INFORMRTION MAPPING FOR DEVELOPMENT *

by A. J. N. Judge

Introduction

The purpose of this document is to report briefly on a preliminary investigation into the problems of mapping satisfactorily for policy purposes the domains of science and technology as applied to development (1). The matter in question is clearly of ever increasing concern within the international community as a whole, as indicated by a number of initiatives, many of them now being timed to focus discussion in anticipation of the United Nations Conference on the Application of Science and Technology to Development in 1979.

Part **1** : **Mapping**

Nature of the problem

The problem of information in the field of science and technology as applied to development processes is reviewed in Part 2 under the following headings :

A. Quantitative aspects

B. Logical aspects; classication
- Multiplicity of classification schemes
- Failure to indicate functional relevance
- Unspecified omissions and partial inclusions
- Macro-level definition
- Interdisciplinarity

C. Operational aspects; organizations and information systems
- Multiplicity of organizations
- Unrelated information systems

D. Comprehensibility
- Comprehension overload
- Issue reductionism
- Communication mode preferences

E. Behavioural aspects
- **Interorganizational antipathy**
- Interorganizational territorially
- Interorganizational rivalry
- **Pre-logical biases**

F. » Mythical » aspects

G. Ignorance and lack of systematically ordered information on :
- Scientific disciplines
- Development processes
- Technologies
- Applications processes.

The first three of the above points are those most frequently discussed when examining the question, since they also tend to be those most susceptible to solution by modifying institutions or their policies and through appropriate use of information science and technology. The last four are those which are much less frequently discussed, partly because they include factors which undermine or oppose conventional solutions to the information problem.

This review shows that there are many severe obstacles, themselves intimately interrelated, which prevent a significant improvement in the accessibility of such information for policy-related purposes. It is not the purpose of this report to comment on conventional efforts to improve the situation or their relationships to the UNESCO/ICSU World Science Information System (UNISIST), SPINES, or the various development information systems. Whilst these may or may not achieve their respective objectives, in the light of the points in Part 2, it would appear to be useful to investigate completely new approaches which may result in information tools which respond to the problem at a more fundamental level.

Information selection and presentation

The heart of the problem seems to lie in the general attitude to information selection and presentation. This is reviewed in Part 3 where it is argued that much of the problem results from the reliance on word-oriented information systems. However in reviewing the alternatives, including computer manipulation of diagrams, it is shown that existing approaches fail to respond to the basic difficulty of how to **improve the relevance of the questions asked to the problem complex faced by the policy-making process. How is the** policy-maker, and those with whom he must communicate, to acquire a better « grasp » of the problem complex and the opportunities for improved application of science and technology to development ?

Some criteria for a desirable solution

The kind of information assistance required could usefully have the following characteristics *(2)* :

- contain a large number of elements relevant to science, technology and development
- elements well-packed for comprehensibility
- presentable in different (but integrated) forms corresponding to the tolerance of complexity of the expert, the non-expert and the general public
- disposition and presentation of elements should have a mnemonic value such that familiarity with the whole pattern may be gradually acquired and not immediately forgotten
- disposition of elements should reflect the knowledge of experts and not a superficial, « glossy », media-oriented impression of aspects of it
- disposition of elements should reflect in a dynamic manner the processes in which they are involved and any evolution in those processes over time

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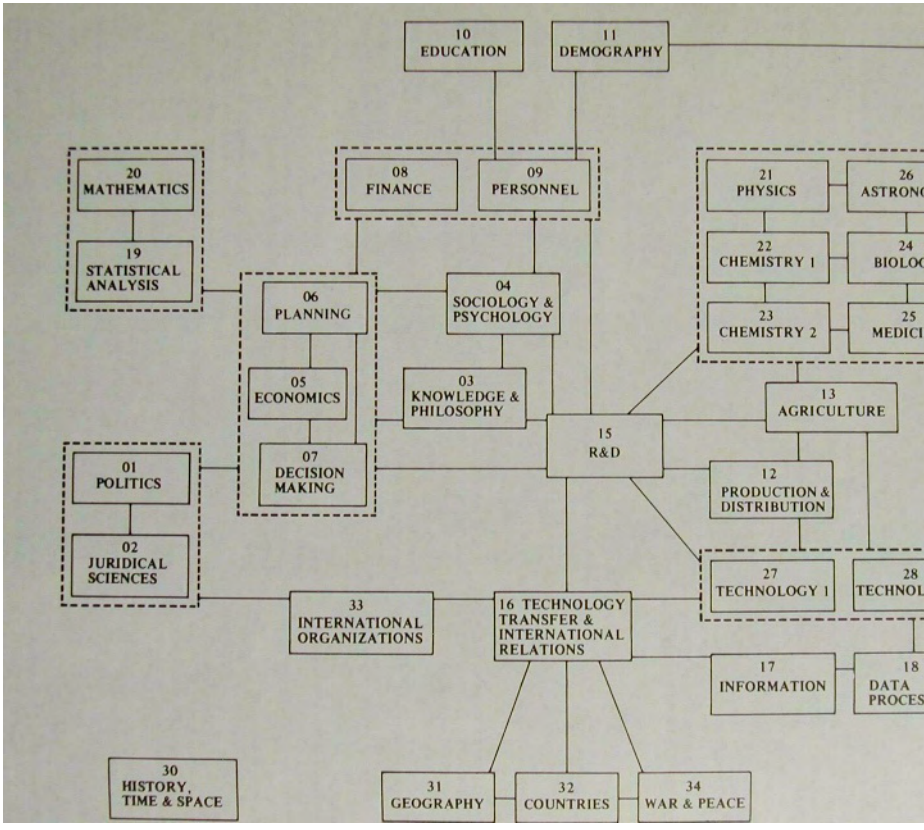

