What Message in the Medium of Information Systems?

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This is a study of 192 information systems maintained by the family of United Nations agencies. The study seeks to determine the impact of the availability of this information capacity on international society, and provides suggestions on how the impact can be conceptualized and studied. The quality of policy might be improved by availability of information, thus perhaps improving development planning. Dependency might be reduced by providing developing countries with knowledge to compensate for economic weakness, thus having a redistributive effect. Cognitive frameworks for defining problem sets could change as a result of information structuring and retrieval routines, thus potentially resulting in greater international complementarity of approaches to problem-solving. The findings suggest that while some trends in the direction of such outcomes can be discerned, the impact of information systems on the whole remains fragmentary and uneven.

The supply of information is increasing at an extraordinary rate, internationally no less than domestically. Of nearly 200 United Nations information systems now in existence, over half have been established since 1970, most of these since 1975. Moreover, the increase is especially pronounced in facilities that process and manipulate information rather than merely storing it, and which have an active outreach component rather than simply

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waiting to be used. The rate of growth in information systems catering to the particular needs of developing countries has been even more impressive; these systems now comprise over one-third of all facilities, up from less than one-tenth only a decade ago.[1]

This extensive institutionalization of international information systems conceivably can effect change in the international political system in several ways. For one, it may upgrade the quality or sophistication of decision making and policy throughout the world, by providing greater uniformity of access to specialized information that some, and perhaps many, decision makers previously lacked. There is no presumption that international harmony will follow. Access to information can as readily sharpen conflicts of interest as attenuate them, but at the least factors and forces that otherwise might have remained masked, or beyond consideration altogether, are now rendered more transparent.

To upgrade the quality of policy or the sophistication of decision making is the intended objective of any intergovernmental information system. But it is not the only consequence imaginable. A possible second-order consequence is particularly important to governments of developing countries and to officials of many international organizations. Here, information and equal access to it are seen as vehicles for reducing dependency in economic and cultural relations. Participation in international information systems makes possible some net transfer of information from North to South, be it in the realm of basic research, or more politicized data concerning trade, technology, or capital; it also provides the occasion for the independent production of such information by the South itself. Thus, on the premise that "knowledge is power," the redistribution of access to knowledge is seen by some as a potential means to compensate for the lack of material bases of power: as a means to substitute "brains" for "muscle."[2]

1. Inter-Organization Board for Information Systems, *Directory of United Nations Information Systems* (1980), 2 vols. Hereafter cited as *Directory*. See also Table 1.

2. Lack of information per se is rarely cited as the major reason to initiate information systems in the United Nations; the problem, more commonly, is to systematize the glut of information available and to get it to the appropriate users at the

A more elusive second-order consequence of international information systems is their potential role as a conceptual guide to policy. This could result if information is structured in such a way that acting upon it channels behavior in certain directions that are deemed desirable from the standpoint of some set of values. Information structuring can be accomplished by means of a thesaurus, for example, which shapes the categories for information collection, storage, and retrieval in accordance with an underlying view of the nature of the problem at hand. Thus, a thesaurus for environmental information would organize such categories into a hierarchy that reflects some understanding of the structure and functioning of ecosystems.[3] Or, still more ambitiously, information structuring can take the form of global modeling exercises, incorporating particular formulations of cause/effect relations and specifying particular solutions (Ruggie, 1980; Alker, 1981; Leurdijk, 1979). With this effect a threshold is crossed, from information provision and its impact on the capacity to act, to some measure of cognitive integration among actors and the subsequent direction of action.

One could push on further, and begin to treat the communicative realm as a quasi-autonomous social realm, shaped by but irreducible to "productive forces" or "relations of force" in society, and capable of generating entirely new forms of social organization via its effect on cognitive transformation (Kingdon, 1973; McLuhan, 1962; Habermas, 1979). To do so, however, would take us well beyond the scope of this article, and well beyond anything that is known about international information systems. Indeed, the present state of knowledge about international information systems is so spotty that no full-scale investigation of any of their possible effects on international policy and politics is possible at this time.

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right time. It is this capacity that developing countries do not possess in abundance, and which preoccupies UN redistributive efforts in the domain of information. "Information Systems within the United Nations Family," ECOSOC Document E/AC.51/90, 27 Apr. 1978.

3. One frequent complaint about INFOTERRA, an environmental information system which we analyze below, is that its codebook entries do *not* reveal "the inter-connectedness of the environment." (Cherfas, 1979: 364.)

Our objective in this article, therefore, is a modest one. We present a preliminary mapping of UN information systems in the hope of throwing some light on themes raised above. We draw on two sources of data: (1) an overview of the entire universe of cases, consisting of 192 information systems operated by 29 organizations in the United Nations family;[4] and (2) more detailed descriptive material of some of the larger of these systems, especially the international referral system for sources of environmental information (INFOTERRA). More is known about INFOTERRA than about most other systems because it has undergone a major review by its parent organization, the UN Environment Programme (UNEP), and because it has sought from its inception to audit and improve itself (Ruggie and Haas, 1981).

This article is organized as follows. Part I contains a summary of the number and types of information systems operated by the United Nations, as well as of the major areas of knowledge in which information is available. And, so as to give concrete referents to the subsequent analysis, we include brief descriptions of some of the major UN information systems. Neither statistical summaries nor verbal descriptions of extant systems can tell us anything definitive about the first of our themes—whether these systems are enhancing the quality of sophistication of national and international policy—but they are suggestive of the *capacity* of information systems to have such effects. In Part II, we examine the rates of participation in these systems. This discus-

4. This overview is based on the UN *Directory*. It lists 335 systems. We excluded 32 of these because they are either (a) not operational, (b) merely public relations centers for the media, and thus not information systems in the sense we use the term here, or (c) restricted in use to its own officials, and thus not international as we conceive of the term for present purposes. We merged another 111 systems because they turned out to be components of larger systems. We thereby arrived at the number 192. As is the case of all UN compendia, the IOB *Directory* is the result of inquiries and questionnaires addressed to the operating agencies by the compilers of the compendia. Compilers, although they seek some rigor in the definition of categories, rarely succeed fully and remain at the mercy of the responding agencies. We, in turn, are the victims of this procedure. The adequacy of our codings is a function of the accuracy of the IOB's survey. Whenever possible, we coded facilities as they are described in the *Directory*. We changed codings only when there was an obvious discrepancy between the type of facility indicated and the description of what it actually does. In cases of multiple activities by a facility, we coded it to reflect the highest degree of information processing in which it engages.

sion is designed to address our second theme—the substitution of "brains" for "muscle." Part III explores the character of information structuring and retrieval in these systems, because it is through these mechanisms that any form of cognitive impact would be effected. Part IV summarizes our findings and conclusions.

