

AN OUTER SPACE COMMUNITY:
A MULTIDISCIPLINARY APPROACH TO AN ORGANIZATIONAL STRATEGY

by

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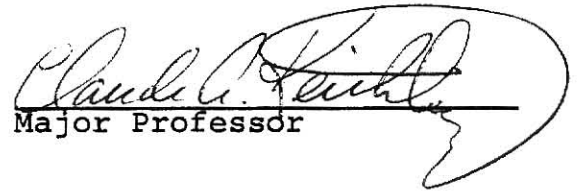
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INTRODUCTION

The objective of this topic is to explore the potential benefits of applying to future space communities the new town planning policies that have been modeled in various countries. New town planning has served as a tool for many nations as an economic and social benefit to handle growth pressures on cities, to generate employment, to offer optional residential living styles, and to open frontiers for future growth and economic practicality. It is the belief of this paper that the formula used by the aforementioned program has obvious applications for handling the problems that will develop when extraterrestrial habitats are promoted for space. There have been only a limited number of proposals written that explain a scheme for implementing a major space venture entailing a large number of human participants. The intent, therefore, of this work will be to demonstrate a possible organizational approach towards establishing a new space agency whose mission is the economic exploitation and the eventual colonization of space.

The study is a timely one in that studies of space related topics to date have not been written so as to make them accessible to the general public. The space program is presently suffering due to the public's negative outlook towards an exotic and costly program. Certain assumptions concerning financing and management schemes of space facilities that have been studied in some depth need to be clarified as a foundation for this paper:

- "1) Most of the actual [R & D] work involved in the program will be carried out by pre-existing contractors and subcontractors. The principal function of a [management] organization at each stage [of development] will be to provide overall technical guidance, program management and control, and financing for the project as a whole.

2) We assume that the program will be implemented only if the capital costs [of a space manufacturing facility] are comparable [to earth based industries or electrical facilities].

3) Assuming that capital costs and/or lifecycle costs [for a space manufacturing facility] are competitive with alternative [earth based options], we further assume that participating companies would be capable of financing the facility in much the same manner as at present - by borrowing funds against future revenues from the sale of [the manufactured goods].

4) We assume that the [development scheme] will be based primarily on private enterprise with varying degrees of governmental regulations."¹

The study includes a fairly thorough literature search of materials describing space systems from a number of disciplines. Interest in these areas has been extensive in the overall academic world, yet planning may provide a new direction offering a different scope to space program development.

The relative similarity between the small communal space environment being proposed and new town planning assumes that the former is consonant with the latter. The thesis, basically, is an attempt to integrate a new town master plan with the professional disciplines participating in the research and development of space systems. The main objective is to prove the capacity and the feasibility of using the new town planning approach to coordinate a community development scheme in an extreme environment. Ultimately, the intent of this paper will be to promote the master plan concept of planning into the design phase of future space oriented facilities.

The conclusions are only suggestive, because the effort to implement will lead to major modifications, if not in theoretical concept, at least in their conversion into a program acceptable for human participation.

Chapter I: A Need For Planning

Of major interest in the development of this topic is the position that planning plays in the generation of the overall master plan. The term planning is ambiguous in its conception, but definable in its generalized parts. In its more narrow sense, planning refers to the activities of the professional planner as an economist, land use specialist, administrator, health system specialist, ect.

In a broader sense, however, planning refers to the process by which decisions are made, on a private as well as public level. In this sense, planning is both technical and political. It encompasses establishment and support of planning as an institution, the conveying of technical information into the stream of political decision-making, and provides avenues to generate support for planning decisions, in addition to the profession's purely technical role.

The planning process functions as a method of mediating a rational plan for development, actuating quasi-scientific methods in its approach. The real issues being to weigh the costs of one approach to another after considering any and all individual factors incrementally. From the outset, the planner is faced with a number of problems:

- "1) to determine whose ends are to be served,
- 2) to create a strategy for achieving consideration and implemetation of his proposals,
- 3) and to decide who is to oversee,² coordinate and insure the implementation of plans."

In so many words, a plan of action that, if founded on reasonable assumptions inspired from reconnaissance studies of potential program participants, will author a positive response amenable to the public and private sectors.

The significance of a plan to promote the exploitation of space would define national and international intent, just as the proposed Law of the Sea gives direction to man's expansive efforts to mine the oceans. The issue being argued here is for a plan that focuses its strategy on a system stressing a cooperative future, whereby the less advantaged interests can benefit from the more progressive and specialized nations according to a mediated plan of action, based in part on a variety of incentives. (Tax advantages; a large percentage of the profits should go back into expanding and building the facility, as do growth industries on earth, the rest is offered as dividends, etc.)

However, one factor that should be considered as given in this plan is that a facility which accentuates the industrialization of space embodies an inherent weakness that is descriptive of the preceding sentence. "Specialization and its attendant technology depends just as much on willing cooperation and exchange of goods between specialists as they do on the competitive urge to increase production and wealth."³ The point being aired is that competitiveness will only foment the growing tend to restrict the exchange of new ideas and findings as is presently exemplified in the scientific professions. This problem must be tempered if not eliminated or a cooperative venture with diversified supporters will never develop.

The adoption of a master plan can represent a strategy that communicates the phased development of a new space era, from vision to reality, that is the development of a new frontier. The incentive for private and public organizations and interest groups to collaborate on bringing into being a comprehensive development package which presumes the formation of a nationally supported space policy, is to air their views and to voice their expectations.

To succeed, a nationally supported program [for expansion into and exploration of space] would attract and generate taxpayer as well as private support, and the benefits of such a program would serve both public and private interests. The public interest refers to general health, safety and welfare of the people, which taken together constitutes the major policy goal of the planning profession in general. From the perspective of new town planning, such a national program represents the generation of a congerie of communities wholly contained within themselves, with all the services necessary for balanced social communities. The balanced systems approach can not be separated from the ultimate scheme of the space community, even on the small scale, because the habitat becomes a living organism of interaction or more graphically, an enclosed ecosystem.

A new towns policy usually reflects the incentive for regional development based on a national policy of land development.

"It is generally understood that a new towns policy should be part of a national plan for urbanization and economic development. New towns cannot be built in vacuo. They are integral both to central city renewal and to the agreed urbanization pattern of the country and must be founded on comprehensive national industrial and transportation plans for spatial/functional development."⁴

In essence, a new towns policy describes the national concept of urban life. A basic ingredient when formulating the framework of the space facility and its ultimate influence on social interaction will very much depend on the concept the design team has of urban life. Life in space will be extremely more static than on earth and containment will redefine the perspective we have of a normal cityscape.

There are a number of areas of conflict that may and have developed due to inadequate consideration of the relations of social values to environmental surroundings in new town developments. The

environment should tend towards an expression of equilibrium. "It is arguably part of a town planners job to . . . provide an equality of physical provisions throughout the city for housing, work, recreation, movement, and education."⁵ Equalization will be essential towards maintenance of a social harmony even though it will not eliminate the normal elitist hierarchy.

Technology and specialization through scientific research and application will define the type of structure that will be built. The degree of specialization will depend on what ultimately will be incorporated into the system and the number of human participants that will need to be involved. The human factors problems that will be encountered in space will only enhance the problems to be overcome by the facility's design team. The primary question will be to assay,

" . . . the selection of scientists, technologists, and skilled workers who have not had the extensive experience in aviation characteristic of the majority of present astronauts. These problems will be compounded by the extended duration of future missions, increased crew size, and greater heterogeneity of crewmembers in past experience and personalities."⁶

There is no single ingredient for characterising and justifying the need for this type of facility. It may be national security, economic strength, world prestige, response to a growing threat, etc. The basic fact is that the potential is there for more than just material benefits for man. It is the Twentieth century's equivalent to the new world of the Sixteenth century. It's an alternative future, an option that can or won't be explored.

The foundation upon which the theme of this thesis is developed is on the existing and successful examples of new towns that have been created in various parts of the world. The reason for establishing the major footing upon new town development schemes lies in

the variety of factors that are central to their growth and development, i.e., the political, social, economic, physical and technological attributes of any and all people-oriented programs, and their religious and cultural associations.

The countries today that are initiating new town development programs have found that there is only partial uniformity of standards for outlining national development strategies. Policy decisions reflect national perspectives based on international studies of other programs. What works in the United States will in part work in Britain and even less in France. All this is decidedly based on the differing aspects of social interaction, governmental stratification, financial resources and ultimately, public support.

To describe the differing styles of countries having new town programs is to reflect the variety of alternatives that have been adopted and the reasons behind the type and style of their individual programs. The intrinsic goal in each country has been shaped by the qualitative solutions to growth pressures in major population centers, economic diversification, housing shortages, etc., and basing the entirety in the rational melding of general public and interest group attitudes. As a result, a second concept can be expounded that may offer a method for attaining a nationally supported space policy. This would be the emergence of interest groups into the political spectrum.

It has been observed that political parties that we have traditionally been introduced to and involved with are on the decline. "The new vehicle for articulating, influencing and implementing the public's policy choices"⁷ is evidenced by the rise of "special" or "single" purpose interest groups. The variety of public interest groups - environmental, right-to-life, etc. - that have multiplied

during the 1970's have made a significant impact on political decision-making. Jeffrey M. Berry, a political scientist from Tufts University, found in a comparative study that public interest organizations, ". . . shape political agendas, enforce the law through litigation, educate the public, and facilitate political participation by members."⁸ From this he concludes that:

"The most important function of public interest groups is, of course, to represent the policy preferences of their constituents. Like all interest groups, public interest lobbies form a linkage element between citizens and governmental elites. In their lobbying, they articulate what they perceive to be the issue positions of certain sectors of society. What is particularly noteworthy about the advocacy work of public interest groups is that they represent constituencies that have been chronically unrepresented or underrepresented in American politics."⁹

As the voice of this largely underrepresented sector amplifies its expectations, it will be necessary to generalize how space related policy issues will fare under increased public scrutiny.

"In the future, public interest group responses may well constitute a type of 'social proving ground' for testing the potential societal viability of space projects. Those projects generating the greatest opposition in the public interest sector may well be the least likely to acquire funding from the federal government. Or, in the case of a private undertaking, the lesson may be simply to avoid investing substantial risk capital in controversial projects which might stimulate substantial interest group opposition."¹⁰

The issue of space program development must in some fashion introduce to the public at large an option for improving their future. It should provide an answer to many of the existing problems that plague their everyday existence. Will space manufacturing facilities and energy systems alleviate the energy crisis, expand employment opportunities, promote the general health, safety and welfare of the state? If the intensity of interest in the space shuttle is any indication, then the future could see significant opportunities for growth.

The growing trend of grassroots citizen involvement in local, regional and state government exemplifies the initiative of the public sector to be more directly involved in their own futures. This trend has also generated numerous coalitions between the "traditional" interest groups - labor, business, and professional organizations - and the public interest groups alluded to earlier. For example, the Citizen/Labor Energy Coalition, the Progressive Alliance and Consumers Opposed to Inflation in the Necessities (COIN), and multi-state organizations such as National Peoples Action, the Association of Community Organizations for Reform Now (ACORN), et al.