DIAGRAM I. *Reproduced from : SPINES Thesaurus, a controlled and structured vocabulary of science and technology for policy-making, manage vslopments. Paris, Unesco, 1976, 3 vols.*

- presentation should be complete, covering the whole range of elements, and not partial; although partial extracts from that whole could be made if required, provided they maintain their relationships to it

- disposition and presentation of elements should reflect alternative perspectives and the behavioural dynamics to which they give rise

- preparation and construction should lend itself to computer assistance (exploiting a data base) but constrained from a perspective of communicability and aesthetics.

Mapping : possibilities offered for a solution

The procedure known as «mapping » suggests a number of possibilities for incorporating the features identified above.

« Mapping » for policy purposes has been used very loosely, even to include a compilation of national science policy surveys in which the « integration » accomplished is limited to the physical assembly of the statements within the same document (3). This usage will not be considered here since it is precisely this type of approach which is of such limited value in the light of the points in Parts 2 and 3. Before outlining the approach suggested here, it is noteworthy that the senior editor of one of the largest scientific publishing houses advocates the use of a spherical representation of the body of knowledge in discussing information transfer implications I3a),

The question is therefore whether a mapping technique can be used in conjunction with this spherical representation as a basis for incorporating the desirable features identified. The model identified in ref. 3a does not attempt to do this although a number of pointers are included explicitly or implicitly. It does not consider the implications of the large amount of quantitative detail which needs to be represented, or how it is to be represented.

Approaching the question from another angle, there is much to be learnt form cartography and the history of geographical map production. The first two-dimensional maps were extremely sketchy and are not too different from the primitive sketches that are produced in graphic models (see Pan 3). Of great interest are the « terminological graphic displays » and sub-displays produced as a user guide to the UNESCO SPINES Thesaurus (« a controlled and structured vocabulary of science and technology for policy-making, management and development » of which the overall display is reproduced in Diag. 1. These lack many of the features indicated above (as well as being subject to other weaknesses identified in Parts 2 and 3) as does the courageous series of concept diagrams included as an anonymous addendum to the integrating volume of the new French-language Encyclopaedia Universalis.

What all these efforts lack is what might be termed a « topographical richness »

onto which the massive amount of detail to be incorporated may be « hung » - including logical continuities and distinctions, as well as behavioural indications arising from territoriality. But this topographical richness must be so represented as to facilitate comprehension at whatever level of detail is appropriate, and the mnemonic features must be preserved.

The radical approach advocated here is therefore to investigate the possibility of abandoning the schematic graphics (such as in SPINES) in favour of mapping the conceptual territory on a spherical surface with conventional topographical features. On the basis of a preliminary investigation, it seems to be possible to incorporate most of the features indicated above.

A further question is whether this approach can satisfactorily reflect the four aspects of the application of science and technology to development. Again, preliminary investigation indicates that this is possible by using four separate spherical representations. Each would contain cross-referencing co-ordinates to the others where relevant, in other words the relationship between a particular scientific discipline, a particular technology and a particular development process would be either explicit or implicit from the context. Clearly conventional projections onto plane surfaces could be used as well as transparent overlays, if required. But the relationship to the overall representation would be preserved.

Conclusion

A number of different approaches to selecting and presenting information can be interpreted as indicating a convergence on a solution which could offer many more satisfactory features to assist policy-makers in their comprehension of the domains of science and technology in relation to development processes.