I. The Provision of Information

Within the generic category of information system, the United Nations distinguishes among libraries, bibliographic systems, referral centers and services, clearing houses, information analysis centers, and data banks. These represent a continuum from "least" to "most" processing of information.[5] Table 1 demonstrates how rapidly the number of such systems has been increasing, especially during the last decade. It also shows that today a higher proportion of these systems engages in some degree of data processing than in the past, and more actually deliver information to users as distinguished from merely supplying bibliographical references. Lastly, it indicates that, in terms of the supply of information at any rate, the United Nations has been extremely responsive to the particular needs of the developing countries.[6]

Table 2 gives us some idea about the range of subject coverage provided by the various types of systems. The social sciences make up by far the largest group. Proportionately, the fields of technology and biology are characterized by the existence of the

5. Libraries and bibliographical systems deliver bibliographies and publications without seeking to structure or rearrange the raw material under master categories. Referral services furnish sources of information, not the actual information which the end user seeks. On the other hand, clearing houses typically prepare summaries and abstracts of actual information. Information analysis centers receive data, classify and process them to some extent, and then issue serial publications, mostly in the form of the well-known United Nations Yearbooks. Data banks not only collect information derived from research or experiments, but also condense, analyze, assess and disseminate it, usually by means of electronic computer. (UN *Directory*, vol. 1, p. 3).

6. We coded as "LDC-oriented" all facilities set up in response to demands by LDC governments and covering subjects exclusively of concern to LDCs. Obviously, the remaining systems often also cover material of interest to LDCs.

TABLE 1

Increase in Number and Type of United Nations Information Systems: 1950-1980

Period	*All New Facilities Created*			*LDC-Oriented Facilities Created*		
	No.	*Percent Processing Data*[a]	*Percent Delivering Information*[b]	*No.*	*Percent Processing Data*[a]	*Percent Delivering Information*[b]
Before 1950	31	13	16	4	0	0
1951-1960	22	59	36	7	57	29
1961-1970	28	43	36	8	38	38
1971-1980	99	63	58	46	61	43
Total	180			65		

SOURCE: Compiled from UN *Directory* entries, Vol. 1.

NOTE: Twelve facilities listed in the *Directory* give no information on their origin, and were therefore omitted from this table, giving us N = 180. Most of the twelve are information analysis centers publishing yearbooks before 1950.

a. Referral services, information analysis centers, and data banks.

b. Clearing houses, information analysis centers, and data banks.

TABLE 2
United Nations Information Systems
Types of Facilities and Subjects Covered

	Total	*Libraries, Bibliographic Services*	*Referral Services*	*Clearing Houses*	*Information Analysis Centers*	*Data Banks*
Applied Social Sciences[a]	61	23	9	11	5	13
Technology[b]	30	9	1	6	3	11
Biology[c]	25	9	1	3	2	10
Social Sciences[d]	22	8	1	1	6	6
Environmental Sciences[e]	16	4	6	2	0	4
Agriculture[f]	13	1	2	3	1	6
Multidisciplinary[g]	9	7	1	0	0	1
Physical Sciences	8	3	0	0	1	4
Informatics	5	0	1	1	1	2
Humanities	3	2	0	1	0	0
Total	192	66	22	28	19	57

SOURCE: UN *Directory*.

a. Includes management science, industrial relations, social welfare, education, development administration, demography.
b. Includes engineering, transport, communications.
c. Includes genetics, medicine, public health.
d. Includes economics, sociology, political science, anthropology, law.
e. Includes physical, chemical, biological pollution and deterioration, meteorology, human settlements.
f. Includes agricultural economics, agricultural management, agronomy, commodity trade and forecasts, fisheries, forestry, animal/plant health.
g. Includes subjects from more than one of the above.

largest number of data banks. The table does not show that over half of all applied social science facilities and nearly one-half of biological facilities (51% and 48%, respectively) cater specifically to the developing countries. Less than one-fifth of technology and basic social science facilities do so.

These figures clearly indicate the growth of sources and the diversification of types of information available to policymakers. To some extent, this development might have taken place in the absence of UN systems, under the auspices of private firms or national governments, for example. But it is doubtful whether any other external means could duplicate the perceived legitimacy of UN systems, and whether many national governments,

especially in the developing world, would have generated an interest in information systems in the absence of at least some measure of external stimulus.

Let us look briefly at some illustrative UN information systems in a bit more detail. First of all, we note that several UN systems appear to be extensions of successful national information operations. For instance, the International Register for Potentially Toxic Chemicals, operated by the UN Environment Programme, is a data bank that stores and provides information on toxicity for the 60,000 chemicals now in common use, and keeps track of the 1,000 additional chemicals introduced into world trade each year. Its classification scheme in essence projects into the international system the scheme employed within the United States by the National Institute for Occupational Health and Safety. The International Education Reporting Service (IERS), maintained jointly by UNESCO and the International Bureau of Education, is a data bank mandated to create a global network which is to do for the world what the U.S. National Institute of Education's Educational Resource Information Center (ERIC) does nationally: to abstract and provide on-line access to the content of all major educational publications. It remains unclear whether IERS will subsume ERIC, or the reverse.

