the belief that underdeveloped countries should follow a strategy



of imitation in planning their institutional development. Whyte (1968, p. 371) points out that this has been the case in Peru :

"There is a widespread tendency in Peru to imitate the institutional structure and practices of industrialized nations and to accept the institutions in other countries as standards against which Peruvian institutions are measured. Peruvians are self-conscious of their imitative tendencies, and we often hear nationalistic condemnation of outside influences and vigorous defense of what is Peruvian. But even those who express themselves in public most nationalistically, in private and casual conversation, talk about the inadequacies of Peru and Peruvians and the need for changing Peruvian institutions in the image of those of another country".

This tendency towards institutional imitation has been responsible for several deficiencies found in Peruvian institutions, particularly in the fields of health care, higher education, industrial development, and even science and technology.

A strategy of institutional imitation is likely to fail and should be avoided for the following reasons : first, the context and the environment in which institutions operate in a developed country are widely different from those prevailing in the underdeveloped ones, and there is no guarantee that the institutions will operate efficiently and contribute to development. Second, if they had the choice, developed countries would probably prefer in many cases to develop a different institutional structure than the ones they presently have and which are being copied. Third, the particular social and historical conditions of the underdeveloped country may provide with opportunities to develop new institutional patterns which are better suited to local conditions, and which could eventually become a model for other countries, underdeveloped and developed.

In underdeveloped countries the growth and evolution of institutions in the scientific and technological system has been slow. Research organizations, universities, research councils, and service organizations have lacked financial resources and qualified manpower, and in some cases, particularly in Latin America, there has been little demand for the knowledge and services they produce.

A well organized institutional structure, particularly at the national level, cannot be developed from scratch in a short period of time. However inadequate, usually there is a core of institutions (even if they exist only on paper) from which to begin institution building and designing the organizational fabric in underdeveloped countries. Institutional planning takes the existing structure as a basis, examines it critically and proposes changes and additions to it. Once proposals are implemented, they should be left to evolve without changing them again too soon. A certain lead time is required for the institutions to stabilize after introducing major modifications, and frequent radical changes may retard the development of the institutional structure.

It is impossible to "optimize" an institutional design in the traditional sense. As far as I am aware, there are no proposed criteria for identifying and generating optimal institutional designs, particularly for the scientific

and technological system in underdeveloped countries. One possible strategy for generating and choosing among alternative institutional designs may be based on a "satisfycing" approach (Ackoff, 1970), in which minimal conditions are established for an acceptable institutional structure. The selection among designs which satisfy the minimal conditions would be left outside the scope of institutional planning.

The "satisfycing" strategy can be improved by adding a second set of criteria based on the institutional design's capability for adjusting to changes in the system or its environment. This would constitute a "satisfycing-adaptivizing" strategy (Ackoff, 1970) for institutional planning in which organizations and institutions are designed to comply with two sets of criteria : *a*) minimal standards which determine acceptability, and *b*) a set of conditions which would ensure the institution's capacity for adaption. However, it may not be possible always to define the adaptivity criteria in addition to the minimal set of standards the institutional design should satisfy [3].

4) *Activity planning*

Activity planning is concerned with the category of decisions referring to the scope and nature of activities to be performed by the system. It is conditioned by the existing and potential capabilities of the system and the dynamics of the processes taking place within its boundaries. Activity planning puts emphasis on the definition of priorities for concentrating activities and also on the evaluation of past performance as a guide for defining these areas. This is achieved through a process involving a diagnosis of the existing situation, setting targets and balancing the diagnosis with target-setting. The procedures to follow in this type of planning include defining the objectives for carrying out activities, defining the orientation which the system should take, and providing operational procedures to control the performance of the scientific and technological system in the selected domains of activity.

The objectives of activity planning are to provide priorities and general orientations for the activities performed by the scientific and technological system and to propose measures to control and regulate the flow of knowledge originating abroad. The methodology should specify the type of activities to be given priority and the areas in which they should be concentrated, taking into account their possible contribution to economic and social development. Thus the tasks in activity planning can be divided into two groups : determination of the scientific and technological activities that should be carried out in the country, and specification of the areas in which scientific and technological knowledge will be acquired from foreign sources.

3. See F.R. Sagasti, *Towards a methodology for planning science and technology in underdeveloped countries*, (1972), chap. 7.