If the perspectives of these grassroots organizations can perceive a future in space program development, then there is every reason to believe that they will involve themselves in efforts to improve and support relevant policy decisions.

The single most important goal is to provide the public a working tool for understanding the extent of research that has been done, what has been learned, and just exactly what can be done with existing and evolving technology. A thin line has been drawn between technological advancement and a growing movement to isolate us from international endeavors so that national domestic problems can be ironed out. It is of utmost importance that the public realize that with a cooperative effort, the two poles can link to support a progressive movement in the interest of economic development and national stability.

The working model of the proposed space facility will encompass a wide variety of disciplines. The exposure of all of these elements in one place and time will reap many statistical pieces of data as well as design and social concepts for use in everyday living; i.e, from engineering improvements to interior design;

psychological perspectives to visual aesthetics; and environmental program incentives to political decision-making.

Many factors of compact living will never be realized without the potential of a facility that requires cooperative collaboration. Humans are social animals with regional perspectives, demanding, sensitive, and economically oriented in the most part with religious and cultural beliefs setting social norms, just to name a few. These points need addressing constantly. Why not create the ideal laboratory as a realistic method induced by need.

Chapter II: New Town Strategies

New town planning as it has been described thus far has a broad spectrum of examples with which to model styles and schemes for use as a blueprint for a space community. This chapter will only present model national programs which reflect economies of style and political and social purpose. The first few examples that follow are merely to demonstrate the purpose for which new towns have been used. The second will describe in greater detail Britain's formula for management and for regenerating housing and unemployment opportunities based on an established new towns policy made necessary after the Second World War. The third part will give two in-depth descriptions of new towns developed as a result of growth pressures, public need, and political and social shortcomings which required alternative futures for communities struggling to manage growing civic disorder.

First, we will present new town planning schemes which exemplify the diversity of national intent in Israel, the Soviet Union and in France.

In Israel, the new towns policy program is administered by the central government with the major emphasis of the project being for the defense of its borders. Any newly established municipality is granted the rights of self-government with the legal understanding that it can not operate independently of the Ministry of the Interior which by law regulates municipal budgets. The new towns, however, are flawed in one significant aspect. They require a regular stipend for municipal functions that can't be covered by the tax revenues generated from the local inhabitants.

The Soviet Union has been administering a new towns program since the revolution of 1917, with the expressed motive being to

colonize the immense expanse of rural land across Russia. A good number were built, with many recently serving as specialized communities (i.e., science cities) and these in turn are created through the initiative of the central government.

The French government has also developed a new towns policy which makes use of a priority urban zone (ZUP), similar to the planned unit developments (PUD) found in the United States. The intent behind its program is to inject some vitality into economically lagging regions and to relieve the growth pressures on Paris. The ZUP program, in similar fashion as the preceding two examples, is also dependent on national financial support and the presence of a strong national planning authority.

Moving on, the British New Towns Act of 1946 was the solution the English government thought best to guide the distribution of urban settlements in England and Scotland after the war. A major premise, they felt, to the success of a new town was the choice of people to plan and build it. Under the New Town Act, the government chooses the board of management or the development corporation. The board then appoints its own staff. The central government, in making its decision as to who should be chosen to participate on the board, has generated the following insight as to what ought to be done when formulating a new board of management:

" . . . first, analyze the qualities and experience needed on the particular board of management and then to set out to find them, regardless of politics. Sometimes it seems that boards are chosen rather as advisory committees are chosen, on the basis of the interests they represent instead of the skill and experience they can bring to the job. New towns, no less than the coal, power, steel and transport industries, ought to be seen as commercial enterprises for all that their purpose is social. The people chosen to run them - in particular the chairman - ought ideally to have a proven capacity to run such enterprises."11

"The board appoints the general manager and the chief officers, the latter being responsible directly to the general manager, and he to his board. So that the line of responsibility is a single, clear and direct one. But almost every general manager seeks to make of himself and his chief officers a tightly-knit, interdependent and friendly top management team, consulting, informing and helping each other as a spontaneous response to each new situation."¹²

Typically, the top management structure consists of five or six full chief officers covering planning and architecture, engineering, finance, law, administration, land and property; and three or four minor chief officers who cover cost planning, surveying, social development, and housing management.

"There is no perfect organization except in relation to a given set of peoples; and the freedom almost every board gives its general manager to build around him and his chief officers the organization structure he wants is a real source of strength, not just to him but the board as well. Not least it enables him to keep the enervating evil of departmentalism right out of his organization. Perhaps most important of all, it allows genuine multi-professional team working on all planning, design and special-study projects."¹³

One problem that was considered a major drawback with the Act was that it did not provide for a central advisory commission.

"Such a commission, if consisting of persons of relevant experience, receiving full information from all the corporations, and advising them without any power of direction or veto, would have enabled them to avoid many mistakes and some waste of money due to lack of previous experience."¹⁴

Due to the British emphasis on physical design and lack of knowledge in social/community planning, their experience with new town developments has been somewhat shortsighted in its entirety. However, it may have been improved if the advisory commission had been enacted to complement their evolving program.

The Act, from the outset, entrusted the Ministry of Town and Country Planning to head up the program whose duties only recently

were given over to the Ministry of the Department of the Environment. Upon approval of the Ministry, the ad hoc development corporations were empowered with all of the provisions of a normal large scale developer. The area to be developed was considered a separate county district and the county authority was elected according to existing methods without impacting the county authority within which it was founded.

A major objective behind British new town development was best expressed by Lord Reith in 1945, a member of the committee which drew up the principle parts of the New Town Act of 1946. He stated that "the guiding principles of [new] towns should be established and developed as self-contained and balanced communities for work and living."¹⁵ The intent behind Lord Reith's statement rests upon the need for an adequate number of houses to match the number of jobs available. Also, the variety of occupations would allow a sufficient level of demand for services by all who were employed there.

The new town as a whole was conceived as a complete system, with a variety of subsystems to insure the city was a success. In essence, it was thought that the features incorporated into an urban system represented a developers perception of a demand for them. In the classic sense then,

"Proper development of a new city means that there be enough land for the schools, roads, homesites, shops and utilities essential for the city's functioning; that there be enough reserve land for growth and green space for recreation; that the industries settling in a new area have access to the space they need and to a work force of varying skills and wage levels that can reach their workplaces without the fatigue of protracted journeys from home."¹⁶

The British are now known to heed the realities of economics and physical planning to encompass regional and national planning perspectives with new town developments. As a result, they are now

promoting the early formation of urban enterprise zones which encourage private entrepreneurship as a source of financial support for the cities. It is their desire to avoid the problems of the past whereby the new town suffered a stagnant period during its growth cycle before it was finally ". . . profitable to construct the sort of town center facilities which make a city urban."¹⁷

To contract the preceding two sections of this chapter, discussion will now center on the vision, plan and ultimate development of two new cities, Brasilia, Brazil and Tapiola, Finland.

Brasilia, the capital of Brazil, was motivated by "the need for abundant water, a healthy climate, a coordinated street plan and general traffic accessibility."¹⁸ In so many words, to get away from the influence peddling, uncoordinated growth and congestion of Rio de Janeiro.

The idea of transferring the capitol city to the interior of Brazil had been a major constitutional issue since the formation of the country. The Federal Constitution of 1946 finally outlined the plan to shift the capitol 900 km. to the northeast, to the high plains state of Goiás. However, there was a significant amount of opposition to this plan. The master plan for Brasilia was reviewed critically by professional men and outstanding architects both native and foreign to Brazil. Those in favor felt it would be a master work of immense proportions, and a fundamental piece of urbanism in the new world.

Critics, on the other hand, called it a monument to human insensitivity. Because the financial strength of the Brazilian economy was in a very poor state, many considered the move lunacy, wishful, irresponsible at a period of tremendous inflation. Others felt the country's efforts could be better directed towards providing basic

necessities, to combat illiteracy that affected fifty percent of the country, and to amplify improvements in commerce and communication across the country.

The directors of NOVCAP (the Company for the Urbanization of the New Capital) believed the project would not be inflationary due to the use of existing federal funds and that the capitol would be moving from the inflationary environment of Rio to an area that existed in depression.¹⁹

Two rationales spurring final implementation of the transfer were that: 1) the long series of constitutional directives (i.e., 1891, 1922, 1934, 1946) had set the national state of mind in a position to fulfill a century old desire or ". . . manifest destiny, through development of the mysterious, and supposedly rich, sertao [backlands],"²⁰ and 2) there was a genuine interest in building the new capitol in a new and sterile environment. By strict enforcement of local land use plans, it was thought that the dilemma inherent to uncontrolled growth could be avoided.

These two rationales alone portray the point ". . . that the new creation was to be an urban colony, primarily political in function and surrounded by controlled environs. It was not to be multi-

¹⁹President Kubitschek was very careful to adapt his economic program to rely on the ultimate development of Brasilia to ". . . divert attention from many difficult social and economic problems, such as reform of the agrarian system and the universities." His economic strategy has also been described as "developmentalist Nationalism," because ". . . underlying the governments statements and actions was an appeal to a sense of nationalism. It was Brazil's destiny to undertake a 'drive to development'. The solution to Brazil's underdevelopment, with all its social injustice and political tension, must be rapid industrialization." By developing the public's nationalist spirit, Kubitschek was able to use Brasilia as a symbol of Brazil's future stability. Thomas E. Skidmore, Politics in Brazil: An Experiment in Democracy. (New York: Oxford University Press, 1967), pp. 167-168.

functional or labor consumptive, but it was to be a catalyst for regional development."²¹

The government wanted to free itself from the dominance of Rio primarily. There were 350,000 government employees in Rio, mostly affiliated by political influence, with little to nothing for them to do. President Kubitschek was betting heavily that thousands of these government parasites would refuse to leave the beaches and night life of Rio, and the easy corruption, to go to the stark interior. Only 35,000 government officials were expected to be needed in Brazilia. The savings in loss of personnel would go to pay for a good chunk of the capital's cost.

The fundamental elements of the master plan included: 1) consideration of the topography, 2) taking into account the city in relation to the projected population density, 3) the relationship between the component sections of the capitol, and 4) the organic connection of the city to its suburbs. These, in turn, reveal factors essential to an urban landscape and as such, were required as part of the master plan for the international competition. The international jury of Brazilian and non-Brazilian architects made their final selection of a site and master plan based on:

- "1) a gently sloping terrain,
- 2) a comfortable climate with no extremes of temperature and rainfall, and no violent winds, and at an elevation high enough to offer freedom from malaria,
- 3) a water supply adequate for a city of half a million inhabitants,
- 4) nearby forested areas where agriculture can become established for the supply of vegetables and milk, and where wood can be procured for fuel,
- 5) a source of low-cost electric power located within 100 kilometers,

- 6) locally available building materials, including lime for cement,
- 7) a subsoil suitable for building foundations and for excavation of sewers and subways,
- 8) an attractive landscape and nearby recreation areas."²²

Of the seven plans submitted in March of 1957, six envisioned a program that grew from a central nucleus. The seventh plan, the winner of the competition and produced by Lucio Costa, was very effective with its use of an airplane design, ". . . incorporating a monumental axis (fuselage) of government buildings flanked by two wings of non-government urban land uses, requiring no slow organic growth."²³

This latter point of no slow organic growth is of major significance because President Kubitschek had given the project his highest priority and he wanted a significant portion completed by the expiration of his term in January of 1961. The gist of the situation being for swift and prompt development. It was his belief that if Brazilia was not demonstrably committed, the capitol plan would never have been more than just another blueprint.