Uncertainty also exists in the field of patent information. The Patent Information Network (PIN) maintained by the World Industrial Property Organization (WIPO) is a major data bank that makes available the content of national patent registries. Prior to its creation, the same service was provided by a private British firm. The rival WIPO system was created at the insistence of the Austrian government, without, however, displacing the competing private operation. It remains unclear to what extent WIPO PIN is truly international, as opposed to being a parastatal commercial operation of the Austrian government.

FAO/ASFIS, the Aquatic Sciences and Fisheries Information Service of the Food and Agriculture Organization, is a bibliographic center that mainly collects information from national services in West Germany, Britain, Japan, the United States, the Soviet Union, Mexico, Portugal, and Canada. The diffusion of information is entirely a function of the search capabilities of the affiliated national centers.

FAO/AGRIS, the elaborate Information System for the Agricultural Sciences and Technology, was created in 1975 to complement the U.S. Department of Agriculture's AGRICOLA, an on-line system which indexes and abstracts approximately 5,000 journals in the field of agriculture, nutrition, agricultural economics, and ecology. While AGRICOLA fully covered the American publications, it was unable to do the same for foreign publications and therefore encouraged FAO to create AGRIS to extend coverage. Worldwide decentralization was to facilitate local processing of local information, and thus enable AGRICOLA to confine its scope to American publications. Pending full satisfaction with AGRIS, however, AGRICOLA continues to operate and a final division of labor is not yet agreed upon.

The systems we describe next are among the most ambitious UN operations; they represent a major and successful attempt at standardized collection and dissemination of information. Some are successful because the nature of the information task is utterly beyond controversy: The World Weather Watch (WWW) is a case in point. Alternatively, controversy is shunted aside because the operation serves an international professional constituency with shared professional standards and goals. This appears to be the case with respect to the International Nuclear Information Service (INIS) of the International Atomic Energy Agency (IAEA). The INFOTERRA referral service of the UN Environment Programme (UNEP), however, was initially unable to benefit from either of these factors.

WORLD WEATHER WATCH

Measured in terms of national participation and interest, the World Weather Watch (WWW), serviced by the World Meteorological Organization, is the largest and most successful UN information system. This is so in part for the obvious reason that its mission is beyond controversy; everyone favors better weather forecasts and welcomes improved access to meteorological data. The WWW became operational in the 1960s. Weather observations are made via the Global Observing System, which coordinates over 19,000 monitoring stations operated by national

weather services. Data are collected in conformity with standard indicators. These observations are processed and analyzed by the Global Data-Processing System for real-time applications and stored for non-real-time purposes. All data for the entire globe are handled by three centers, in Melbourne, Moscow, and Washington. Processed data are then distributed by the Global Telecommunications System, which also transmits observations to the data-processing centers. The telecommunications system links each national weather service with one or more of 29 regional telecommunications hubs and 25 regional centers.

Service is free of charge; any national system offering facilities to WWW is entitled to receive the data. Approximately 2,000 weather charts and ten million characters of alphanumeric data are exchanged every day. Information made available by anybody is accessible to everybody. Costs are borne by national weather services with the exception of a headquarters staff of six, who ensure the standardization of routines. Technical assistance was made available to developing countries to establish, although not to operate, national monitoring stations. Since all participants agree that the purpose of these activities is to improve weather forecasting, and since neither the data nor its application is problematical in terms of theory and selectivity, no centrally imposed structure of topics and subtopics is required. The data can be used without integrating them into strategies of economic development or preferred roads to industrialization.

INTERNATIONAL NUCLEAR INFORMATION SYSTEM

INIS is an illustration of operations facilitated by the professional consensus of its designers and clients even though the diffusion of nuclear information is, in itself, highly controversial. INIS, moreover, has sought to structure its data so as to make them compatible with national energy, research, and industrial policies.

Operational since 1969, INIS maintains a data bank in Vienna serviced by 45 employees, and a network of over 60 focal points in some 70 participating countries. Each focal point, or local liaison

officer, provides input from the area according to a standardized routine. This input consists mainly of local technical publications which are abstracted in machine-readable form and communicated to Vienna. Vienna makes the abstracts available on request to local users and also publishes the master abstracting journal *Atomindex* (circulation: 1400), to which local users must subscribe. INIS liaison officers are carefully trained in the indexing and abstracting routines approved by Vienna. Moreover, IAEA conducts a training program for national officials charged with responsibility for nuclear data. In 1978, over 70,000 items were abstracted. Most local users communicate with Vienna by mail and phone. On-line service, although planned, is currently available only in Europe. The participating states include all industrialized countries and many developing countries interested in reactor technology, notably in Asia and Latin America.

The INIS thesaurus is the device that effectively links the center with its participants. The thesaurus seeks to connect physical and engineering information with a variety of practical applications in biology, medicine, and energy production. Abstracters are trained to employ the analytical descriptors used in the thesaurus and thus determine the cognitive ordering on which users must depend.

Reliance on such a highly structured method of arranging information may limit the user's opportunities for choice and thereby strengthen the power of the center to determine how the information will be applied. On the other hand, the high degree of professional consensus among the users may make them indifferent to this condition if they all rely on the same work routines and share identical scientific values. In either event, reliance on a highly structured indexing and search-and-retrieval system centralizes information control despite the many national focal points.

INFOTERRA

UNEP's INFOTERRA represents neither the extension of a national system nor one benefiting from lack of controversy or

professional consensus. It had to be built, from the bottom up, through standard political bargaining and compromise.

