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PRIORITY RESEARCH NEEDS ON TECHNOLOGY-RELATED TRANSNATIONAL AND GLOBAL POLICY PROBLEMS

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INTERNATIONAL TECHNOLOGY AND INTERNATIONAL ACTION: WHAT, WHO, HOW, AND WHY?

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PURPOSE AND SCOPE

This memorandum is an effort to identify possible approaches to the systematic consideration of internationally relevant technological issues. The purpose is to contribute to a clearer discussion of policy options; the method is to explore the interface between several now-fashionable approaches, to note their limits, and to suggest ways of combining them. We proceed by (1) identifying what is "international" about a given technology and (2) exploring the degree of cognitive and administrative complexity required for its management, regulation, or study. In so doing we arrive at a list of priorities and strategies desirable for the further exploration of these interfaces, and we argue that this exploration is a necessary preliminary step to the detailed consideration of specific technologies and their international regulation. We do not admit that currently established and/or recognized relationships are necessarily optimal for the future, and we ask our questions in such a way as to suggest alternative possible relationships. We subordinate the entire exploration to a major proposition: "technological problems" cannot be identified, "organizations" chosen, or the scope of "regulation" prescribed without putting this entire range of options into the larger context of first establishing the human purposes to be served. We submit that this prior question is not usually asked. Therefore our presentation will first explore what is to be regulated, how regulation can and does proceed, and who is to do the regulating in order to show that these separate approaches do not serve us well.

WHAT IS AN INTERNATIONAL TECHNOLOGICAL "PROBLEM"?

What is the "problem" associated with direct broadcast satellites? For the engineer it tends to be the optimal design of the device; for Marshall McLuhan it is the character of the coming global village. Both are "right"; neither exhausts valid identification of the problem; both are wrong in suggesting that his way of slicing into the matter is best because it begs the question of "best for what?" In short, we must face the fact that the mere specification of the unit of analysis implies a set of conceptual and practical consequences which seriously influence our idea of the problem and hence its solution. We illustrate alternative "valid" ways of conceptualizing the same international technological problem.

We distinguish between foci of analysis which select the "cause" of the problem (input foci) from others which stress concepts for controlling the "effects" of the same problem (control foci). Input foci includes (1) specifying the capability of the hardware, especially the aspects which make it

of more than national concern; (2) describing the activity of the hardware in terms of its international ramifications; (3) foreseeing the externalities, positive and negative, likely to be triggered by the activity; (4) identifying the spatial impact beyond national jurisdiction associated with the externalities; (5) identifying and analyzing the human decision-making arrangements called for by the spatial impact. Using the instance of remote sensing from satellites as an example, we recognize that each focus has in fact been used as an entry point into the "problem":

Hardware	Activity	Externalities	Spatial Impact	Decisionmaking
Sensors Satellites Tracking Telemetry	fly-overs with indiscriminate data gathering; foreign bases	+ weather data; resources; erosion - espionage; unequal access to data	regional and global weather systems; trade patterns; alliances	new networks of national and international administrative units; new private actors; rival cost/benefit analyses; more complex bargaining patterns and strategies

Obviously the "problem" of remote sensing looks different, depending on the cell in which we begin the tracing of arrows of influence, depending on whether we work from right to left, or vice versa. If we start with the more complex foci on the right we can subsume the mere "practical" considerations on the left -- but we tend to lose specific linkages; if we reverse the procedure, we recognize so many links that cognitive mastery becomes dubious. Yet it makes a huge difference which way we choose, as shown when we turn to the control foci.