The approach advocated requires further exploration to determine in detail exactly how the different features could be incorporated and the limits imposed by this approach.

Part 2:

REVIEW OF THE INFORMATION PROBLEM

A. Quantitative aspects

It is understandable that there is a very large amount of « scientific and technological » information which may be considered relevant to « development ». Even if it is only (say) 1 % of the literature, this would amount to (4) :
- 60 to 70 new articles and reports per working day (1970)
- a cumulative total of 200,000 to 300.000 journal articles (1970)
- 80,000 to 140,000 new documents per year (1985 est.).

But there is also a very large quantity of information about the application of science and technology to development and much new material is being generated in anticipation of UNCSTED 1979 (4a). The question is whether such information can be mastered and by whom, even if those who should have access to it have no problems in obtaining or assimilating it, which is seldom the case (5).

The usual practice is to ignore the mountain of documents already in existence and to prepare a quick « study of the key issues » based on some of the « key documents » available. Such an approachs then justified by policy-making deadlines and similar pragmatic constraints. It is adequate if it is assumed that the few documents selected from society's prolific production cover the relevant issues. This assumption is however only valid if the majority of the studies is assumed to be of inferior quality, of limited relevance or a duplication of those selected (6).

There is no procedure whereby this can be proven in a particular case since relevance is defined more in terms of what the agency is constrained to do than of what needs to be done according to any wider perspective.

B. Local aspect; classification

Multiplicity of classification schemes

The device developed to ensure access to « relevant » information in any particular case is the (document) classification system and the associated thesaurus. There are many such systems, often based on the practice in international agency libraries or departments. As such they reflect a variety of perspectives. Effective integration, even at the conceptual level, has not proved possible *(7)*,

Failure to indicate functional relevance

These remarks would be unnecessary if it was possible to use each such system to identify « relevant » documents. This is not the case (unless the user knows the document in advance), for the ambition of the classification system is generally limited to identifying the standard subject categories to which the document relates, usually on the basis of its title. Now policy matters and development problems are not experienced as subjects nested nearly in logical hierarchies, but rather as action domains embedded in a network of interrelated issues - where the relationships recognized depend in part upon the objectives and sensitivity of those concerned. The logical relationships between issues classified as subjects do not therefore reflect the functional relationships between interacting issues (e.g. problem A aggravates problem B). Classification systems therefore assist in locating documents on an issue but not on issues « relevant » to it.

Unspecified omissions and partial inclusions

Classification systems fail in another respect. For example, with a scheme purporting to cover « science », the user is seldom explicitly informed what categories have been omitted as not pertaining to science according to those who conceived the scheme (8). On the other hand, a scheme purporting to cover « development » may also incorporate large portions of « environment », and vice-versa each defining the other as a subset but failing, necessarily, to specify what is omitted as irrelevant (9). A factor contributing to this problem is the widespread disagreement as to what « sciences » should be considered as « science », with the social sciences frequently omitted in the anglo-amencan, tradition as pseudo-sciences. This conflict is embarrassingly explicit in Unesco activities (10.

Macro-level definition

This links on to a further difficulty, namely the considerable intellectual effort devoted to the definition of « science » and its characteristics by philosophers of science of various persuasions (11). This is usually undertaken without taking into account the views of those sensitive to non-western cultural perspectives on science (12). A corresponding effort is being devoted to defining (or, more recently, to « redefining ») « development »(13). Unfortunately these exercises focus on the « macro-concept » and fail to identity or to distinguish the « sciences » which constitute science (14) or the «development processes » which constitute the development process (15). The result is a large number of excellent studies, grouped within various schools of thought, but of very limited relevance to policy formulation concerning the application of science and technology to development. The studies reveal scholarly disagreement at their macro-level of focus (*) and fail to decompose the concepts to a level which is of practical significance (16). Exercises in the redefinition of macro-concepts such as the « development process » within the politicized intergovernmental context, may mark a change in orientation but the nature of any relationship to the many unspecified development processes remains subject to confusion and discord.

Interdisciplinary

Although « science » remains a focus of constant attention and a convenient label for a blurred domain, and although, in contrast, individual disciplines are relatively well-defined, the interdisciplinary relations even amongst the sciences remain a no-man's-land and a question of embarrassment or disdain within any discipline (17). This disdain is particularly tragic when extended through the « pecking order » of disciplines to the « applied sciences » and « technology ». Yet the need for genuinely in interdisciplinary applications of science to development is well-recognized and the weakness of superficial or token initiatives is acknowledged (18). But relevance of disciplines to a problem situation can only be settled non-scientifically now by weighted voting techniques in expert panels - if the politics of the situation resulted in their effective representation on the panel.