There was widespread agreement among governments at the 1972 Stockholm Conference on the Human Environment that nothing more ambitious and costly than a referral service for sources of environmental information should be attempted, at least in the short run. However, there was a good deal of disagreement concerning the design features of the system. Differences of view stemmed from the fact (common to all information systems) that information does not exist in a socioeconomic vacuum. Information and information technology are goods that are owned and controlled by concrete private actors. And, to some extent, they reflect the needs and interests of their originators. Therefore, the characteristics of the technology to be used and the range of subject coverage to be included raise rather than resolve issues of dependency, preferred development priorities, and differences in scientific power. This is true particularly in the field of human environment, which is intimately related to domestic development patterns and lifestyles.

In the struggle over the design of INFOTERRA, the basic division was between the technologically advanced countries and the developing nations. Some of the early initiators of INFOTERRA from the technologically advanced countries, of Western Europe in particular, saw it potentially as an on-line, satellite-based, computerized system, concerned largely with physical parameters and problems, especially pollution. Others, including the United States, were satisfied with more modest means that would enable existing information and experience to flow from the industrialized to the developing countries. Most developing countries rejected both the high-technology design and the concept of a simple transfer of the environmental lessons of the North to the South, on the grounds that this would lock them into existing patterns of technological and informational dependence. Instead, they wanted a "soft-technology" system that paid greater attention to the particular environmental problems of most serious concern to them, such as soil erosion, human settlements, and natural resources depletion.

UNEP attempted to resolve these differences by opting for the gradual build-up of a system in which there would be no technological constraints on participation, designing its routines in such a fashion that manual operations would suffice, and by broadening the range of planned subject coverage. In the process, however, some of the enthusiasm for INFOTERRA of early supporters in the advanced industrial countries waned, and they now show little interest in the system as potential users. Today, scanning for sources is computerized in some 20 countries, although no on-line search capability exists, and is performed manually in the rest. The system comprises 26 broad subject areas for which sources of information can be supplied, and nearly 1,000 cross-referenced key words denoting more specific areas of expertise of listed sources.

INFOTERRA is aimed mainly at the needs of decision makers, not those of scientific specialists. It is a decentralized system, based upon and operating through 112 (in 1981) focal points. These offices, in appropriate national ministries, identify local sources of information, register them in a directory maintained by UNEP in Nairobi, and respond to requests for sources of environmental information from domestic would-be users. INFOTERRA headquarters coordinates these activities and provides training seminars for use of the system's tools.

As of January 1981, over 8,000 current sources were listed in the INFOTERRA directory. A cumulative total of approximately 7,000 referrals had been processed. After having levelled off at about 150 per month in 1978, the monthly referral rate has more than doubled. Still, our evidence suggests that the system is far from being overburdened. Many focal points are inactive, and a recent survey found that most of them could be consulted from three to six times more frequently than at present (Ruggie and Haas, 1981).

We cannot determine, from these indicators of availability and summary descriptions of UN information systems, whether they have enhanced the quality of national and international policy-making. We can say that the capacity to have this effect clearly exists, albeit not equally so for all types of countries in all subject

areas. The case of INFOTERRA provides more pointed evidence that may have broader applicability. An independent evaluation team conducted a questionnaire survey of national officials whose offices are the institutional link with the international environmental information network organized by INFOTERRA.[7] Better than half of the respondents reported an increase in the demand for environmental information within their respective countries since their establishment, and about a third reported that their own establishment also had triggered other institutional developments domestically in the provision of environmental information. These effects were found to be more pronounced in developing countries. However, the data also show an apparently higher demand for information for specialized scientific and technical purposes than for use by policymakers. This tendency was also found to be more pronounced in developing countries.

II. Participation in Information Systems

A possible second-order consequence of international information systems is the reduction of the dependence of developing countries on the industrialized North, by redistributing access to knowledge so that it is no longer simply a function of material capabilities. The hope that this will occur and indeed compensate for material inequalities has energized the creation of numerous information systems in recent years. How plausible an expectation is it? Obviously, certain kinds of proprietary information and information related to national security are not available through the UN to begin with. Beyond this basic constraint, the answer lies in the distribution of access to international information systems, as well as in the structure of demand for and supply of the information they make available. Not enough is known at this point about any of these factors to answer the question definitely.

7. This survey was part of a broader evaluation of INFOTERRA. The results are published in UNISIST, *Report of the Evaluation of INFOTERRA for the United Nations Environment Programme* (Paris: UNESCO, 1981). Questionnaires were sent to all National Focal Points of the INFOTERRA network (about 110 in number when the survey was conducted); 61 responded in time to be included in the analysis.

TABLE 3

Geographical Distribution of National Focal Points by Income (N = 1199)

Acronym	System	Focal Points	Percentage of Countries Which Are: Very Poor	Poor	Medium	Rich	Very Rich	OPEC
			27.2	20.4	14.2	16.7	17.3	4.3
			Percentage of Focal Points in Each Group					
	All regional systems (see note 8)	160	35.0	20.6	10.6	15.0	17.5	1.3
WMO/WWW	World Weather Watch	146	28.8	17.8	15.1	16.4	18.5	3.4
UNIDO/INDIS/INTIB	Industrial/Technological Data Bank	130	26.2	16.2	15.4	18.5	18.5	5.4
UNEP/INFOTERRA	Referral System for Environmental Information	99	16.5	17.5	15.5	19.4	21.4	4.9
FAO/AGRIS	Agricultural Sciences/Technology	98	22.4	15.3	17.3	18.4	23.5	3.1
UNESCO/UNISIST[a]	General Information Program	92	17.4	14.1	17.4	19.6	27.2	4.3
FAO/CARIS	Agricultural Research Information	78	30.1	21.8	17.9	17.9	7.8	3.8
UNEP/IRPTC	Toxic Substances	68	20.1	13.2	16.2	20.1	27.9	1.5
IAEA/INIS	Nuclear Information System	62	16.1	9.7	12.9	30.0	37.1	3.2
WIPO/PIDS	Patent Information Network II	53	15.1	13.2	5.7	20.8	43.4	1.9
UNESCO/IBE	Educational Information Network	51	19.6	11.8	19.6	17.6	23.2	7.8
WIPO/BDES	Patent Information Network I	46	6.5	6.5	8.7	28.3	50.0	0
ILO/CIS	Occupational Health/Safety	38	5.3	5.3	7.9	21.1	57.9	0
UNCTAD/ISFAL	International Trade Procedures	38	7.9	13.2	13.2	13.2	52.6	0
FAO/AGLINET	Union List of Serials	16	12.5	12.5	6.3	18.8	50.0	0
FAO/ASFIS	Aquatic/Fisheries Science	9	0	0	11.1	11.1	77.8	0
UNESCO/COMNET	Communications Research	10	0	0	10.0	10.0	80.0	0
UNCHS/HABITAT/VISION	Habitat Library	5	0	40.0	20.0	0	40.0	0