The philosophy underlying the category of activity planning is that scientific and technological autarky is practically impossible and even undesirable in the modern world, particularly for the underdeveloped countries of Latin America. The strategy proposed for scientific and technological development is one of *selective interdependence* with other countries and their scientific and technological systems. This implies that the underdeveloped country will seek to concentrate its scientific and technological efforts in areas for which it already has relatively high competence, or can acquire it in the short-term, and in areas for which knowledge cannot (or should not) be imported. The local scientific community would attempt to transform itself into a world center for those particular areas of scientific and technological knowledge in which it has decided to concentrate its efforts, trying to compensate the flow of imported knowledge. The selective interdependency strategy also implies the possibility of the country importing know-how, processing it further and then re-exporting it. Therefore, the selection of domains for scientific and technological activities becomes of crucial importance.

It is also necessary to control effectively the import of technology originating abroad, in order to ensure that in those areas in which the country will be dependent on foreign knowledge, it would obtain the best possible conditions from its suppliers. The bitter experience of Latin American countries with regard to the acquisition of foreign technology, shows the need for exerting more adequate control over the process of international transfers of technology to underdeveloped countries.

The concept of a strategy of *selective interdependence* is based on the work of Emery (1967), Trist (1969), and Emery and Trist (1965), on the interactions between a system and its environment. Both Blackett (1967) and Gilpin (1969), have argued in favor of strategies for determining priorities which are closely related to the strategy of selective interdependence. Blackett emphasizes that underdeveloped countries should not re-invent whenever they can avoid it, and that before starting expensive research and development efforts, the country should buy its way as near as possible to the front line of technological advance. Gilpin identifies three general strategies for selecting priorities for scientific and technological development :

"The first (strategy) is to support scientific and technological development across the broadest front possible [...]

The second strategy is scientific and technological specialization. The essence of this strategy is to support specific areas of science and technology, usually of commercial utility and concentrate one's resources upon them [...]

In contrast to the first two strategies, the third is an importation strategy. Emphasis is placed on importing foreign technology by the purchase of licenses [...] Although this strategy, like the second, implies specialization, it differs in that relatively little basic research is carried out. Instead [...] resources are concentrated on improving and redesigning imported technologies, especially for subsequent export" (p. 442).

The selective interdependence strategy proposed for scientific and technological activity planning in the Latin American context encompasses both

the second and third strategies identified by Gilpin. The existence of unused natural resources, for which technical knowledge is not available elsewhere, imposes the need for the "specialization" component of the strategy. The heavy reliance on foreign technology found in Latin America imposes the need for a component of the strategy based on imports of technical know-how. The lack of human and financial resources preclude underdeveloped countries to follow the first strategy identified by Gilpin, which has only been followed by the Soviet Union and the United States.

The methodology to be followed in determining domains and priorities for scientific and technological activities is based on the Requirements and Possibilities method (Sagasti, 1971*a*), which consists in comparing the capabilities or potential for doing science and technology with the demands or requirements of the economic, educational, physico-ecological, and other systems in the nation. It examines the functioning of these demand generating systems, identifies their needs for knowledge, and brings them into the open. Once this is done, a comparison between requirements and possibilities is made to determine imbalances, seeking to couple demand for with supply of knowledge. This balancing process would replace the market mechanisms for scientific and technological knowledge which operate in countries with well developed institutional structures.

However, it was found necessary to modify and extend the approach proposed by this method, particularly by refining the general concept of "requirements". In both the OECD and OAS versions of the method, requirements are derived from economic, educational, cultural and other activities on the basis of a one-way analysis : the needs of demand generated activities are projected onto the scientific and technological system. The possibility that capabilities for science and technology may give rise to demand generating activities, which in turn would create requirements for science and technology, is usually not considered. Schema 1 shows graphically the concepts to be introduced.

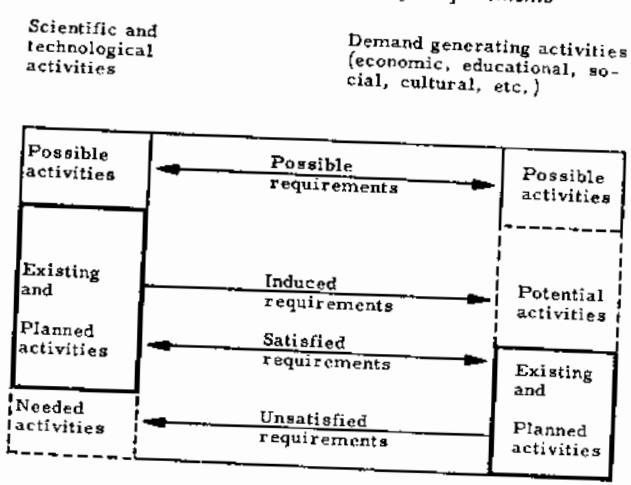
For each of the two groups of activities under consideration, the scientific and technological and the demand generating groups, the activities can be classified into several categories which could give rise to different types of requirements. Beginning with the demand generating activities (economic, natural resources, social, cultural, etc.), there are *existing and planned* activities, which generate requirements for science and technology that may be *satisfied* or *unsatisfied* depending on whether the relevant scientific and technological activities are being carried out or not. The unsatisfied requirements are those which generate a need for new scientific and technological activities while the satisfied requirements find scientific and technological activities which correspond to the needs they create. Unsatisfied requirements may be identified at different levels. At an aggregate level, priorities for science and technology could be established for general problem areas of national importance, or for economic sectors. At the level of productive units and specific technologies, research projects could be identified and priorities attached to them. Different methods will have to be used for selecting areas of concentration and determining priorities at each of these levels.