Decisionmaking could be considered a control focus since it seeks to manage the "problems" caused by the other four; but if we postulate cybernetic inefficiency and imperfect feedback, it becomes part of the "cause" of the difficulty at issue. Control foci deal with the delimitation of the "system" that requires management. Systems can be defined as (1) spatial, (2) functional, and (3) global or total. Each has its advocates today and the identification is determined by the selection of more or less abstract input foci. As applied to the case of remote sensing, we recognize the following patterns of advocacy:

Spatial System	Functional System	Total System
Treated as part of the issue of "outer space" and thus becomes part of a set of hardwares, activities, etc., to be subjected to a comprehensive space regime. Many subsets are aggregated under the physical definition of "outer space," which tend to cluster on the "spatial impact" entry point.	Treated incrementally as separate concerns as they bubble up from the hardware-invention context. Leads to separate regimes for broadcast frequencies, orbits, data sharing, etc. Features disaggregation and clusters on hardware and activities as entry points	Ecosystem approaches. Every activity is linked to every other. Total systems management held imperative. Activity becomes part of concern to protect entire human environment. Considers all input foci as inadequate entry points.

Clearly, remote sensing is not the only current preoccupation of people concerned with international technological issues. Suppose we add just <u>one</u> family of additional hardwares: improved machinery for mining the seabed. It begins to complicate the input foci clustering around externalities (resources, distribution of skills), affects the spatial impact because of the trade system, and further complicates the decisionmaking patterns by introducing new actors and concerns. If we concentrate on hardware and activities alone we would miss these features but we also simplify the problem of control. An outer space spatial system of control would neglect the oceans; a set of functional systems specific to remote sensing would be beside the point; only a total perspective would do justice to the pattern of linkages. Which definition of the "problem" is the right one?

All and none. Problems are now being defined in terms of the properties of each cell; moreover, they can be legitimately defined in such terms because almost any conceivable linkage arrow has been or could be drawn. But the ascertaining of the probability of influence is still in its infancy. The importance presently attributed to linkages remains speculative and hence arbitrary. Historical analogies are not very reliable yardsticks; simple projection of trends are inadequate. None of us "knows," no matter how expert in his field, what the strength of the linkage arrows should be. Yet we blithely select our entry points and proceed to diagnose and prescribe accordingly.

We suggest that such definitions of the "problem" are dangerously premature unless we specify <u>first</u> why we wish to control or manage this or that technology. In part this requires objective knowledge of externalities. It also calls for a good appreciation of the politics of decisionmaking in such settings. But a prescription regarding optimal combinations also requires a better appreciation of actual and potential linkages. Linkages are a function of perception and emphasis on the part of the observer; while they do exist "in nature," they exist in such abundance that the identification of the most important requires an act of intelligent (though not arbitrary) selection. This selection, however, is partly a function of the normative commitments of the selector, of the specification

of why he wishes to control or regulate before he identifies what requires regulation. Only thus can we avoid the pitfalls of excessive concreteness (hardware and activity foci) and the mysticism of the ecofreak for whom the "human environment" is a natural and a religious system.

HOW CAN TECHNOLOGY BE HANDLED?

How can and does international management proceed? We "know" there to be some relationship between the nature of the "problem" to be managed and the character of the organizational arrangement designed to do the managing. But, not knowing precisely what the relationship between the two is, we cannot specify which system of management will be the most appropriate for any given "problem." Some possibilities are explored below.

The international management of technology may be viewed as consisting of two component elements: the construction of international regimes, and the specification of roles, within regimes, that international institutions are to play. An international regime is here taken to mean simply any collectively defined and adhered-to system of organization; the World Weather Watch might be cited as an example. As for the role(s) of international institutions, to continue with the example, the World Meteorological Organization serves as a forum, facilitator, and enabler but it does not have an operational task itself. All operational activities are performed by national meteorological services.

There exist several types of international regimes. Some are constructed for the purpose of joint production of goods or services; their intent is to provide a capability or resource to their members. Some are constructed for joint administration of a set of activities; their intent is to coordinate or harmonize a set of activities within an agreed-to scheme or plan. Finally, international regimes exist for the purpose of exercising joint jurisdiction over a set of activities or an area; their purpose will be to regulate and/or own some jurisdictional space.