SOURCE: UN *Directory*, compiled from Vol. 2; the World Bank, *World Development Report 1979*, pp. 126-127, 176.

NOTES FOR TABLE 3

NOTE: Income attribution (GNP per capita in 1977):

Very Poor:	$300 or less
Poor:	$301 to $700
Medium:	$701 to $1200
Rich:	$1201 to $3000
Very Rich:	$3001 and over
OPEC:	OPEC member countries, over $3000

a. UNISIST includes these more specialized systems: CLEAR, INFOTERM, ISDS, ISORID. All maintain their own national focal points; several other component systems do not. Each participating country is counted only once, irrespective of the number of total focal points associated with UNISIST.

However, we are able to adduce a number of indicators that are suggestive of a more complete answer.

With respect to the distribution of access to international information systems, our most informative measure is the global distribution of National Focal Points (NFPs). This is so because NFPs are considered and designed to be a major aid to users of information. Focal points, it will be recalled, are offices in appropriate national ministries, designated to serve as the liaison centers within an international information system. They bring system and user closer together, which is particularly important for developing country users. Focal points decentralize international information systems in two ways. First, they make it possible to gain access to a system without having to visit or even make contact with the headquarters of the system. Second, they mobilize indigenous information for inclusion in the system, thereby in principle reducing the power of central information managers and augmenting the range of local and regional information and choice.

In 1980, 17 major global information systems maintained 1039 NFPs; UN regional commissions maintained an additional 160.[8]

8. The following UN regional commissions maintain these information systems with focal points:

ECE/GEURR	Group of Experts on Urban/Regional Research
ECA/DATA BANK	Multipurpose regional data bank
ECLA/CLADES	Regional Center for Economic/Social Documentation
ESCAP/DIS	Multipurpose data information service
ESCAP/FADINAP	Fertilizer Advisory Information Network

Table 3 shows their distribution compared to per capita GNP. Measured in this fashion, the rich and very rich countries appear to be considerably overrepresented in most UN systems. However, this is not uniformly the case. The WWW and UNIDO's data bank of industrial and technological information maintains NFPs roughly in proportion to the percentage of countries in each income group. And two systems maintained by the FAO cater to the poorer countries out of proportion to their numbers. The fact that WIPO, ILO, IAEA, and UNESCO show a concentration of NFPs among the richer countries may indicate that developing countries have not shown a strong interest in the information they provide, which, if true, would be particularly surprising in the the field of patent information.

But treating countries as the unit of analysis can be quite misleading, because they differ vastly along dimensions that affect their relative need for information. Accordingly, Table 4 matches income groups with several indicators of potential demand for information, and then compares these findings with the distribution of NFPs. We assume here that the demand for information is roughly correlated with population size, and with the extent of industrial, scientific, and technological activity. Thus, income groups that consume a great deal of energy account for most of the world's exports of manufactures, and employ the bulk of scientific and technical personnel, are expected to generate and use a disproportionate share of the information available through UN systems. The evidence, however, suggests otherwise.

The relative shares of NFPs indicate a redistributional thrust insofar as access to information systems is concerned. Although the rich and very rich countries dominate each activity of concern, they account for only 45.6% of focal points; and although the poor and very poor countries generate little information-inten-

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ESCAP/PCHIS	Population Clearing House
ESCAP/TIS	Trade Information Service

ECA maintains 46 focal points, but ESCAP/DIS accounts for only 14. Precise numbers are unreliable because different UN sources differ slightly in their estimates. In addition, WHO, ICAO, UNESCO, and IAEA maintain information systems at their regional offices.

TABLE 4

Distribution of National Focal Points by National Shares of Selected Global Indicators (N = 1199)

Income Group	*Percentage of Countries*	*Percentage of World Population*[a]	*Energy Consumption*[b] *Mean*	*Energy Consumption*[b] *Deviation from Mean*	*Percentage of Export of World Manufactures*[c]	*Percentage of World S/T Personnel*[d]	*Percentage of Focal Points*
Very Poor	27.3	30.5	79	-2020	.8	6.2	21.5
Poor	19.9	30.1	469	-1630	1.0	2.9[e]	15.6
Medium	14.3	6.7	837	-1262	2.1	2.0[f]	14.4
Rich	16.8	8.0	2260	+ 161	6.6	14.3	18.6
Very Rich	17.8	24.3	5628	+3525	89.2	74.3	27.0
OPEC	4.3	.4	1322	+1223	.2	.2	2.9

a. *World Development Report* 1980, pp. 110-11, 159. Figures for 1978. World Total = 4245 million.
b. *World Development Report* 1980, pp. 122-23. Consumption per capita in 1978, measured in kg. of coal equivalent. World mean = 2099 kg.
c. *World Development Report* 1980, pp. 132-33. Value of manufactured goods exported in 1977, in U.S. $. World total = $647,873 million.
d. UNESCO, *Statistical Yearbook* 1980, pp. 755-58. World total, based on various years during 1970s = 68.7 million. We call attention to the utter lack of uniformity in the way these statistics are collected and reported.
e. Excluding China.
f. Excluding Algeria, Mexico, Turkey.