C. **Operational** aspects; organizations and information systems

Multiplicity of organizations

The application of science and technology to development involves national and international organizations. The intergovernmental number over 300 already, and the nongovernmental number over 5,000 (19): the national remain unnumbered and unestimated within any country, in striking contrast to their populations (20). Clearly only a percentage of these will be considered of relevance to the development process by those producing the directories in connection with UNCSTED 1979, but the criteria by which relevance is determined will in all probability exclude many bodies which will continue to contribute, if only in their own eyes, to that process. The problem remains of providing some overview of which aspects of science and technology which organizations for divisions of or ganizatlons) help to make relevant to which aspects of the development process - currently, potentially, and whether or not their initiatives are perceived as counter-productive by evaluating bodies and irrespective of whether or not their activities are coordinated through some umbrella body or programme.

Information systems

Here again there are many unrelated systems of differing degrees of relevance to development processes. The additional problem which emerges more clearly than in the case of organizations is the lack of integration between the operational « modes » which the information systems are designed to serve. It is typical to find little, if any, system-level integration between information systems (even within the same agency) for : research, policy formulation, programme management, public information, education/briefing, and documentation - even when all of them are concerned with facilitating the same development processes. The reason is that the responsible organizational units in each case perceive the processes differently and have no reference framework within which to interrelate them. The information systems are not designed to facilitate comprehension of their own content (by those not oriented to their format and especially non-westerners) or of the content of systems with which they should be integrated.

D. Comprehensibility

Comprehension overload

« Consider this dilemma : while our technological abilities to generate and disseminate potentially useful data have increased manyfold in the past few years, man's physical capacity to register and to process potentially informative data has probably increased very little, if indeed at all » (21). In policy circles, a widely favoured response to this constraint is to use inefficiencies for even abuses) in procedures, and the consequent « lack of time », to filter out the majority of communications - and to require that the remaining issues be stated very briefly (22). The argument being that if the matter is important enough it can be stated briefly (however complex the chain of reasoning required to substantiate it) - and if it is too complex for this, it can be safely ignored because few people will have the attention span to be able to understand in order to protest (23). It

There are pre-logical or temperamental biases which contribute to this disagreement. There are referred to under point E.

is unclear how many problems (such as « environment » and « resources ») may
have been «recognized » too late for other than crisis action, because of this approach.

Issue reductionism

A more rational approach to the dilemma is to require that potential policy problems be identified and « evaluated » so that the 6 (say) « key » or core problems selected can be reviewed for action in the policy formulation process (24). The seventh and remaining problems must await until they themselves reach crisis proportions for acquire a political champion) before they are recognized *(25).* The only clue to the reason why 6 to 10 key issues are always selected seems to lie in evidence that this is « the maximum number of different possibilities among which the human mind can meaningfully discriminate » (26). It is also, roughly, the maximum number of divisions of any agency administration which would have to deal with a set of problems (27). Beyond the 6-10 limit lies confusion, according to current methods - irrespective of the number of problems « out there ».

Communication mode preferences

Another servere problem is the limited value of the written word for communication. Many will not read until they have heard, although others refuse to « waste time » listening unless they have found the basic points worthwhile through reading. Others demand a quantified argument, possibly expressed through equations, graphs or matrices. Others are « innumerate », and demand visual images, diagrams, and films before they can comprehend an argument (28). To complete the circle, the latter are viewed with disdain by those who favour the discipline of the written word not recognizing that they themselves are « visually illiterate » (29). Policy makers and those with whom they must communicate may belong to any of these categories, although the prevalence of a particular category may be culturally determined.

E. Behavioural aspects

Interorganizational antipathy

The behaviour of agencies, organizations and professional associations is not simply governed by programme directives, statutes and principles. The well-known antipathies amongst the UN Agencies and their competition for resources, are a matter of common knowledge as is the case amongst their creators, namely the equivalent national agencies (30). Such behavioural phenomena, often reinforced by political considerations (e.g. vis-a-vis the World Bank or « non-universal » bodies such as the OECD, the Council of Europe or the Commonwealth), are seldom acknowledged in writing (31). They are however evident in the absence of reciprocal arrangements and, more important, in comissions from documentation by each concerning other bodies relevant to the application of science and technology to development. The data provided deliberately conceals the behavioural phenomena, whether advantageous or disadvantageous to development and field-level coordination. In this sense, « positive, cooperative » public information and protocol statements may be counter-productive by concealing a situation which those less well-informed need to take into account if their initiatives are to succeed.