Development and creation of Brazilia was essentially the implementation of Brazil's national destiny. Until that time, approximately seventy-five percent of Brazil's populace existed in five coastal states. The political system was multi-party with little or no unity of representation from within or outside those five states. The interior of Brazil could have been equated to America's "Old West".

The salient point here is that Kubitschek was the first president to have been elected from the interior. His desire was to terminate the status quo of political motivations inherent to Rio and redirect

this weakness by improving the commercial and political position of the interior states that had until that time been dominated and taxed by coastal interests with little benefit from government programs. It was also his intent to create a unified political party, open up the interior to development and to establish a transportation network to improve commerce and agricultural growth across Brazil. However, as a consequence of his economic program, and despite the success of Brazilia to bring ". . . a faith in the future such as had rarely been known in Brazil,"²⁴

"The mistake was made of not correlating non-economic factors with development. No stimulus was given to saving; on the contrary, in the circles surrounding the President, the spirit of conspicuous consumption prevailed."²⁵

The focus, therefore, behind this new town development was first, socially and politically motivated; second, a response to a century old desire to be nearer to the interior of the nation and hence closer to the people; third, a plan which allowed uniform growth in general rather than from a central nucleus, for the sake of speed and a limited timetable; and fourth, through this massive growth campaign, Brazil hoped to lay the foundation for its perceived destiny as a world power.

In sharp contrast to the preceding Brazilian program, is a Finnish new town development authored by private entrepreneurs without the need of governmental assistance. Tapiola, is the most noted example of a community which was built specifically to accommodate the overpopulation from a major metropolitan center, Helsinki. Asuntosäätiö, a Finnish housing foundation, planned and built Tapiola by creating a private non-profit organization made up of six firms, labor unions and service associations. They represented Finland's

entire consumer range of housing and even more important, the full spectrum of Finland's political system. Three were conservative and the remainder were socialist. The board was headed by Heikki von Hertzen, a lawyer and director of a commercial bank in Tampere, Finland. Through his efforts as the managing director of the Finnish Family Welfare League, a leading social organization in Finland, he was able to spearhead the creation of the housing foundation that developed this model housing community program.

Von Hertzen based his reasoning for creating the housing foundation with the above social and political characteristics on three points:

- "1) It could not be done by normal private enterprise whose purpose is, after all, to make a maximum profit.
- 2) Nor could it be done by an existing public agency that could not be geared to the likely complexities and needed skills [of a new town].
- 3) Something between the two was required, something that would have the flexibility and freedom of action of a private company but, at the same time, the power and influence of a public authority. What was needed was a foundation with powerful social and political backing. And it would have to be able to operate dynamically like a private company."²⁶

Von Hertzen's analysis, which led to the Tapiola plan, reflected his previous experience with contrasting styles of community development among the various Scandinavian countries. He formulated a pamphlet entitled "Homes and Barracks" whereby he contrasts the idea of single-purpose housing with the idea of full-range communities.

"The book tried to show that the difference between merely putting roofs over peoples heads and providing them with viable multi-faceted communities lay in basic intentions, in intelligent planning and in effective execution. Narrowly conceived housing, in fact, could cause social pathology with such symptoms as malaise, indifference, crime and vandalism."²⁷

Von Herten also stressed objectives that were similar to the intent of Radburn, New Jersey, which developed the idea of traffic separation between pedestrians and vehicles; Greenbelt, Maryland, similar to the Radburn model; and the open air city of Malinö, Sweden, where carefully designed row houses and their small gardens opened onto a common neighborhood space.

"These objectives were not 'to house so many people', 'develop so much residential land', or 'create so much construction employment', but to create socially, biologically, and physically healthful environments."²⁸

To avoid these perceived problems, von Herten stressed the need for individuality in the design, i.e., each new town is a separate unit. This is important from the standpoint that studies done by U.S. environmental psychologists agree that design schemes will influence behavior, efficiency and social communication.²⁹

Finally, "provocative" planning was a necessary tool in Tapiola to initiate interest by industry and commercial businesses to come to the city. The Foundation provided the buildings and the infrastructure and more to develop interest. The result proved the expense worthwhile, and their expenditures were returned in full. The ramifications of this statement should reflect the position government can play as a catalyst to encourage development by private industry with a guaranteed return over the long term.

To review, the preceding discussion of new town strategies has focused on the following arguments:

- 1) Israel, the Soviet Union, and France representing examples of direct governmental control through an autonomous government agency;

- 2) Britain and Brazilia exemplifying the use of independent government agencies; and,

3) Tapiola portraying a private non-profit organization based on private funding by cooperative private sector organizations.

Contrasting these three styles of new town planning, the question that arises is, which style, based on existing circumstances, would best fulfill the programming requirements necessary for implementing a U.S. space manufacturing facility?³⁰ By observing the trend of American government when initiating new governmental agencies, it is apparent that there is a preference for independent government agencies, i.e., HUD, AID, CIA, etc., all similar to the British and Brazilian examples. Each is founded on nationally directed goals and objectives, broad in scope, with a mission statement to develop innovative and comprehensive programs based on those goals and objectives.

The independent option would allow for government participation, partial coordination and sponsorship as well as an avenue for private industry involvement. However, there is a problem that presently exists which could hinder the progressive development of a master plan. The move to affirm the decision to initiate development of a space colony would depend on how successful the organizers are in linking the interests of private industry with government programs to reflect intended public benefits.

"Intuitively, a space facility development program would not be initiated to achieve relatively limited returns, because such a program would require relatively large front-end governmental or corporate investment, would entail a degree of risk in developing necessary technology, and would be perceived, in general, as a 'unique' program." ³¹

³⁰"All . . . mining, material processing, and fabrication facilities - plus . . . handling and logistics equipment." This definition is found in E. H. Bock's "Space Manufacturing Facilities," in Fourth Princeton/AIAA Conference on Space Manufacturing Facilities, Report No. 79-1374. (New York, N.Y.: American Institute of Aeronautics and Astronautics, 1979), p. 1.

Creating a link which integrates the unique status of a space facility to demonstrated research and development projects should accentuate the progress of human technological advancement and reduce the degree of uncertainty inherent to the public and government alike to space industrialization. It is apparent that there are problems in getting a consensus of key participants to agree on policy issues related to space oriented programs as a result of this uncertainty. However, more and more support is being generated in private industry to buttress U.S. space policy as outlined by the Carter administration who openly encouraged the commercial exploitation of space through national and international means. Their policy directive clearly expressed a desire to:

"Assure U.S. scientific and technological leadership in space for the security and welfare of the Nation and to continue space R & D necessary to provide the basis for later programmatic decisions.

Demonstrate advanced technological capabilities in open and imaginative ways having benefit for developing as well as developed countries and to foster space co-operation with other nations."³²

The purpose of this chapter was to create a setting which outlined thorough and rationally approached new town programs so as to bolster the apparent hesitency by the federal government to subsidize research that has heretofore been without a clear policy framework or developmental format.

Chapter III: Areas of Major Disciplinary Concern

There are many areas of concern that arise from the discussion found on the preceding pages. These include a list of parameters that a comprehensive design plan should entail, if the project expectations are to be achieved.

When discussing the development process, it pays to bear in mind that a general maturing of circumstances and growing public awareness is necessary if the benefits to be gained from space related activities are to be realized. The general maturing of circumstances describes several initial areas of concern when formulating a thorough comprehensive program. These being vision and the foundations upon which that vision becomes reality. At present, the vision exists as the Space Shuttle and the Soviet Space Laboratory. The foundations, or the generalized goals and objectives, and mission statement, for an outer space community is being bantered about in the United Nations in the form of a moon treaty based on the industrial potential of space. The main theme of the debate being that the benefits be shared equally in any space enterprise. The Carter administration's space policy reflected this international intent by,

" . . . emphasizing space applications that will bring important benefits to our understanding of earth resources, climate, weather, pollution and agriculture thereby increasing the return on the Nation's investment in space to the benefit of the American people and all of mankind."³³

But as the list of participants grows, the reality of an effective management scheme and power structure that is suitable to all concerned becomes a gray area of conflicting viewpoints. The question now is: how is power to be delegated and on what shall it be based? From a planning standpoint,

"Participants in new town planning have found that psychosocial planning is a very key part when formulating authority relationships, lines of accountability, and decision-making levels. For new towns, the psychosocial design must consider who has control and who is accountable for what, what the input channels into decision-making should be, and the appropriate power balance between initial investors [private developers or government] and residents. The workability and the acceptance of such a balance, and more generally of the power distribution structure, will change over time. Thus the psychosocial design must include a process for change in the power distribution that is both orderly and adaptive to changes in the resident population and in society."³⁴

The establishment of a clear and effective command structure or organizational format that is sensitive to individual autonomy and set within extreme command standards should offer adequate opportunities for optimal human performance. It is obvious that any command system used initially will need to adapt and mature to the stresses placed on it. This will most likely be the case for individual space facilities with differing personnel types (i.e., scientific or technical). With small crews,

"... a strong centralized command structure is necessary to ensure the safety of missions and to respond to emergency situations. With larger crews on long-duration missions, it may prove advantageous to have several command structures: a strong leadership for mission control and flight safety decisions and a more democratic structure for everyday life and leisure."³⁵

The subject of this paper considers the employment of small to large and expansive crew populations, and the expected heterogenous and/or international flavor of the crews will vary with the variety of projected habitats. On these terms, it has been well founded that optimizing the match between what individuals need and prefer with respect to services and leisure opportunities and what the community actually provides and positively reinforces will be of major importance. The problem that has been realized here is the

general ". . . lack of uniformity of individual behavior across different environments."³⁶ Studies done by Endler and Hunt, 1966, 1968, 1969; Moos, 1968, 1969; Prescott, 1978; and other have found out that,

"the same situation has different meanings for different individuals. The strength of individual characteristics in determining behavior is not set in any fixed ratio but varies with such characteristics as age, sex, IQ, and psychiatric status and is different for different behaviors (eg. anxiousness, being more situationally influenced than hostility)."³⁷

The point to be stressed here is when the individuals involved with predicting the needs and expectations for those residents that will be living in a new town, or space environment, it is only possible to anticipate on a wide scale the psychosocial priorities. "Widely differing individual characteristics . . . cannot be adequately anticipated."³⁸ Therefore, a number of physical and environmental needs must be anticipated and studied as part of the research and development projects.

One part will be positive vigilance practices which are closely related to the arrangement of physical space. Much of the literature emphasizes the need to provide tasks which vary in complexity and difficulty to keep the extent of human visual responsibility as aroused as possible. Human operators, over time, tend to fall away from an optimum level of performance as the initial level of interest and expectation wears off.