Turning now to the other side, there are existing scientific and technological activities which do not find counterparts in demand generating activities. They could *induce or promote* economic, educational, social, and cultural activities which would in turn generate requirements for science and technology. Thus, scientific and technological activities in this category, could create demand for themselves by promoting their corresponding economic, social, etc., activities. Requirements derived from these "induced" demand generating activities will be called *induced requirements*. The importance of induced requirements becomes apparent in the light of the characteristics of scientific and technological development in Latin America.

Many countries possess capabilities in some areas of fundamental, or even applied research, which have had little direct application. For example, it is not uncommon to find relatively high levels of competence in areas such as electronics, physics, and chemistry, for which there is no effective demand due to a lack of activity in the corresponding economic sectors. These capabilities for doing scientific and technological work could act as promotors or inducers of economic activities, which would in turn require the research services that the scientific and technological system is capable of providing. These *induced requirements* could play an important role, not only in the development of economic and social activities, but also in scientific and technological progress.

Schema 1. *Different types of requirements*



For the sake of completeness, it is possible to define another category of requirements, for which neither the scientific and technological nor the demand generating activities exist or are planned. These *possible requirements* would be generated by activities arising from a different development strategy than the one pursued by the country, and from a critical examination of the role that science and technology play in advancing economic growth under different models of development. This category of requirements becomes particularly important when the possibilities of skipping stages and of pursuing different styles of economic development are considered explicitly.

Therefore, at least four types of "requirements" can be identified : possible, induced, satisfied and unsatisfied. The original version of the requirement and possibilities method, both in the OAS and OECD versions, only considers the last of these categories. Priorities for scientific and technological activities have been usually established from an analysis of existing and planned economic and social activities which generate unsatisfied requirements. The explicit consideration of possible and induced requirements would alter these priorities by taking into account potential and possible activities, and the demands for knowledge associated with them.

5) *Resource planning*

The last category, resource planning, deals with the allocation of resources, it is conditioned by the availability of resources and by the possibility of directing the way in which they are allocated, it therefore puts emphasis on influencing the pattern of resource allocations to and within the system. Resource planning mainly constitutes an allocative and distributive process, which should also allow interpreting allocation decisions within an experimental context. The procedures followed to carry out this type of planning activity include acquiring and distributing resources, defining specific aims and goals to be achieved with given resources, establishing priorities for resource allocation, and generating a data base which would allow to interpret each resource allocation decision, taking an experimental point of view, as a sample point in a universe of possible decisions.

Planning agencies seldom have a sizeable portion of the total resources allocated to science and technology under their control, it is necessary to include other institutions, such as private research organizations, universities, and government dependencies, as effectively engaged in resource planning, even if they are not conscious of the role they play. Taking the planning agency's point of view, resource planning should therefore be aimed at allocating its own resources efficiently, as well as at influencing the way in which other institutions and organizations in the scientific and technological system allocate their resources.

With regard to human resources, scientific and technology planning agencies in Latin America have little direct control over the preparation and training



of highly qualified personnel. These are functions of universities and other institutes of higher education, and the agency in charge of planning scientific and technological development can only propose policies, coordinate efforts and in general try to relate educational plans with scientific and technological development plans. Taking the areas of concentration defined in activity planning, the agency could point out to educational planners the needs for highly qualified researchers and technical personnel, suggest policies for retraining scientists whose skills appear to be irrelevant. It could also promote meetings, and conferences to increase communication and interchange of experiences in the scientific community, as well as devise means for awarding prestige to scientific and technological activities which have direct relevance to development.

There are two areas of human resources planning in which the planning agency may exert direct control. These are the administration of fellowships and scholarships and the preparation of qualified personnel for scientific and technological planning and other supporting activities for the scientific and technological system. Through the administration of fellowships, particularly those to study abroad, the planning agency would be in a position to influence directly the volume and composition of highly qualified personnel, and therefore, exert a certain degree of control in the orientation of its development. The preparation of personnel for science and technology planning and the training of all kinds of auxiliary personnel needed for supporting activities (documentation specialists and librarians, for example) are additional tasks which the planning agency could handle directly.