The concept of institutional role too admits of several classificatory distinctions. Above, the distinction between a facilitative or enabling role and an operational one was drawn. One way to differentiate between the two is to suggest that the first makes no attempt to add to the sum total of activities now existing, but seeks to change them; the latter adds to existing activities. Furthermore, in adding to existing activities in the international technology field, several means exist; research, monitoring, and regulation are the most frequently referred to.

One can, of course, continue to spin off classificatory distinctions ad infinitum. Our only purpose here is to argue that there exist two quite distinct components in any scheme of international management: international regimes and international institutions. And, while these two components may be seen to covary in fact, we have no way of specifying such covariation in theory or of predicting it in new and different situations. But perhaps an illustration can help us along.

Systems of International Management

Role(s) of International Institution

International Regimes	Enabling	Operational
joint production	GARP ENEA	CERN ELDO ESRO
joint administration	W.W.W. Earthwatch	IFRB
exercise joint jurisdiction	IAEA - NPT safeguards	IAEA statutory safeguards Earatom safeguards

Take the statutory safeguards of the IAEA as an example of an international regime. One of the "problems" to which it is a response is the proliferation of military nuclear capabilities which might accompany the spread of knowhow of peaceful nuclear uses. In terms of the scheme developed above, the safeguards program is an illustration of joint jurisdiction. Its area of jurisdiction includes, e.g., the fuel cycle of those materials which a nonweapon country has received from the international agency. The Agency has the operational role of inspecting those national facilities utilizing "internationalized" materials -- although there is nothing inherent in the regime necessitating such a role, as subsequent events have shown. By 1967, the jurisdictional domain of the regime included but six percent of the total peaceful plutonium production in the world. A new regime, the NPT safeguarding system, came into being. It expanded the jurisdictional domain of the previous regime to include all peaceful nuclear industries in nonweapon signatory countries. At the same time, however, the role of the Agency in inspection changed subtly; it became less operational, relying more upon national and regional on-site inspection, and limiting itself to standardizing (enabling role) and verifying these.

We wish to make three points: (1) there are two distinct components of international management systems, regimes, and institutions, and these do not follow a single pattern of covariance; (2) there probably exist statistical relationships between the character of regimes and the roles of institutions, and between both and the nature of the "problem" to be managed. But (3) these relationships have little or nothing to do with the "technology" as such, and cannot be explained or predicted without referring to the configuration of actor purposes and objectives. In the case of the peaceful atom, cited above, the purposes and objectives of actors, both "haves" and "have nots," clearly changed over time, as both technology and politics changed, from the time of the Baruch plan, the Atoms for Peace proposal,

the Statutory Safeguards, and the NPT Safeguarding regime. We turn, then, to the "why" question.

WHY DEAL WITH INTERNATIONAL TECHNOLOGICAL PROBLEMS?

We approach the question of "why?" with a number of illustrative questions, all of which suggest that the linkage patterns are highly complex; nevertheless, we shall have to opt for some pattern in our selection of research priorities. The pollution of the marine environment is, among other things, a negative externality of nuclear power generation; in stopping it, do we do it out of regard for fish and swimmers, for the quality of the atmosphere, for the amount of rain, for agricultural productivity, economic development, or the entire ecosystem? Drought- and pest-resistant varieties of wheat reduce malnutrition; they also interact with rural development, landownership, and social stratification, and make possible a larger population at higher nutritional standards and thus complicate the pollution issue while influencing world trade patterns; what do we seek to control: the green revolution or international trade policy? What is the cause of poverty? Population growth or the functioning of the international economic system? Granted that there are links between the two, do we perfect the technology of birth control without considering world trade and monetary issues? Do we recognize the "systemic wholeness" of the oceans by subjecting fishing, mining, shipping, oceanographic research, pollution, and nuclear submarines to a single international regime? If these activities are all aspects of economic welfare, however, why not approach the oceans in terms of international economic planning? (or of arms control, or of safeguarding the human environment, or..., or...?) There is alleged to be a world energy crisis: do we increase production of nuclear power, raise oil prices, do research on solar energy, limit demand, create a World Petroleum Authority, a Global Energy Assessment Board, or an Ecumenical Council for the Worship of the Ecosystem?