TABLE 5
Distribution of INFOTERRA Sources and Referrals
by World S/T Personnel

Income Group	*Percent World S/T Personnel*[a]	*Percent INFOT Sources*[b]	*Percent INFOT Referrals*[b]
Very Poor	6.2	11.5	18.6
Poor	2.9	5.0	9.7
Medium	2.0	5.8	3.9
Rich	14.3	8.1	7.0
Very Rich	74.3	69.6	60.4
OPEC Very Rich	.2	0.04	0.4

a. From Table 4.
b. Calculated from UNEP Document INFOTERRA EM-1/6-C. Figures are based on cumulative tables as of January 1980.

sive activity, they account for 37.1% of focal points. We can therefore conclude that the system of access maintained by UN information systems favors the developing countries, and represents an investment in the future demand of these countries for specialized information.

More specific measures of demand can be culled from the case of INFOTERRA. Table 5 compares the percentage of world scientific and technical personnel accounted for by each income group with the proportion of INFOTERRA sources each group has contributed and the proportion of referrals each group has processed. The results are striking. The poor and very poor countries account for just 9% of the world's scientific and technical personnel, but for 16.5% of INFOTERRA sources and 28.3% of referrals processed. The rich and very rich countries are proportionately underrepresented on both measures. Viewed in this fashion, the poorer groups contribute more to and gain even more from INFOTERRA than the richer countries.

INFOTERRA also sheds some light on the structure of information flow. Consider first the question of quantity and direction. Table 6 presents the system's most active members. There is a substantial difference between levels of activity

TABLE 6
INFOTERRA's Most Active Members
(Cumulative Totals as of January 1981)

Sources Registered		*Referrals Processed*[a]	
U.S.A.	1495	U.S.A.	1625
United Kingdom	1045	Morocco	476
Federal Republic of Germany	910	India	458
Canada	663	China	344
Australia	514	United Kingdom	265
India	501	German Democratic Republic	260
Netherlands	389	Australia	217
France	225	Colombia	213
Thailand	168	Kenya	193
Bangladesh	163	Poland	155
Total for all Member Countries	8213	Total for all Member Countries	5741

SOURCE: UNEP/GC.9/5.
a. Preliminary figures; total is expected to be approximately 7000.

measured by sources registered and by referrals processed. With respect to sources, the top five countries, all Western-industrialized, account for well over half of the total. Referral activity, on the other hand, is distributed far more evenly among various groups of countries, with LDCs constituting five of the ten most active members. Information clearly flows from North to South. This conclusion is reinforced when we look at a more qualitative measure, the subject areas in which information is most frequently sought. At the time of the Stockholm Conference and for a period thereafter, the industrialized and developing countries disagreed fundamentally on the priority subject areas for INFOTERRA. The industrialized countries were concerned largely with physical parameters and problems, especially pollution, whereas the developing countries were more concerned with such issues as human settlements, soil erosion, and natural resource depletion. Today, the main areas of inquiry are precisely those originally stressed by the industrialized North: pollution, chemical and biological agents, technology and industry, management and planning, atmosphere and climate, and monitoring and assess-

ment.[9] The most plausible explanation for this change in the position of the developing countries is that their earlier posture was articulated by and large by representatives of foreign offices, whereas INFOTERRA's present clientele consists of officials representing environmental agencies and concerns, the creation of which UNEP itself helped to catalyze.

In sum, what little we know about these factors suggests that the distribution of access to UN information systems favors the developing countries, as does the extant structure of demand for and supply of information when measured in quantitative terms. Thus, if dependency is seen as a condition resulting from the global maldistribution of material resources, to the extent that this condition is amenable to change via information inputs, UN information systems have gone some way toward reversing dependency. If, on the other hand, dependency is conceived of as a cultural phenomenon, of being tied to the precepts of Western science and technology, shaping one's world view and inspiring one's plans for the future, then the advent of UN information systems has not reduced dependency. Indeed, it has probably increased it, because the flow of information continues to run from North to South, and the principles of design underlying the systems are Western in nature. Here, however, the decentralized design of several of the major systems, including INFOTERRA, and their intended catalytic effects within the Third World, may in the end result in a greater role for indigenous products and designs, and thus facilitate greater self-reliance.

III. Specifying Problem-Sets and Structuring Information

Many information systems, national and international, appear to be based on the presupposition that just as "nature" is uniform, so too are the relationships among information supply, information use, and problem solving. This appealingly naive view of the

9. Reported in UNEP Document INFOTERRA-2/4, p. 10. For complete data on which these conclusions are based see Ruggie and Haas (1981).

relationship between information and action cannot be accepted in a politically sensitive analysis. Information has no self-evident quality that decision makers will recognize readily. The problems for which information may provide solutions are neither uniform nor undisturbed by social, economic and political rifts. Instead, they are characterized by differences in the specification of "interests" and the interpretation of "facts."

The critical step in solving problems is the ability of information systems to link their supply of information appropriately to the demand pattern of would-be users. This is critical for two reasons. First, the indiscriminate collection and dissemination of all possible information merely leads to "noise" and information overload. Any possible effect of such systems on decision making will be more or less random. Second, any selectivity involves choices: what to include and what to omit, as well as how to organize what is included. Does underdevelopment fall into the category of environmental information, or does it belong somewhere else? Should information be structured by means of the Dewey decimal system or under attribute lists which are predicated upon known or assumed cause/effect relationships among items? Neither choice is predetermined by nature. Both involve questions of facts and values, and the potential effects of information systems on policy and politics are likely to be very different, depending on how these choices are made.

With this in mind, let us turn to our universe of cases, and see how UN information systems go about (1) specifying the nature of the problem on which information is to be brought to bear; and (2) designing the search-and-retrieval tools to be employed, or what we might call information structuring.