With regard to the allocation of financial resources, two different procedures may be followed, depending on whether funds are controlled directly by the planning agency or are under the control of other institutions. In the first case the resources made available to the planning agency should be allocated to the general areas defined in activity planning. If research activities in these areas can be performed directly by the planning agency or one of its dependencies the problem becomes one of generating and selecting the projects they should be allocated to. If projects are to be performed by other organizations, the planning agency should request that proposals be submitted in the domains or areas given priority. The problem then becomes one of selecting among research proposals submitted to the planning agency. Procedures such as cost/benefit analysis are available for this purpose.

For the financial resources that are not directly under its control, the planning agency should propose allocation methods and criteria to other institutions, suggest uniform budgeting procedures which would allow inter-institutional comparisons, and initiate the preparation of an annual consolidated budget for science and technology showing how financial resources are being allocated in the nation. Resource planning would also include the generation of information systems and a data base on resource allocation, which would help in the construction of mathematical models for the allocation of financial

resources, and in the interpretation of allocation on decisions within an experimental framework.

Measures to rationalize the use of physical facilities should also be included in resource planning. These would refer to the use of buildings, laboratory equipment, instruments, computers, libraries, and documentation centers, among others. It is within the scope of the planning agency's functions to propose policies and plans that would lead to more efficient utilization of physical resources in the scientific and technological system.

The decisions involved in resource planning are in principle amenable to quantification, at least to a larger extent than those in activity, institutional, contextual and stylistic planning, and the use of mathematical models may prove useful in this area. However, it is doubtful whether they would be relevant at the stage of scientific and technological development in which most underdeveloped countries in Latin America are at present.

## 5. Summary

This essay has put forward several ideas for scientific and technological planning in underdeveloped countries. Section 2 introduced the concept of planning which was used throughout the work, and related it to recent advances in planning theory. Section 3 proposed several principles for scientific and technological planning, which could be viewed as guidelines for the development of planning methodologies.

Section 4 placed emphasis on the analysis of the different types of decisions involved in scientific and technological planning, grouping them into five homogeneous categories. The categories of stylistic, contextual, institutional activity, and resource planning, constitute a frame of reference to identify and evaluate the different types of decisions that must be taken, particularly in underdeveloped countries. The proposed categorization underscores the need for developing different planning paradigms for the different types of anticipatory decisions. The work on which this essay is based (Sagasti, 1972) explores in more detail the methodological implications of the conceptual framework and provides some examples of its application.

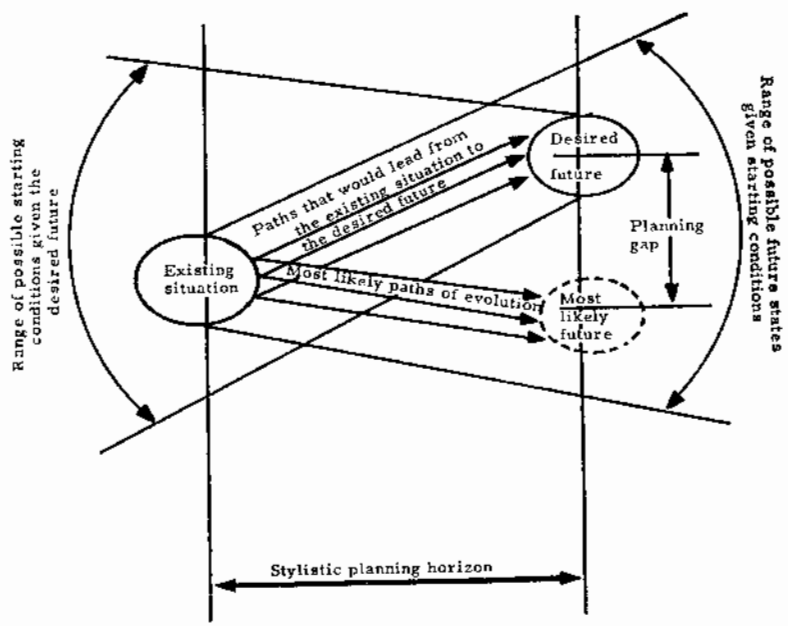
## APPENDIX

### *Further notes and stylistic planning*

The relation between the system's present situation and the desired future image merits further analysis. Stylistic planning involves a two directional process with respect to the time dimension : it requires designing a desired future image and working backwards towards the present (in order to derive the strategy that would lead to it), and it also requires diagnosing the existing situation and assessing its potentialities for future development. From the interplay between these two types of analysis an innovative but realistic image of the desired future would emerge.