Medical studies pertaining to sensory, perceptual and motor skills offer differing opinions concerning the data received from research carried out on these topics. In a mission of long-duration, the astronauts will need to make specific and valid responses to the data input placed before them. The importance given to sensory, perceptual and motor skills, emphasize the need to have every

effort taken to quantify as well as qualify the results of tests received under extreme conditions. These results may influence to a great degree the criteria necessary for consideration in the final layout of interior technical systems.

N. H. Mackworth, psychologist, has provided a practical definition of the term vigilance in connection with technical systems. He considers it as ". . . a state of readiness to detect and respond to certain specified small changes occurring at random time intervals in the environment."³⁹ the emphasis here is to maintain a standard degree of spontaneity as a safety factor in a high risk situation. The development of a reinforcement schedule that provides for regular shifts in task situations and individual programs would limit the problem of diminishing performance.

A second part to be included in R & D studies is a discipline which strongly relates to the previous section with respect to optimization of the human/physical environment, this being the developing area of environmental psychology. It is specifically concerned with the process of human-environment optimization. It proposes a cyclic, directional approach to design activities relating to the internal environs. Cyclical optimization is sequentially directed through three determinants of human-environmental interaction.

"1) Orientation - pertains to the processes by which people perceive where they are, predict what will happen there, and decide what to do.

2) Operation - refers to the processes by which people act upon, and are affected by, their surroundings.

3) Evaluation - involves the assessment of how effective one's actions on the environment have been in procuring certain goals and how adequate the environment is as a context for future activity and goal attainment."⁴⁰

With respect to internal systems, the inner environment should be reflective of human personalities. With the realization that an individual or group of individuals will be sequestered for a long period of time in a restrictive, unchanging modular habitat, it would be beneficial to include the impressions of the participants in the discussion and design of the visual factors in that environment. This agrees with the notion put forth by Wicker (1972)⁴¹ of behavior-environment congruence, which denotes the belief that environmental conditions have associated response patterns.

Optimization programming stressed by environmental psychologists, strives to direct individuals, in this case, a multi-disciplinary design team to approach the ultimate physical environment in a qualitative sense, which conforms to a set of preconceived expectations. Daniel Stokols, proposed that primary settings, where people spend a good part of their time, and where they perform activities that are more important and of a more personal nature (non-workplace), will experience more intensely, crowding and stressful situations in those areas that have personal implications associated with them. Secondary settings are looked upon as being more impersonal and transitory when away from the former situation (workplace). "Analysis of this type could yield setting-specific guidelines for the design of environments that are maximally congruent with the needs of their users."⁴²

The relationship between vigilance and environmental psychology is relative to the associations which develop when an individual is placed into an active situation. Human motivation incorporates the aspect of need arousal which encourages a level of interest relative to an actor's responsibilities. There is a perceived probability of success, inherent to a position, of a

preconceived result. Various elements of an environment continually define and redefine the nature of the active system.

Identifying the cognitive processes that influence human behavior will aid the medical team in determining psychological and motivational standards that will act as norms for subsequent project teams. The behavioral effect being described, and which needs to be addressed from a community standpoint, is that:

"... the regularity and consistency of behavior in given physical settings over time and space occur because such settings are closely and tightly interwoven with the fabric of social, organizational, and cultural systems that circumscribe the day-to-day life of any group of individuals. In effect, any given physical environment is not only a behavioral environment but also a social organization, and cultural environment."⁴³

With the general understanding of how the psychosocial elements must be incorporated into the ultimate design scheme, it now becomes necessary to demonstrate the importance of generating a framework or strategy that will mesh the above elements to actual physical design components. The result should portray, as was stated in the first chapter, the concept the design team has of 1) urban life, and 2) an enclosed, balanced and social ecosystem.

Physical design specifications for the internal systems will be of paramount importance relative to the optimal environment that can be achieved. Of major concern to bioengineers, interior designers, and human factors engineers, will be the particular physical characteristics of an individual or a group of individuals. Even those astronauts who have participated prior to this time are not readily adaptable to a unique, static physical environment.

"Long duration missions will bring to bear two new elements that will have substantial impact on [facility] design and operations. The first is that such missions can exacerbate to the point of intolerability some of the design compromises that proved acceptable for relatively short flights. Second, international participation and the science oriented crews likely to be involved in long-duration missions can result in greater heterogeneity in physical characteristics, this could effect habitability requirements."⁴⁴

Further analysis of these disciplines (bioengineering, interior design, electrical engineering, systems engineering, et al.) outline some of the more significant interrelationships involved with human engineering and habitability that have not been fully researched in the past. These factors encompass a wide range of criteria. For example, the intensity of noise and its disruptive effects; lighting systems to optimize performance and to minimize annoyances; internal mobility for improving performance under the effects of weightlessness and partial gravity; overcoming the problems associated with sustenance and sanitation in a low gravity environment; regenerative life support systems for removal of contaminants; and aesthetic design of interior spaces.

Design decisions on the actual physical components of technical systems that will be man-machine oriented, need to comply strongly with human considerations in mind. The specific decisions agreed upon can either plague normal operations and cause unsatisfactory system performance, or they can operate in a complimentary manner and bring about increased system performance.

With respect to employee qualifications, ". . .it should be noted that personnel matters need to be attacked during the development of physical equipment, especially in the case of complex systems."⁴⁵ The practice to date has been to design aircraft and spacecraft to rigid physical specifications. Human engineering principles are not brought into play until after the basic design

concept has been established.

For example, dynamic anthropometric design, which relates to paths of physical movement, should be used to tailor the environment to a level of comfort suitable for long-duration spaceflights. Anthropometric tailoring should also program for a three-dimensional environment because Apollo astronauts found that cabin space increased substantially under weightlessness. This discipline is based on extreme individual physiques. At the lower end of the spectrum, or minimum dimension, the facility being designed would be based on upper percentile values as in the case of doors, escape hatches, and passageways. On the other hand, the maximum dimension is based on the lower percentile values corresponding, for example, to the distance of control devices from an operator. The 95th and 5th percentiles, respectively, are frequently the data measurements used for these design standards.

Additional criteria to be integrated into the preliminary anthropometric design scheme is the work area arrangement for the optimal utilization of each individual space. These being segregated into prioritized panel sections by degree of importance, frequency of use, function, and sequence of use. (Linear programming applications have been used before to locate optimal arrangements of controls.)

Expanding the discussion of physical requirements, it would appear that prior to any agreement as to what the final design plan should entail, a series of impact statements describing controlled situations will need to be evolved which coordinates a systematic programming of cabin areas to psychological and physiological needs for attaining optimum performance.

It is known that man can successfully tolerate exposures of long-duration in low pressure environments (258 mm Hg)⁴⁶ without suffering any adverse effects. There can be detrimental effects if pure oxygen is used as the sole atmospheric component. However, this restriction can be eliminated with the incorporation of diluent gases (inert gases) into the atmosphere. Various psychological and physiological disorders have been attributed to pressure changes, but a causal relationship has not been demonstrated. "The few studies which have been performed thus far have shown no effects which can be attributed to a metabolic influence of these gases, though the experiments have been of short duration."⁴⁷

Research done by Bennett (1967) and Bennett and Elliot (1969) have concluded after limited study that neon gas probably has the greatest advantages for use as a gas diluent in space operations.

"On the basis of very incomplete data, it doesn't appear that the gas has toxic effects which would preclude its use in . . . space operations . . . where it can lessen problems in communications and heat loss without appreciably increasing the risk of inert gas narcosis or decompression sickness during reascent."⁴⁸

The range or temperature deviation which is possible in a space environment has led to an exhaustive amount of research to determine the physical adaptability of the human body. Three major areas that have been considered as critical to space operations are: environment, body state, and clothing. The optimum relationship between skin temperature and clothing has been found to be 91.4°F and 0.25 Clo, respectively (which is representative of the heat transfer characteristic of the underwear worn by the Gemini astronauts).

The interdependence of these variables requires the support of reasonable assumptions and sound experimental results.

"Maintaining a thermal balance requires the regulation of environmental parameters to maintain man in a state of thermal equilibrium (or compensable quasi-equilibrium) at all anticipated levels of activity to ensure adequate performance and preclude irreversible physiological effects."⁴⁹

An alternative which would prove to be one of the most energy efficient in the situation of a rotating space station, is the Free Convective Heat Transfer approach, as opposed to the forced convective environment. The former does not rely on additional fans to provide cooling. The latter assumes that the facility will rotate to provide a quasi-gravity environment.

The use of either method for cooling assumes that there is an optimum thermal comfort setting in operation. In this respect, P. Krantz has described a comfort design method which,

". . . involved analysis of the environmental conditions to estimate the radiation and convection heat transfer from the body. The metabolic rate necessary to sustain the activity level is estimated. The difference between the metabolic rate and the radiation and convection heat loss, therefore, is the required evaporative cooling."⁵⁰

This point reaffirms the statement noted in the physical design factors section (Environmental Psychology), that it is imperative to include the participants in the design phase of the facility so that their medical histories can be linked to internal specifications in order to optimize physical comforts.

The ideal being to limit evaporative heat loss to,

". . . respiration and diffusion through the skin without the activity of sweat glands, and that body and skin temperatures be maintained near normal values of 37°C (98.6°F) and 33°C to 34°C (94.5°F to 93.5°F) for a resting subject."⁵¹

More research will need to be conducted in order to validate the use of different gas mixtures in cabin environments as a thermal control variant. Several studies have found that comfort temperatures

can be maintained in N_2-O_2 at approximately 78°F using a varied work/rest cycle with participants wearing clothes that have a temperature conduction constant of 0.7 Clo (a little denser than light indoor clothing which are 0.5 Clo).

A second example is that of a $He-O_2$ atmospheric environment that allows a comfort setting at 85°F under similar circumstances.

Due to the potential physiological consequences of weightlessness, the individuals that will be participating in this project will require special training preflight with medical histories catalogued and thorough postflight studies to update medical histories as case studies for future flights. The point was stressed that ". . . space vehicles must be designed with all aspects of operation in zero gravity taken into account."⁵² This factor alone requires that individuals need to be trained for this environment in the chance that a 1 g environment is not used.

Physical changes have been noted in the past to some extent postflight and extensive monitoring will need to be maintained during the duration of the projected program. Apollo VII crewmembers complained that after contracting head colds during flight that the weightless environment ". . . was in fact detrimental to relieving cold suffering."⁵³

Factors influencing the deconditioning of cardiovascular functions can not be specified as yet. Studies have indicated that hypodynamia and fatigue may be the cause as a result of the weightless environment and reduced hemostatic pressure in the circulatory system. Diminished work capacity is considered to be a result of deconditioning rather than inability to extract oxygen from the atmosphere.

A similar problem that has plagued crewmembers on earlier flights is the loss of calcium from their systems due to reduced gravity and counter-gravitational pressures in the zero g environment. Studies by both the U.S. and Russian researchers have revealed similar findings, and attempts to increase the exercise workload during flight has failed to diminish the loss.