To put the matter quite succinctly: there are no natural systems which allow us naturally to subsume these concerns; all systems are human artifacts designed to facilitate choice. Moreover, they are overwhelmingly dependent on the hierarchy of values in the mind of the system's architect. When such systems emerge from the deliberations of governments, committees, and international conclaves, they can be no more than the compromise struck among the values in the minds of the negotiators.

Hence it bears repeating that the "problem" of managing this or that technology is not identical with the "problem" of more adequate international organization. First, not all technological issues are international. Many are of concern only to single societies, or even sectors in such societies, and there is nothing in "technology as such" which makes it international. Issues related to the introduction of new hardware and techniques become international only when they are so perceived -- because of externalities or spatial impacts -- by an important clientele. Second, we have argued above that the administrative techniques of how to manage technologies which have acquired international salience are not linearly and directly linked to

the issue of who does the managing: institutional forms and international regimes do not follow a single pattern of covariance. It is not possible, in pursuing policy-oriented research, to simply stipulate that such and such a technological problem calls for such and such a regime which ought to take a determinable organizational form, in other words.

We urge that the key to unlocking the box lies in subordinating the questions raised above to the prior question of why actors seek to do something about international technology. Our list of purposes and values is not exhaustive. While it ascends the ladder of complexity of linkages and abstraction, the "higher" purposes and values do not systematically subsume the "lower" ones. The values typically encountered in this field include the following:

1. Maximize the efficiency of the technology at issue. The inventors of and first investors in new technologies (engineers, corporations, governments) usually wish to shape the international environment so as to make it "safe" for the full utilization of the new hardware and/or techniques.

2. Diffuse and distribute the benefits of the new technology. No effort is made to think beyond first-order benefits which might be derived from the utilization of the new technology and the assumption is made that if properly distributed and understood it is "good for everybody."

3. Limit unwanted first-order consequences of the technology. Along with the second set of values, it is also recognized that some negative externalities might be involved and hence the bundle of values is enlarged to include technology assessment.

4. Identify and limit unwanted second-order consequences of the new technology. Here more elaborate linkages are included in the value scheme because it is now recognized that a given technology may have effects in sectors of human activity not initially connected to the new activity, as suggested in the list of questions given above. Technology assessment is then enlarged to include notions of the economic and social systems and leads to the linking of social indicators to technology diffusion studies.

5. Link technology to international economic development. The mixture of values under (4) is explicitly focused and redirected to the subordination of technological innovation to the norm of improving the performance of national (and international) economic systems. The awareness of second-order consequences, positive and negative, then imposes the imperative for more conscious planning at the international level.

6. Use technology as the stimulus for generating a new global consciousness of respect for the ecosystem. The awareness of ever more complex links among technological activities

can be used to inculcate a new respect for the connectedness among human and nonhuman structures and thus suggest limits on the amount of innovation to be attempted.

7. Link economic development planning and a new respect for the ecosystem to the creation of world peace. This bundle of values makes the assumption that peace is related to well-being and respect for the environment: improving one consolidates the other.

8. Create new human institutions to consolidate and accelerate learning processes which lead to a recognition of interdependence. Technological issues have been so treated by some and the process could conceivably be intensified.

9. Work toward world government. Commitment to the creation of a world government could draw on several of the "lower" or more modest values and purposes; some advocates of world government in fact do so.

Any research or action strategy will differ according to which of these (or other) purposes and values are selected as the ordering device for approaching single technologies. The broader the purpose the larger the family or bundle of technologies which one will seek to regulate or manage internationally. Also, the broader the purpose the more complex the linkage pattern we must assume to exist among the various technologies, activities, impacts, and externalities. It is not surprising, therefore, that the "higher" of these value clusters tend to approach the messianic in tone because the actual linkages are not known and are therefore asserted as a matter of faith.