SPECIFICATION OF PROBLEM-SETS

Many facilities have no specific purpose or mission other than to make available every possible source of data in a given field of interest. Here no effort is made to tailor the supply of information in any way: The burden of selecting information appropriate for solving a problem is on the user. We refer to this as "diffuse"

specification. Our survey indicates that 29% of the UN systems are of this type, half of them libraries.

More frequently, information is gathered and organized to meet specific purposes: improving the purity of water, finding experts on desertification, collecting data on supplies needed for disaster relief, establishing the physical and chemical properties of nuclear particles, improving skills needed to establish adult education centers. When each of these problems is treated as though it were self-contained, we refer to the specification as being "simple." Of all UN facilities, 43% fall into this category.

Other facilities seek to bring information to bear on more general metaissues, such as those that have dominated the debates over the New International Economic Order, the world population crisis, resource depletion, or the problems of advanced industrialism. Here an attempt must be made to bridge established disciplines because the problem-set transcends any single body of knowledge. The manner in which the products of different disciplines are juxtaposed within an information system determines a further distinction. Disciplines can be aggregated simply by adding their content without also worrying about which is prior to others in terms of their causal order. For example, it is not necessary to decide whether engineering subsumes agronomy, or vice versa, when the two are combined in the search for information on how to deal with aspects of desertification. However, when the issue is not desertification as such but manipulating the man-nature interaction in desert environments so as to enhance human welfare, then it may well be that economics and anthropology are prior in the chain of causation to ecology, agronomy, and engineering.

Hence, we distinguish between "compound" and "complex" specification of problem-sets. Compound specification involves combining the content of disciplines without concern over causal priority. Information concerning a problem-set simply elucidates its component parts. Compound sets account for 19% of UN systems. Complex specification is predicated upon a causal ordering. Information is organized in terms of some implicit theory of how the several disciplines are to be related to one

TABLE 7
Types of Facilities and Specification of Problem-Sets

		Specification (percentage horizontal)			
Facility	*Number*	*Diffuse*	*Simple*	*Compound*	*Complex*
Libraries	66	42	33	16	9
Referral Services	22	15	28	42	15
Clearing Houses	28	14	64	8	14
Data Banks	76	26	47	20	7
Total	192	29	43	19	9

SOURCE: UN *Directory*, Vol. I.

another in dealing with a metaissue. Only 9% of UN systems are of the complex type.

Table 7 summarizes the current situation with respect to the specification of problem-sets in the various types of UN facilities.[10] Of the 54 compound and complex facilities now in existence, 34 have been created since 1970. The newer facilities (data banks and referral services) tend to be of this type. These indicators suggest that an effort *is* being made via UN information systems to expand mankind's cognitive horizon toward more sophisticated problem solving. On the other hand, this tendency is by no means uniformly in evidence in all disciplines. Informatics, the applied social sciences, and agricultural sciences tend toward sophisticated specification of problem sets; basic social sciences, engineering and technology, physics and chemistry do not. In almost every case, the sophistication of LDC-focused facilities is equal to or exceeds the trend for all systems.

INFORMATION STRUCTURING

Ambitious problem-solving with the aid of theoretically aggregated information also calls for appropriate tools that will yield the desired information to the would-be user. A diffuse or

10. Tables 7 and 8, being based on data reported in the IOB *Directory*, should be interpreted subject to the caveats expressed earlier regarding this source.

nonspecialized collection of data can be organized according to very general classification schemes, such as the Dewey decimal system. A specialized statistical collection can rely on such gross indexing tools as standard economic indicators, countries, commodities or tariff headings. A mission-specific information system requires only a subject heading list, or index, appropriate to its particular mission. The descriptors used in searching need not be arranged in such a way as to suggest alternative cause-and-effect relationships between terms (variables) because, in the minds of the users, such relationships are considered well known and understood. But in the world of complex problem-solving under uncertainty, information systems cannot be used effectively without more elaborate conceptual or theoretical guidance for the user. Hence, information systems of the more ambitious types ought to have a descriptor list (permuted index) or, even better, a full-scale thesaurus. Thesauri attempt to group key terms used in searching for information so as to highlight connections among variables, a challenging intellectual task which requires an understanding of theories that claim to explicate such connections. Ideally, facilities dedicated to compound and complex problem solving ought to have thesauri. Table 8 shows that this is not consistently the case.[11]

11. The official definitions of these search tools are as follows: "*Thesaurus:* a list of terms, which are specially chosen and related in specific ways to one another, used in indexing the documents in a data base. Such terms are called *descriptors*. . . . One descriptor can represent one concept. The relationship between descriptors may be that they are equivalent, . . . that they are graded . . . or that they are associated; *descriptor list*: a list of selected terms without any structure, used for indexing or searching or the preparation of a thesaurus; *subject heading list*: a selected vocabulary of terms arranged so that each entry may represent many concepts and be composed of many terms." Additional terms are *classification scheme* and *specialized nomenclature.* These are the standardized classification schemes used within a discipline or profession, that is, very specific subject headings (United Nations, 1979: 7). We fully appreciate that various complexities may well militate against the consistent use of thesauri, despite the theoretical argument in their favor. Software usually lags behind innovations in hardware. Designers of search tools may be unable to devise a search language which incorporates an agreed theoretical ordering. Users may be dissuaded from mastering complicated thesauri because their own problem-solving proclivities are mission-specific, despite the fact that the system in question is more sophisticated. In other words, the matching of search tools to mission requires a level of cognitive similarity among users which may not exist in the real world.

However, the major non-UN international information system, Euronet DIANE, which groups over 190 separate data banks (many of them commercial information

TABLE 8
Conceptualization of Problem-Sets and Search Tools (N = 93)

		Search Tool (percent horizontal)		
Specification	*Number*	*Simple Index*	*Descriptor List*	*Thesaurus*
Diffuse	27	78	7	15
Specific	36	66	6	28
Compound	16	50	6	44
Complex	14	58	14	28
Total	93			

SOURCE: UN *Directory*, Vol. 1.