Figure 1 depicts these concepts graphically. Coming backwards from the desired image to the present, we find a range of possible starting states which are potentially capable of reaching the future image. Similarly, going forwards from the present into the future we find a range of possible future states given existing conditions. If these two ranges contain the present situation and the desired future image respectively, then the stylistic planning process has produced a future image which is attainable. This image will therefore have an operational value for guiding other planning tasks.

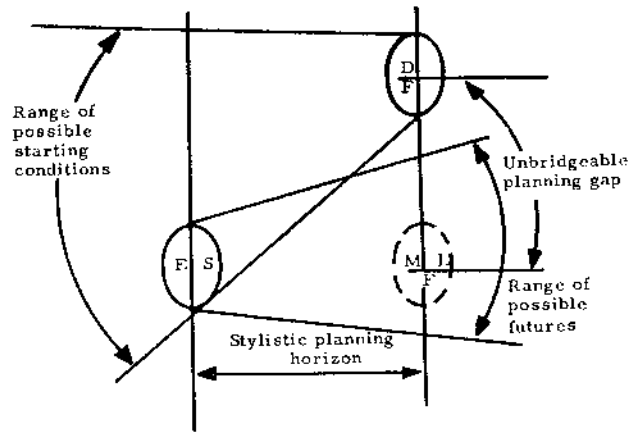
Figure 1. *Relations between existing and future situations in stylistic planning*



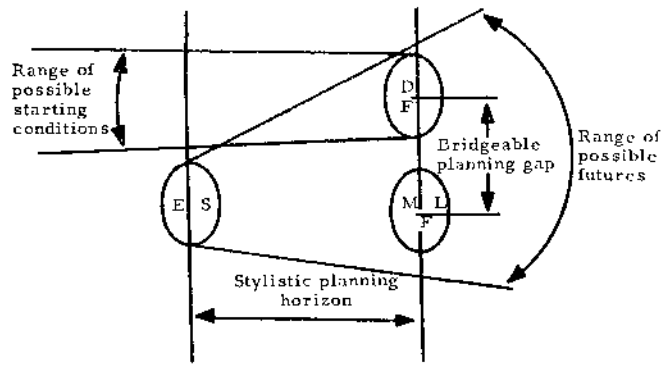

Two pathological conditions in the relation between the existing situation and the future image are presented in Figure 2. The first arises when the future image is designed in such a way that coming backwards from it there appears to be a possibility for reaching it, but the existing situation and trends will not allow the system to attain the desired image. The range of possible future states, given present conditions, does not include the desired future image. This defines an unbridgeable planning gap between the most likely and the desired futures. Borrowing a concept from statistical inference we may call this the Type 1 error in stylistic planning : designing a desired future image which is apparently attainable but which really is not.

The second pathological condition arises when an analysis of the future image, and of

Figure 2. *Pathological relations between existing conditions and future images in stylistic planning*




Type 1 error in stylistic planning




Type 2 error in stylistic planning

the present states that may lead to it, shows that the range of possible starting conditions does not include the present situation, although a careful examination of the present state, its dynamics, and of the possibilities for action would show that the desired future image is indeed attainable. We may call this the Type 2 error in stylistic planning : rejecting a desired image on the grounds that it is apparently not reachable when it really is attainable.

Of course *a priori* it is not possible to know with certainty whether the process of designing a desired future image for the system will lead to any of these pathological conditions or not. Uncertainties regarding the behaviour of the system and its environment during the time encompassed in the planning horizon prevent planners from devising a strategy which would lead inexorably to a designed future. In addition, the desired future image is likely to shift continuously, reflecting changes in values, the inclusion of different interest groups in the planning process, and changes in assessing what is feasible. The point to be made is that stylistic planning requires careful analysis in the two directions along the time dimension : from the desired ideal state to the range of possible starting conditions leading to it, and from the present situation to the possible futures open to it.

Furthermore the methodology for stylistic planning should lead to a framework for thinking about the other categories of planning activities, providing guidance to contextual, institutional, activity and resource planning. However, the desired future image need not be specified with great detail and constructed all at once. It could be designed through a series of modular studies forming part of a framework, but which would also have value and operational significance on their own. Through a continuous iterative process the framework would be filled in sequentially by carrying out modular studies. The final outcome would be a set of scenarios depicting the desired future image of the system and its interrelations with other systems. It would be obtained by integrating the different modules into a composite view of the desired future.

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