Our preference for an entry-point into these sets of questions hovers around the identification of second-order consequences and the linking of technological issues to economic development. Values "above" this threshold depend on our understanding linkages which we, in fact, do not yet grasp. To work with them implies systems constructs which are both artificial and highly oversimplified, no matter how passionately advocated by the Club of Rome. To adopt such systems as "real" implies a belief in the "naturalness" of an imperfect heuristic device. Values "below" our threshold, however, suffer from fragmentation and the undesirable consequences of indefinitely following an international regulatory strategy of disjointed incrementalism. Such a strategy tends to inhibit efforts at identifying intersectoral linkages and externalities.

SOME OBVIOUS IMPLICATIONS

Positing a scale of values and selecting one or the other as an entry-point permits the subordination of questions of what, who, and how to some specified purpose. If we wish to improve the international economy, we will analyze and organize the mining of the seabed and remote sensing differently than if we wish to create a world government or improve the

technology itself. Such a choice suggests whether we will seek to regulate just externalities or to deal instead with the more complex matter of decisionmaking networks; it would help us decide whether we wish to opt for a regime of joint production or joint administration, whether the focus should be functional or spatial, regional or worldwide.

Clearly, this way of looking at the problem includes the art of technology assessment, which has evolved autonomously from these concerns, as an integral part of the process of regulation and/or management. It also takes for granted that the activities and externalities identified above should be considered in a network of linkages. Our approach further implies a commitment to some species of "planning," though the details of such an approach have not been thought through. Our approach opts for "aggregation" at some middle level of abstraction, disputing the virtues of the extreme disaggregation currently practiced and cautioning against premature aggregation of the "whole systems" variety. Finally, we have tried to suggest that, from the point of view of future policy options, a concentration on "technology itself" is neither interesting nor fruitful.

SOME NOTIONS ON RESEARCH PRIORITIES

Our analysis suggests a number of obvious research priorities. First, and before all else, whatever the particular research focus selected, we suggest that the notion of a "natural system out there," to be discovered and simulated, be abandoned. We must recognize that systems analysis is useful insofar as it gives clarity in terms of a specified human purpose, and that each purpose will yield a different -- and equally plausible -- system. Priority number one, then, is the construction of research designs around the concept of purpose.

Second, having for so long fused (and confused) international management with the activities of international organizations, we need to know more about the two components of international management systems: regimes and institutions. How does the process of regime construction proceed? Which actors, under what kinds of circumstances, and for which purposes, seek to manage which aspects of what problems internationally? How do different actors select and define the "problems" to be managed internationally? Which definition of the "problem" gets incorporated into regimes, and how and why? Likewise, we need to ask the same kinds of questions about institutional roles. Finally, these questions need to be asked about the relationship between the character of actor-defined problems, regimes, and institutions.

Third, we ought to explore what should be done by international management systems, and how, and by which kind, depending upon assumptions about purposes and objectives. This, in essence, would be an exercise in positive theory or advocate planning, focusing not on hardware, spatial effects, or ecosystems, but upon human purposes and objectives to be achieved.

Finally, to systematically relate data about existing management systems to alternative future management systems, more generalized knowledge

than we now possess is required. Thus, in addition to data-gathering activities, we suggest an emphasis on model-building, theory contruction, and forecasting techniques as well. Our selection of an entry point around the identification of second-order consequences suggests that econometric analyses of lower-order phenomena, while being necessary for the construction of base lines, will be insufficient; and it further suggests that world dynamics modeling, based upon oversimplified and reified ecosystems, assumes more than we now can or wish to handle. The only viable alternative we see is the construction of policy-systems models, at a level of abstraction high enough to include second-order consequences, but concrete enough to permit the assessing of actual policy alternatives.