Again, the problem of the loss of muscle tone has caused a high degree of physical discomfort during post-flight recovery. Exercise has stayed the effect of loss to a partial degree in those muscles subjected to periodic stress loads. Preventive maintenance programs will need to be developed if the effects of weightlessness are not to have a detrimental effect to those individuals returning to earth gravity.

Individuals chosen to participate should have as part of their medical history, a thorough description and graphic charting for metabolic assessment. These data can be useful in providing accurate life support demand requirements and may contribute substantially to effective mission planning.

Respiratory support systems will entail a new degree of complexity that has yet to be integrated into earlier open-looped breathing support systems. Normal respiration in a closed environment, where the gases are kept below normal body temperatures of 37°C and in a dry state, creates two specific engineering problems. A cool environment will cause expelled breath to condensate on surfaces which could generate corrosive action. Also, compressed or liquid oxygen which is used for its cooling ability during expansion, in a saturated environment could cause the valves of the respiratory system to freeze.

In resolving problems of physiological comfort, priority should be given to engineering lest the cost of incorporating a highly suitable environment becomes excessive and places unnecessary constraints on the system.

Chapter IV: Procedural Plan

Chapter II argued and proposed that the most effective option for initiating a viable and expanded space program is through the creation of a government sponsored independent agency. An agency that makes use of private and public entities as an economic necessity, with the ultimate motive being a self-generating system for the economic exploitation and for the eventual colonization of space.

Studying the schematic of the Preplanning Phase (page 39), the first and second steps have essentially been carried out over the last decade. The key to further progress lies with the United States Congress. It is critical to the further development of space that the facts, both for and against, be set before congressional hearings. The merits of creating an independent space agency which promotes the methodology of new town planning as the approach for creating space manufacturing facilities, should be fully argued both privately and publically and with international considerations included. Potential funding sources should be ascertained in order to assure a diversification of financial support. A proposed organizational format and mission statement which reflects the general goals and objectives of the program should be provided. By no means should they be established as fact because it will be the responsibility of the new agency to declare its directives and principles to the satisfaction of Congress.

The mixed economy approach through public and private collaboration, presumes a quest for profits. Consequently, profit restrictions proposed by various members (or commissions) in the United

Nations will need to be defused or private enterprise will lose its major incentive to participate.

The agency itself will need to be established under different standards and policy directives than those used to create NASA. NASA has been considered a monopolistic entity that impinges on the flexibilities of the private sector. The agency's charter is such that any industrial activity it promotes, it can also regulate. The agency is also not required under its regulations to maintain secrecy of any new process that may develop as a result of space related experiments. This very effectively discourages involvement by private industry who rely on their unique technologies to attract a market and subsequently turn a profit.

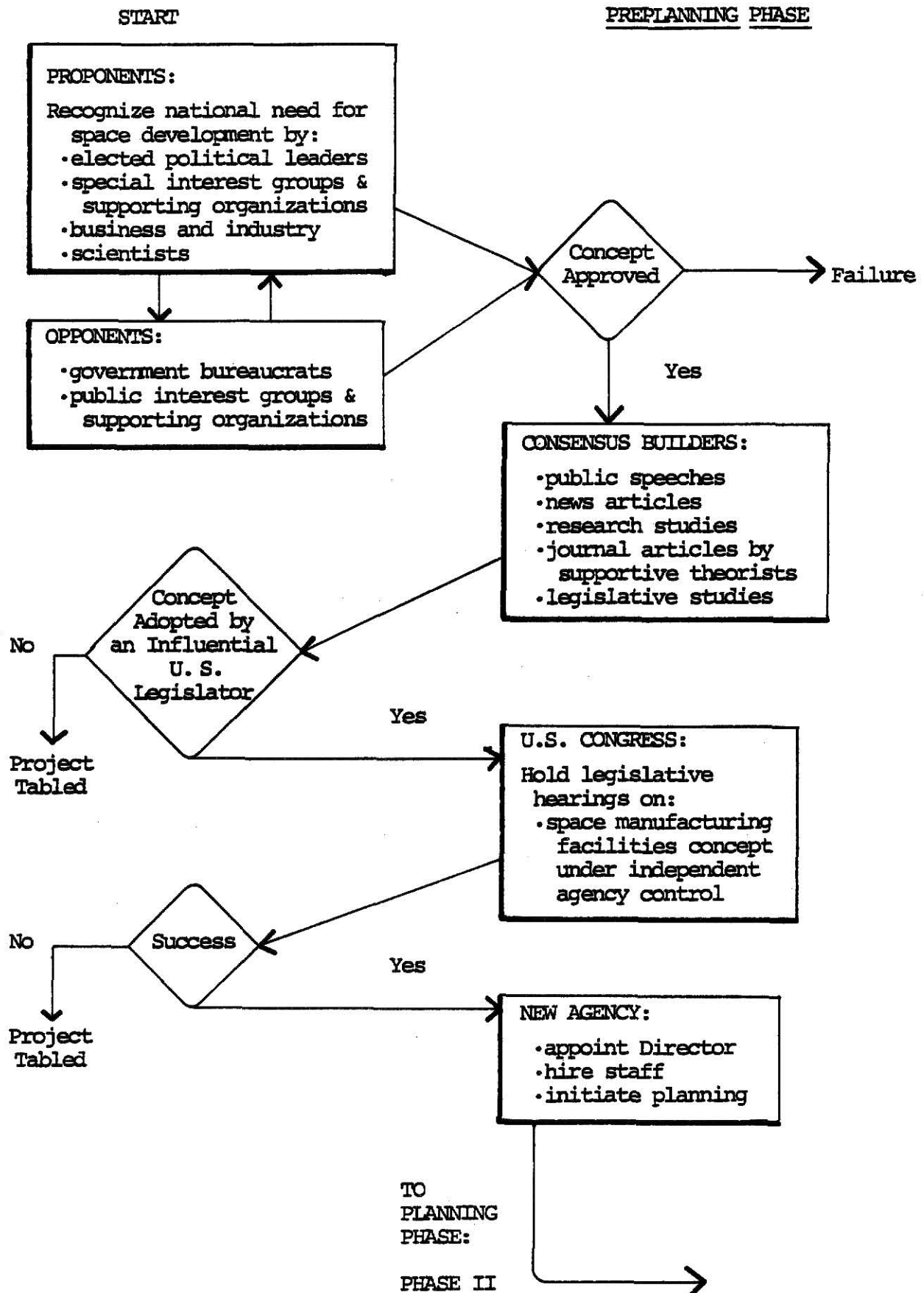
NASA programs have thus far been oriented towards academic and militaristic purposes while at the same time avoiding the opportunity to commercialize its activities. The examples of Comsat and the National Oceanographic and Atmospheric Administration who operate outside NASA's sphere of influence and who provide communication and weather monitoring services, have shown the profit potential which stimulates those systems.

The profit incentive is the catalyst that will attract private business, both small and large. The next step is to generate a stimulus to attract the private sector to work jointly with the public sector. The approach which follows outlines a program of action that works toward that end.

Phases II through IV are explained, step by step, on pages 43 - 52.