Since the UN *Directory* gave information on search-and-retrieval tools for only 93 of the 192 systems, we cannot map the entire universe of cases. Table 8 shows the relationship between information structuring and search-and-retrieval tools in the 93 systems for which we have this information. Ironically, the facilities most in need of the more complicated tools, if they are to meet their compound and complex missions, are not well equipped on the whole to do so. With respect to subject area, our sample does not include enough of the facilities in biology, agriculture and technology to allow us to draw any inferences about them. The highest proportion of thesauri in the remaining cases appears in the physical and environmental sciences (50% and 44%, respectively). One would, of course, expect greater agreement on causal linkages in these fields. However, the figure for the applied social sciences is also high (31%), indicating that thesauri need not be limited to narrowly specialized physical domains. With respect to LDC-oriented facilities, only in the applied social sciences is there a significant number of thesaurus-equipped systems.

services) into an integrated system for all of Western Europe, is in the process of creating a master search language for the separate thesauri in use in its component systems. (European Communities, *The Key to Information in Europe; Euronet-Diane Directory*; personal communications.)

In sum, there exists a small but growing number of UN information systems devoted to the more complex forms of problem solving. The number of facilities employing sophisticated search-and-retrieval tools is also growing. Both tendencies are potentially conducive to cognitive restructuring on the part of users;[12] but the two tendencies are not perfectly correlated. Accordingly, a substantial degree of eclecticism can be expected to prevail in the specification of problem-sets, in views about cause/effect relations, and in approaches to appropriate solutions.

On the other hand, since the newer systems are more likely to exhibit both tendencies, the potential exists, at least in some fields, for information systems to shape the frames of reference and substantive understanding among actors concerning major global problems. Indeed, in this rarefied realm, governments are committed in principle to the creation of a *general* information system, through UNESCO's General Information Programme (UNISIST), "designed to provide a conceptual framework for the establishment and control of national and international scientific and technological information systems and services to facilitate access to the world information resources and to create the necessary conditions for systems interconnectedness and compatibility" (UNESCO 1979, p. 17).[13] Needless to say, were

12. The thesaurus-equipped systems with compound and complex missions are:

United Nations: Development Information System, UNDP Project Institutional Memory, Marine and Coastal Technology Information Service.
UNESCO: International Network of Centers of Documentation on Communication Research and Policies, General Information Programme.
ILO: Social and Labour Bulletin Documentation Unit.
UNIDO: Industrial Information System.
UNEP: Information Service of Industry and Environment Office.
IAEA: International Nuclear Information System, World Request List for Nuclear Data.
UN Economic Commission for Latin America: Latin American Population Documentation System, Latin American Center for Economic and Social Documentation.

13. UNISIST began in 1971 with the launching by UNESCO of an effort to identify and unify, for the use of the developing countries, all existing data sources dealing with science and technology. The objective went beyond sectoral programs because semantic *unification* of norms and standards was seen as an integral part of the effort. In 1976, the effort was relabeled as the General Information Program because it was expanded to

UNISIST to succeed, which is unlikely, it would be the most ambitious of all UN information systems. It would be a metasystem, which would result in nothing less than semantic unity among scientific and technological information systems in the service of global public policy. Even though its realization is not imminent, the mere attempt to establish anything remotely resembling its blueprint will engender an imitative effect in other systems, if for no other reason than to forestall being absorbed into or taken over by a "grander" enterprise. The struggle itself, with the difficult technical issues of semantic and terminological standardization, as well as with the attendant political concerns as to whether such a system would amplify the prospects for user autonomy or universalize the hegemony of a single viewpoint, represents a form of international cognitive integration.

IV. Summary

In the final analysis, it is necessary to study precisely who makes what use of which kinds of information before more systematic conclusions can be drawn about the impact of information systems on the international system. We hope to have demonstrated in this article that the effort is worthwhile. In addition, we suggested some of the variables and indicators that bear watching in future research.

We suggested that information systems can affect the international system in several ways:

(1) They can improve national and international policy by giving decision makers greater access to information not otherwise available. Increased access would change international society, provid-

include the development of all kinds of information systems in *all* substantive fields; moreover, it was decided to merge a number of separate information-promotion and standardization efforts with UNISIST. The resulting program was reviewed by an intergovernmental conference in 1979, with recommendations to continue it essentially unchanged, despite the Secretariat's candid self-criticism concerning specific activities. For a fuller description, see *Main Working Document*, PGI/UNISIST II/4, Paris, May 1979, and *Selective List of Activities in the Field of Information*, Doc. PGI/UNISIST II/Ref. L, Paris, May 1979.

ing actors with more knowledge-based options in policy domains ranging from industrialization and agriculture to informatics, not necessarily by becoming a more harmonious and tightly linked family of nations. Our preliminary conclusion is that international information systems certainly have the capacity to produce this effect, although it is not uniformly prevalent for all countries in all sectors of information.

(2) Information systems can also affect the dependency of poorer countries on the industrialized North, by compensating for the lack of material bases of power within the developing world. Again, such an outcome would not produce international harmony, but it would attenuate a source of serious grievance in the contemporary international system. Our preliminary conclusion is that the distribution of access to UN information systems is characterized by a redistributive thrust, so that developing countries get considerably more than their corresponding share of material capability or present need. On the other hand, if one takes seriously the problem of cultural dependency, the results are mixed; in the short run at least, the internationalization of Northern designs and products are enhanced rather than diminished by the prevailing structure of information flow.

(3) Finally, information systems, through the mechanisms of structuring concepts and retrieval tools, can affect the cognitive frameworks within which problems are defined, understood, and acted upon. Here, greater standardization could result which would promote consensus in the conceptualization of problems, although not necessarily in perceived interests. Our preliminary conclusion suggests a small expansion of the cognitive horizon of the international community, alongside continued eclecticism in the formulation of global problem-sets.

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