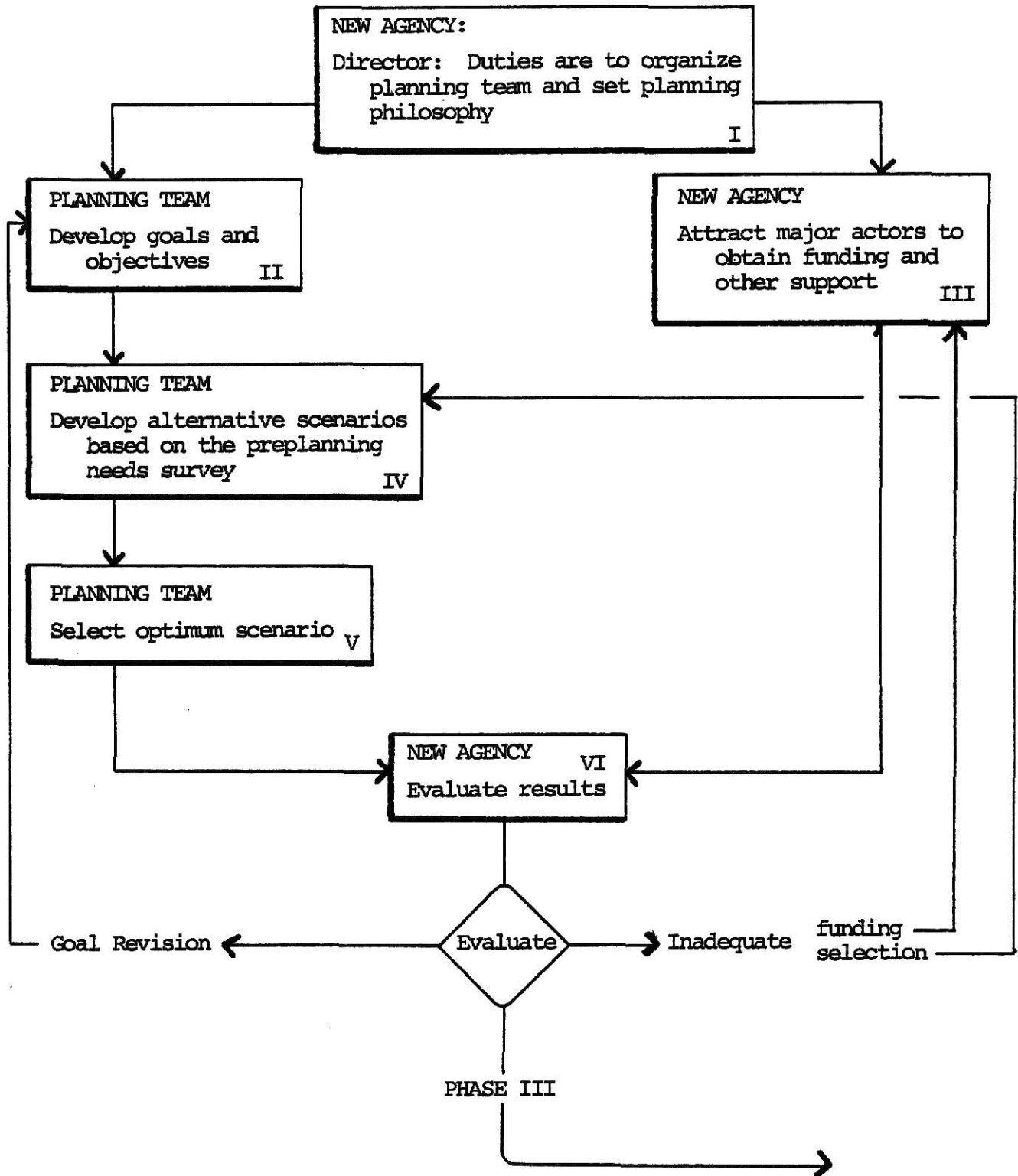
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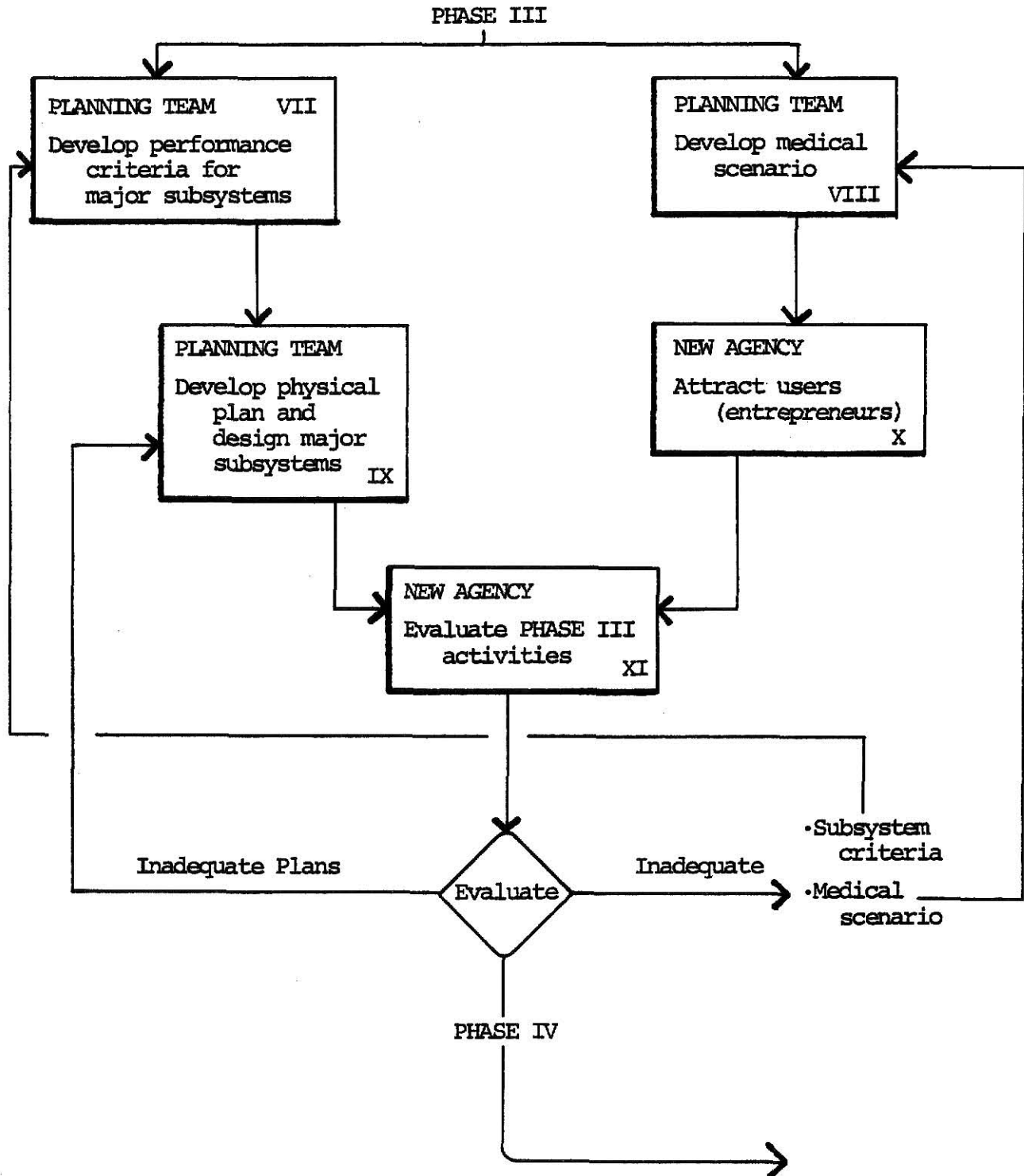
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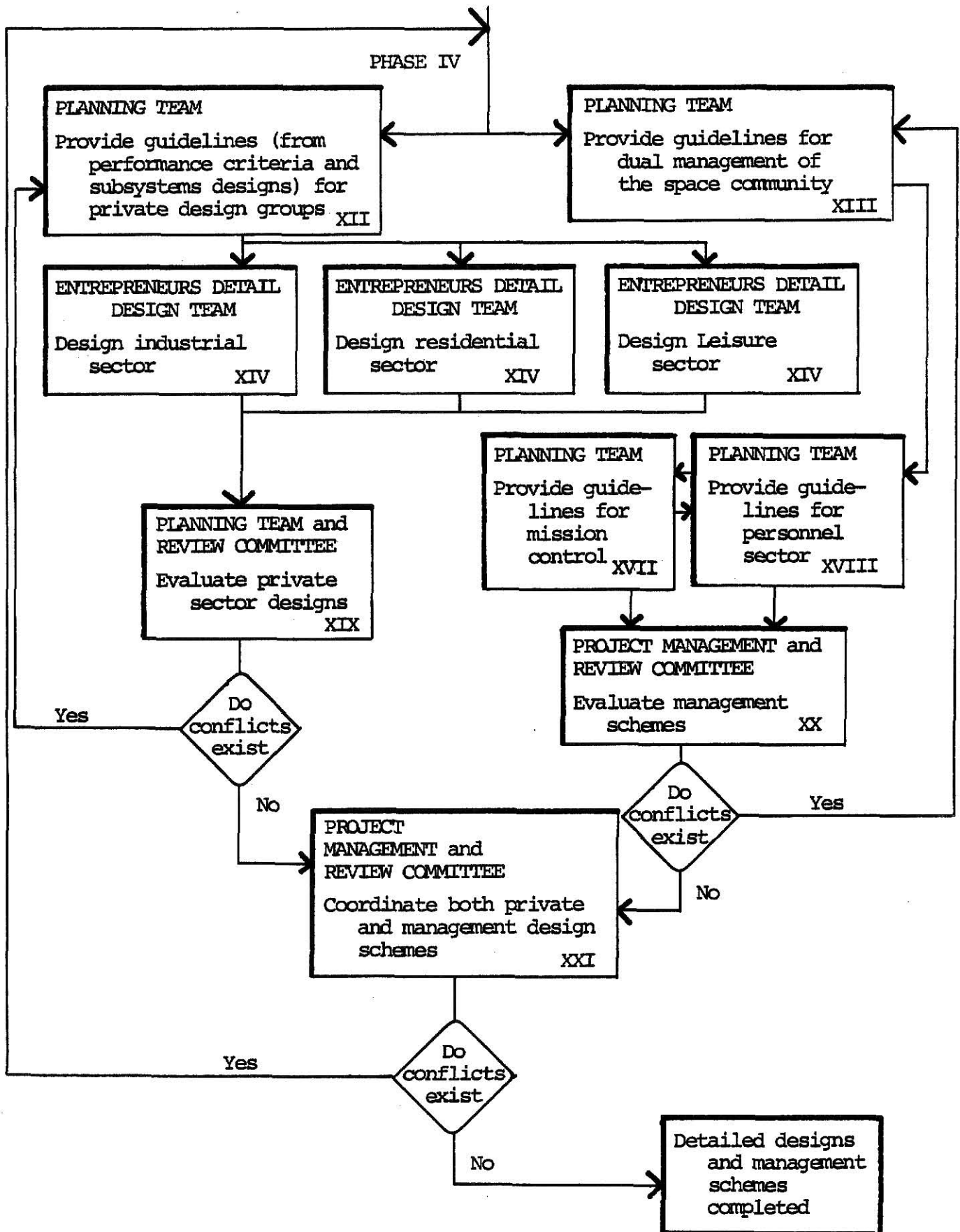


PHASE II

PLANNING PHASE







PHASE II

I ORGANIZE A PLANNING TEAM: Before deciding on the type and variety of individuals to be involved on the planning team, it is best to decide what is to be accomplished and then agree on who would provide the most effective insight on a space community/facility developmental format as the British Town and Country Planning Ministry so strongly advised. The planning philosophy and/or principles upon which development of the project as a whole progresses must represent a unanimous commitment for maximum cooperation and communication among the members of the planning team. The Director and his staff will manage the project, and full latitude will be given to the planning team to meter out an effective design concept.

II DEVELOP GOALS AND OBJECTIVES: One of the first duties of the planning team will be to formulate a number of goals which will define the intent of the systematic planning process for the space community. These goals must aggrandize those that were generated during the preplanning phase to promote the concept into a working model. The key activities at this point will be promoting the value of the project and specifying the objectives to be achieved. The method for promoting the concept altogether should be carefully developed in a fashion that builds upon the previous arguments and studies used during the preplanning stages of the space community/manufacturing concept. Since the community being promoted will be both government sanctioned and in large part federally funded, it is feasible to assume that the public will be given ample opportunity to review and offer feedback on the direction of development being forwarded by the proposed goals and objectives.

It is at this point that the public interest groups who support and see a useful purpose behind the development of space would be given a chance to voice their approval or disapproval of the specified goals and to suggest changes that keep the focus on the harmony between the public good and private enterprise.

III OBTAIN SUPPORT: The new agency will be responsible for attracting major investors beyond its relationship with the federal government. This will assure the public that the large front-end costs to be incurred will be dispersed among a number of sources rather than just a few. Early ventures will most likely mean high losses. Thus individuals with capital to invest - if they will - will ease the drain on the U.S. Treasury. Therefore, a financing scheme will need to be introduced that will offer an incentive to industry and other private interests to incur the high risks in return for a share of the potential benefits.

It is well founded that there exists a healthy strata of government agencies around the world with high foreign exchange earnings which operate analogous to private sector multi-national corporations. This is essentially the intent of this new space agency.⁵⁴ However, the fallacy of forcing countries who are interested in space and can afford to participate to be locked into a negative position of negligible earnings potential as is outlined in the 1967 Treaty of Principles and the proposed Moon Treaty, must be revised to express a more positive intent.

⁵⁴What is at stake: shall the res nullius (property of nobody) of space accrue to the United Nations and profit from its use accrue to the United Nations for distribution as "dividends" to all members; or shall the res nullius accrue to individuals or private juridical persons and therefore to their countries of origin with ultimately the exclusion of the less technologically advanced and less wealthy nations. This is the same problem that is involved in the quarrel over exploitation of the seas.

Arthur M. Dula, a technologist and legal historian, with his major interest being the practice of aerospace and technical law, was interviewed in the August, 1981, issue of OMNI magazine. Mr. Dula agrees that private business should worry about what is developing at the United Nations.

"'The one thing that could stop the development of space by free enterprise would be to outlaw making a profit in space,' he says. 'The Soviet Union and Third World countries are now attempting this through the Moon Treaty.'"⁵⁵

Mr. Dula was very clear when airing his concern that free enterprise won't go anywhere if there is no hope for a profit. And profit derives from exploitation of rights of ownership (directly, if property is owned; shared, if leased or held by concession), and this is essentially what the treaty restricts.

IV DEVELOP ALTERNATIVE SCENARIOS: This activity will provide the planning team with a variety of perspectives toward resolving the points of conflict that were uncovered during the needs survey⁵⁶ and to visualize in graphic form what was only communicated before in a variety of ways. This is where communication among the interior designers, environmental psychologists, sociologists, anthropometric specialists, et al., will be imperative in order to formulate an initial design concept of a living environment to which human factors engineers and medical technologists at a later stage must adjust their detailed designs. At this point, however, the scenarios

⁵⁶The groundwork for the design scenarios will be based on the tangible results of surveys and tests made during the preplanning stages as government sponsored tests on a representative sample of potential private industry participants and facility personnel. This will basically describe a needs assessment pertaining to space requirements, energy needs, human requirements vs. automation, aesthetics, leisure, lighting, privacy needs, etc.

would be delineated by function and later, in Phase IV, by technical alternatives.

This step is similar to the planning competition used for the creation of Brazilia's master plan. The methodology and graphic delineations were presented and the optimum solution chosen. The specific architectural, engineering, and social considerations were then generated to suit the site which allowed for its most effective use.

V. SELECT OPTIMUM SCENARIO (S): The project management, government sponsors, outside consultants, and an independent review committee, will study the leading candidates and provide feedback on the design concepts. The intent of this activity will be to give increased definition to the project and to develop a general consensus of opinion. A comprehensive master plan, envisioned by the project management, draws on a broad range of professional expertise that must be give focus by a uniform perspective. Once the concept is established, the scheme has a functional idea around which work can progress.

VI EVALUATE RESULTS: The project management and the independent review committee will evaluate the interrelationships of the goals and objectives, the leading candidates, the existing technological support capabilities, the sources of financial backing, etc. Revisions and modifications will be made where necessary and upon final approval of the project management, Phase II will be complete. Evaluation of the results will continue only until an additional evaluation exceeds the probable benefit of the additional clarification. If at that juncture problems still persist, a review of the planning staff, its working philosophy and its definition of the design concept will be carried out and changes made accordingly.

PHASE III

VII DEVELOP PERFORMANCE CRITERIA FOR MAJOR SUBSYSTEMS: At this point, decisions will be made as to the type of major subsystems to be included as part of the basic infrastructure of the facility: integrated circuitry, computer systems and level of automation, lighting, sanitation systems, energy systems, method of air regeneration, medical surveillance network, etc. Indices for optimum life expectancy with a minimal maintenance requirement should be outlined.

Many of the systems that represent the present state-of-the-art already include these considerations. The problem will entail any new areas of development that will most likely be included. One specifically being the use of robotic systems.

VIII DEVELOP MEDICAL SCENARIO: The medical segment of the planning team should develop a comprehensive program for testing prospective volunteers for space duty. A series of standards should be set that are within certain physical and mental extremes to guarantee a consistent competency level and personality type by all future crew members. The existing medical requirements will therefore need to be relaxed in some aspects to a more realistic level of physical qualification because the present norm for astronauts is beyond the standard that could be achieved by a significant percentage of potential volunteers.

IX DEVELOP PHYSICAL PLAN AND DESIGN SUBSYSTEMS: This activity will require the greatest amount of expended effort than all the other planning sectors. The final facility design concept must be chosen, the major engineering and design specifications and the basic

infrastructure with the highest performance standards, must be agreed to. The physical plan will include the technical drawings of the major subsystems that were agreed to in Step VII. The plans will need to be approved by the project management, the outside consultants and the independent review committee to avoid design conflicts.

X ATTRACT USERS: Large industry, government agencies, research firms, etc., that were initially contacted for funding support will need to be firmly convinced to continue with the project. A key factor will be the completeness of the previous step to portray the physical structure and its inherent systems and how it can be adapted for a variety of uses. This will be a major aspect which could define the attractiveness of the facility for use by the entrepreneur.

XI EVALUATE PHASE III ACTIVITIES: The performance criteria, the medical scenario, the physical plan and major subsystems will all be reviewed for cohesive interaction and to remove conflicts. The outside consultants, the independent review committee, and the project management will check the results of the planning team's recommendations and respond accordingly.

Concerns that may be cause for study should be:

- Effect on personnel - Has an optimum solution been prepared that doesn't offer disadvantages to some portion of the facility's personnel?
- Effect of incremental introduction - Will the piecemeal approach towards major system development jeopardize its performance capability and make it vulnerable to design flaws?
- Review of system designs - Has the contextual integrity of the facility design plans been studied for

shortcomings or excessive system performance that are beyond adequate cost considerations?

- Ratification procedure - Have enough rational individuals been involved in the selection of the alternative solution?

PHASE IV

XII PROVIDE GUIDELINES FOR PRIVATE DESIGN GROUPS: Forward the results of the planning team's performance criteria and subsystems designs that will make up the basic infrastructure of the facility. This will ensure that there is sufficient communication between the project management and the private sector design groups. The individual industry design groups will build upon that basic infrastructure for their more specialized needs, and they will work within the standardized extremes (i.e., anthropometric design standards) the planning team set to allow some measure of flexibility in design format.

XIII PROVIDE GUIDELINES FOR DUAL MANAGEMENT OF THE COMMUNITY:

Establish an organizational format that distinguishes between mission control and the community's personnel sectors. Mission control will encompass the operation of the basic systems of the facility, establishing priorities to those systems and regulating them accordingly. The mission commander will have ultimate authority over the entire facility, and he will only invoke that authority over the industry personnel under various situational necessities and specifically during times of emergency. The formal operating procedure of the personnel sector will be controlled by division heads, who will operate according to standard management practices. There will be

constant review and comment between division personnel and division heads so as to keep conflict situations from developing.

XIV DESIGN INDUSTRIAL SECTOR: The entrepreneur will make use of the facility design guidelines and performance criteria to draw up design specifications for his industrial complex. It has been assumed that the initial needs survey outlined potential interior space requirements for a variety of industrial systems, and the basic facility shape and infrastructure was designed to handle and contain any specific necessities.

XV DESIGN RESIDENTIAL SECTOR: The same entrepreneur as in XIV will prepare residential drawings, architectural and interior, based on recommended study parameters outlined by function by the planning team in part IV. The entrepreneur will make use of his own studies of employee amenity preferences and psychological profiles and incorporate them with the recommended anthropometric guidelines that promote an economy of space.

XVI DESIGN LEISURE SECTORS: It will be very important that there be a recreation area which satisfies medical studies for reducing stress and trauma. Of significant importance will be the need to provide a full program of stimulus enrichment which would aid in avoiding the problems of social withdrawal and encapsulation that can result from a low stimulus environment.

XVII SPECIFY GUIDELINES FOR MISSION CONTROL: The planning team will work closely with the existing command format used by the present space program, and they will also incorporate any legal procedures established under space law. The guidelines will clarify

and define the specific extent of authority the commander and his staff have over the industry personnel sector under various situational extremes.

XVIII PROVIDE GUIDELINES FOR PERSONNEL SECTOR: The measures to be addressed at this juncture in the management organization will very likely be along the same lines as those recommended by B. Tuckman in describing a developmental process specifically oriented to a closed work environment. He lists four stages:

"FORMING - The early stage of group formation wherein individuals get acquainted and orient to each other and the environmental situation.

STORMING - A common phase of grouped development, particularly for problem-solving groups, where individuals work out interpersonal hostilities, dominance struggles, differences of opinion on relevant issues, and other aspects of interpersonal stress and threat.

NORMING - A phase succeeding the storming phase and characterized by the development of shared values, role expectations, codes of conduct, and the like.

PERFORMING - The phase wherein individual roles have been defined, functional specialization has developed, and the details of functional interdependencies have been clarified to the point that the group can function effectively in accomplishing its tasks."⁵⁷

This method in which roles are cast could be made an integral part of the medical scenario during the isolation period prior to their departure into space. The division heads will already have been selected prior to this process, thereby leaving this period of interaction as a method for clarifying the informal interpersonal working environment.

XIX EVALUATE PRIVATE SECTOR DESIGNS: This activity will be handled by the planning team and the independent review committee to study the feasibility of their plans, the cost analysis, the inclusion of

human factors engineering, etc. Conflicts will be reworked to meet the highest standards of efficiency achievable by the available state-of-the-art technology.

XX EVALUATE MANAGEMENT SCHEMES: The project management and the independent review committee will need to critically review the guidelines suggested for management. The management scheme will in most instances be similar in style and have adjustments in the personnel sector being reflected by the emphasis of the facility; that being industry, research, or energy oriented.

XXI COORDINATE DESIGNS AND MANAGEMENT SCHEMES: It will be the responsibility of the project management and the independent review committee to study the results of the private sector designs and management format to see if one conforms to the other. Any conflicts will require a complete restudy by the various steps outlined in Phase IV.

Confirmation will establish the existence of a complete set of working drawings for an outer space community.

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CONCLUDING COMMENTS

The proposed outline is in all respects one of many alternatives which could be used to create an independent space agency. The presumption of getting this concept through Congress would appear to be no sooner than the turn of the century. It is also apparent that a good number of developments will need to take place before a serious investigation into the merits of this program could occur. Several developments could include:

a) Small scale experiments showing the feasibility of growing a sustainable food supply for maintaining an adequate diet for facility personnel, which reduces the reliance on earthbased supplies.

b) Small scale experiments which improve the optimum quality and efficiency for smelting metals to assure any interested party of a sufficient return on his long-term speculative outlay. Adequate access to an abundant energy source and materials to smelt should also aid in attracting investors into the program.

c) Improved earthbased launching methods that reduce the potential of damaging the environment over the long-term.

d) Approval by the general population that is a result of the public initiative and referendum process to obtain a clear commitment by a majority of the United States population to support the large financial and material outlay inherent in the venture.

e) More studies on human performance in contained environments to determine the effects of a variety of interior design schemes which create a high stimulus environment.

f) Full agreement by members of the United Nations of a body of law governing space and its resources probably derived from the age old concepts dealing with res nullius.

Examples (a) through (e) describe developments alluded to in Chapters II through IV. However, the remaining development is the

point of paramount importance upon which the future of this space community concept rests.

The arguments that have been set forth in Chapter IV clearly state the basis on which free enterprise would most likely be attracted into supporting a program of this type. Private and public collaboration in this program will rest primarily with the potential degree of return, with the most obvious result being profit. A secondary stimulus which could also act as a primary justification for selling the program, may very easily be to enhance the public good, through the expansion of technology, commerce and trade, cheaper energy, reduced demand on earth resources, etc. The latter would be advertised to the degree that it would overshadow the former, giving the program a sense of enlightenment and merit.

The implementation of the project presented in this study depends on the outcome of the issues and treaties being resolved at the United Nations. The issues being debated which deal with a body of international law governing the acquisition and use of property and related activities in space, those matters are as yet undecided. There is an obvious parallel between the discussion of space and the Law of the Sea treaty that is useful for this paper. It took centuries to come to an "acquiescent" understanding of the Freedom of the High Seas, which culminated during the Eighteenth century. The Law of the Seas, now at a standstill due to a cautious reserve by the American delegation over the ultimate precedent that would be set by agreeing to the treaty, displays fully the trouble of justifying the use of that which over centuries was not subject to any binding force of law.

The underlying belief of the aforementioned treaty, is put forth by the international customary law of the Freedom of the High

Seas which rests on three basic elements: the prohibition of appropriation of any portion of the high seas, the exercise of jurisdiction on the high seas, and the lawful uses of the high seas. The law clearly states the distinction between the high seas and the bed and sub-bed of the sea. The principle coastal state and the adjacent continental shelf and the area outside the territorial waters to a depth of 200 meters, can be exploited for its resources by that state.

The high seas, per se, is by international customary law considered res extra commercium. "That is, excluded from areas that may be lawfully occupied and subjected to exclusive jurisdiction by any international person."⁵⁸ This law has hence been applied to the 1961 and 1963 Resolutions that were adopted by the General Assembly of the United Nations which stated that ". . . outer space and celestial bodies are not subject to national appropriation."⁵⁹

Up until the moment the United States landed a man on the moon, it was appropriate to conclude that space was res nullius. "That is to say, it was so far unappropriated because, as yet, no subject of international law has been able to do so."⁶⁰ The principle behind res nullius is that it is the property of nobody. In its fullest sense, it means ". . . a thing that has no owner, either because a former owner has finally abandoned it, or because it has never been appropriated by any person, or because (in Roman law) it is not susceptible of private ownership."⁶¹

It can be assumed that the latter point is the intent behind several members of the United Nations to include the phrase, which is the central bone of contention in the Moon Treaty, "for the benefit of all mankind."

The Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, reiterates the "not subject to appropriation" clause, and it also provides for the ". . . freedom of exploration and use, including scientific investigation,"⁶² of space.

One may assume that a long period of negotiation will be required before an understanding is reached among the various members of the United Nations which can be used by the member states to generate interest within their separate countries. Suffice it to say that, until the two points, quoted above, are defined in such a way that the feasibility of capitalizing space is not undermined by bitter and jealous debates over a reasonable and just share for all, regardless of their degree of involvement, there will be no cooperative partnership.

Once this understanding has been agreed to, then the opportunity for a government sponsored independent space agency would be at hand.

FOOTNOTES

¹J. Peter Vajk, et al., Financing Alternatives for Space Industrialization. (New York, N.Y.: American Institute of Aeronautics and Astronautics, May, 1979), p. 2.

²Robert T. Deland and John A. Parker, "Roles of the Planner in Urban Development," in F. Stuart Chapin and Shirley F. Weiss (eds.), Urban Growth Dynamics. (New York: John Wiley, 1962), p. 9.

³Phil Heywood, Planning and Human Need. (Newton Abbot, Devon: David and Charles Limited, 1974), p. 27.

⁴H. Wentworth Eldredge (ed.), Taming Megalopolis, Vol. II. (Garden City, New York: Anchor Books, Doubleday and Company, Inc., 1967), p. 824.

⁵Heywood, Human Need, p. 824.

⁶Kirmach Natami, "Future Directions For Selecting Personnel," in T. Stephen Cheston and David L. Winter (eds.), Human Factors of Outer Space Production. (Boulder, Colorado: Westview Press, Inc., 1980), p. 28.

⁷Hugh Heclo, "Issue Networks and the Executive Establishment," The New American Political System. (New York: American Enterprise Institute, 1978), p. 117.

⁸Jeffrey M. Berry, Lobbying for the People. (Princeton, New Jersey: Princeton University Press, 1977), p. 7.

⁹Ibid., p. 288.

¹⁰Joanne Omang, "The Great Nuclear Non-Debate," The Washington Post. (March 12, 1978), p. C5.

¹¹Hazel Evans (ed.), New Towns: The British Experience. (New York: John Wiley and Sons, 1972), p. 43.

¹²Ibid., p. 47.

¹³Ibid.

¹⁴Frederick J. Osborn and Arnold Whittick, The New Towns: The Answer to Megalopolis. (London: Leonard Hill, 1969), pp. 103-104.

¹⁵Evans, New Towns, p. 47.

¹⁶Eldredge, Taming Megalopolis, p. 851.

¹⁷Ibid., p. 822.

¹⁸Sam Pope Brewer, "Brazil Preparing to Shift Capitols," The New York Times. (March 29, 1955), p. 14.

¹⁹Thomas E. Skidmore, Politics in Brazil: An Experiment in Democracy. (New York: Oxford University Press, 1967), pp. 167-168.

²⁰Armin K. Ludwig, "The Planning and Creation of Brasilia: Toward a New and Unique Regional Environment," in Eric N. Baklanoff (ed.), New Perspectives of Brazil. (Nashville, Tenn: Vanderbilt University Press, 1966), p. 181.

²¹Ibid.

²²Ibid., p. 189.

²³Ibid., p. 191.

²⁴José Honório Rodrigues, The Brazilians: Their Character and Aspirations. (Austin and London: University of Texas Press, 1967), p. xxi.

²⁵Ibid., p. 152.

²⁶Heikki von Hertzen and Paul D. Spreigen, Building a New Town: Finland's New Garden City, Tapiola. (Cambridge, Massachusetts: The MIT Press, 1972), p. 76.

²⁷Ibid., p. 73.

²⁸Ibid.

²⁹William Griffitt, "'Crowding' and Human Social Behavior," paper presented at the XV Interamerican Congress of Psychology, Bogota, Colombia, December, 1974.

³⁰E. H. Bock's, "Space Manufacturing Facilities," in Fourth Princeton/AIAA Conference on Space Manufacturing Facilities, Report No. 79-1374. (New York, N.Y.: American Institute of Aeronautics and Astronautics, 1979), p. 1.

³¹Charles M. Chafer, "The Role of Public Interest Groups in Space Policy," in Fourth Princeton/AIAA Conference on Space Manufacturing Facilities, Report No. 79-1388. (New York, N.Y.: American Institute of Aeronautics and Astronautics, 1979), p. 1.

³²U.S. Congress. Senate. Hearings Before the Subcommittee on Science, Technology, and Space, of the Committee on Commerce, Science, and Transportation, U.S. Civilian Space Policy. 96th Cong., 1st Sess. (Washington, D.C.: Government Printing Office, 1979), p. 5.

³³Ibid.

³⁴Stanley A. Murrell, Community Psychology and Social Systems. (New York: Behavioral Publications, 1973), p. 35.

³⁵Robert L. Helmreich, John A. Wilhelm, and Thomas E. Runge, "Psychological Considerations in Future Space Missions," in T. Stephen Cheston and David L. Winter (eds.), Human Factors of Outer Space Production. (Boulder, Colorado: Westview Press, Inc., 1980), p. 15.

- ³⁶Heywood, Human Need, p. 38.
- ³⁷Ibid., p. 39.
- ³⁸Ibid.
- ³⁹N. H. Mackworth, "Some Factors Affecting Vigilance," in Advanced Science. 53 (1957), p. 389.
- ⁴⁰Daniel Stokols (ed.), Perspectives on Environment and Behavior. (New York and London: Plenum Press, 1977), p. 16.
- ⁴¹A. Wicker, "Processes Which Mediate Behavior-Environment Congruence," in Behavioral Sciences. 17 (1972), pp. 265-277.
- ⁴²Stokols, Behavior, P. 17.
- ⁴³William H. Ittelson, Harold M. Prohansky, Leanne G. Rivlin, and Gary H. Winkel, An Introduction to Environmental Psychology. (New York: Holt, Rinehart & Winston, Inc., 1974). p. 91.
- ⁴⁴Space Science Board, Human Factors in Long-Duration Space Flight. (Washington, D.C.: National Academy of Sciences. 1972), p. 71
- ⁴⁵Ernest J. McCormick, Human Factors Engineering. (New York: McGraw-Hill Book Company, 1970), p. 25.
- ⁴⁶Charles E. Billings, "Barometric Pressure," in James F. Parker, Jr. and Vita R. West (eds.), Bioastronautics Data Book, Second Edition. (Washington, D.C.: U.S. Government Printing Office, 1973), p. 7.
- ⁴⁷Billings, "Atmosphere," Data Book, p. 52.
- ⁴⁸Ibid., p. 59
- ⁴⁹Berenson and Robertson, "Temperature," Data Book, p. 72.
- ⁵⁰Ibid., p. 86.
- ⁵¹Ibid., p. 87.
- ⁵²Berry, "Weightlessness," Data Book, p. 351
- ⁵³Ibid., p. 350.
- ⁵⁴What is at stake: shall the res nullius (property of nobody) of space accrue to the United Nations and profit from its use accrue to the United Nations for distribution as "dividends" to all members; or shall the res nullius accrue to individuals or private juridical persons and therefore to their countries of origin with ultimately the exclusion of the less technologically advanced and less wealthy nations. This is the same problem that is involved in the quarrel over exploitation of the seas.

⁵⁵Ron Bitto, "Space Laws," in OMNI. Vol, 3, No. 11 (August 1981), p. 51.

⁵⁶The groundwork for the design scenarios will be based on the tangible results of surveys and tests made during the preplanning stages as government sponsored tests on a representative sample of potential private industry participants and facility personnel. This will basically describe a needs assessment pertaining to space requirements, energy needs, human requirements vs. automation, aesthetics, leisure, lighting, privacy needs, etc.

⁵⁷Space Science Board, Human Factors in Long-Duration Space-flight. (Washington, D.C.: National Academy of Sciences, 1972), p. 162.

⁵⁸Georg Schwarzenberger, A Manual of International Law, Fifth Edition. (New York - Washington: Frederick A. Praeger, Publishers, 1967), p. 118.

⁵⁹Ibid.

⁶⁰Ibid.

⁶¹Henry Campbell Black, M. A., Black's Law Dictionary, Fifth Edition. (St. Paul, Minn.: West Publishing Co., 1979), p. 1174.

⁶²Georg Schwarzenberger and E. D. Brown, A Manual of International Law, Sixth Edition. (Milton, England: Professional Books Limited, 1976), p. 93.

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AN OUTER SPACE COMMUNITY:
A MULTIDISCIPLINARY APPROACH TO AN ORGANIZATIONAL STRATEGY

by

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ABSTRACT

The purpose of this paper is to generate a workable organizational strategy necessary for implementing a program dedicated to the exploitation of space. The strategy is first given a planning perspective in Chapter I whereby the coordinating and administrative techniques of that profession are outlined to achieve a comprehensive development package following the methods of new town planning. The use of this method reflects the emphasis it directs toward the exploitation of undeveloped property for economic, social and political reasons.

Chapter II offers a rationale for the creation of national new town planning strategies and the need for government intervention to aid the faltering urban economies that haven't been capable of handling the growth of urban populations and social services. For comparison, an enterprise undertaken by a private corporation is discussed in which the central government was not willing to supplement increased public expenditures to handle similar problems. The focus on the public and private sector strategies sets the stage for Chapter IV in which a meshing of private initiative and the public sector into a partnership is used for attaining a goal which when separate is unattainable. Of secondary, if not equal importance, is the proposal to form a financial consortium more extensive and equitably applied than is a purely public program in which private firms serve solely as contracting agents. Just as special districts charge for specialized urban services, private corporations who participate as a partner and who expect to benefit as a result of their participation in a project, should or are obligated to share

in the initial front-end and continuing capital expenditures and maintenance costs.

Chapter III describes the necessary involvement of a number of specialized disciplines to handle long-duration physical, environmental, personal and social concerns for integration into the design scenarios of a space facility.

- The focus of Chapter IV is to draw together the materials previously discussed into a plan of action as a strategy for designing a comprehensive space facility based on a concerted effort between private and public interests.