Interorganizational rivality

Another aspect of this problem is evident in the information systems, classification schemes and thesauri produced by such international bodies - or even within their own divisions. With respect to the application of science and technology to development, each has its own (resources permitting) and will argue in all seriousness that they are the most relevant to its particular programme objectives (32). Needless to say the lack of relationship between them does not facilitate the development process with which they are, in principle, ultimately concerned (33).

Interorganizational territorially

Related to this question is the marked tendency for issues to constitute the arena for interinstitutional territorial dynamics. With the division of intellectual and operational space into smaller and smaller compartments and the multiplication of institutions and professions which assume the management of each such territory, results the formation of a feudal system which governs the majority of science-related enterprises. Under the pretext of division of labour, each intends to be master of its own domain and to defend its position against enemies from without and emerging institutional and professional rivals from within (34). Because the arena is ill-defined and unmapped it is difficult to comprehend such dynamics.
When a new issue emerges, suddenly providing an expanse of unoccupied institutional territory, each body makes every effort to demonstrate its right to a portion of that territory, either by « reinterpreting » its past initiatives to show relevance or by redefining existing initiatives under appropriate labels. The succession of special UN Conferences (environment, water, population, habitat. etc.) may be seen as catalyzing such responses, whether they are made in a spirit of cynical opportunism or perceived as a fresh opportunity through which it may at last be possible to define » the good, the true and the beautiful ». And in this sense all the past unresolved issues get redefined under new labels in the hope that they may be resolved within the new framework. UNCSTED 1979 is one such opportunity and the same dynamics will be repeated unless such dynamics are more adequately portrayed for comprehension.

Pre-logical biases

Finally, it is appropriate to note the existence of pre-logical or temperamental biases which determine individual (and, by extension, institutional) preferences for the nature and organization of information presented, namely the kinds of explanation that are felt to be satisfactory. As such they characterize not merely the physical theory that a society develops but also much of the legal, political, and social behaviour of that society. There is evidence that such prelogical biases may prevent logical consensus, such as on the nature of « science » or « development » (35).

F. « Mythical » aspects

Information on the application of sciences and technology to development is also distorted by a number of myths whose nature may be well described but rarely, if ever, in the same context. There is the myth that science based on western values is neutral and universal (36) - and that indigenous practices and folk wisdom are dangerous or charming nonsense. There is the myth that there is a scientific or technological solution to every « real » problem - other problems being subjective. There is the myth equating development with economic growth and industrialization, which conceals the problems of development and the limits to growth. There is the myth that cultural development is a direct consequence of the application of science and technology of development, since it is assumed that the acquisition of science enhances a culture rather than eroding its values (37). There is the myth of the problem as existing » objectively » and susceptible to « properly organized » remedial action, There is the myth that it is only the lack of «political will», and the undue importance attached to non-scientific and non-rational arguments, that prevents problems from being solved. As mentioned earlier, there is the myth which limits attention to the 10 Key development problems, as though each was nicely ordered in administrate units.

though it is widely recognized that it is their interrelatedness which is fundamental to any action strategy. This links to the myth which conceals the fact that existing institutions, and their associated bodies of knowledge, are (despite Ashby's Law) adequately structured to respond to complex problem networks (38). Underlying this is the myth that the fundamental problems are always » out there - and never in the attitudes, procedures and structures with which they are perceived and engaged. And there is the myth that if a responsible body is created to focus on a problem, then action will be seen to have been taken and because it will then cease to be perceived as a key issue for policy purposes, it may be assumed to be under control. As in any primitive culture, such myths are necessary to create a semblance of order in the face of a reality to which no better response has yet been developed. New approaches are required and both science and technology should be used to assist in their development.

G. Ignorance and lack of systematically ordered informatic

The kinds of information available relevant to the application of science and technology to development reveal a number of important gaps :

Scientific disciplines

There is no framework within which is collected together the succinct descriptions of the special insights, sensitivity or integrative characteristics of each scientific discipline :

- in what way is it relevant to understanding or facilitating which development processes: what is its unique contribution (Even systematic identification of the key concepts - and associated distinctions - unique to each discipline has not been made, nor is any attempt made to register systematically the laws or theories which govern the use of those concepts)
- conversely, what are its special « blindspots » or « handicaps » as perceived by others and the excesses to which they give rise if uncontrolled by other factors (Namely, what tend to be the negative consequences for the development process resulting from irresponsible practice of the discipline or its inappropriate institutionalization)
- On what other disciplines is the discipline dependent for its own effective development and appropriate application, and conversely which other disciplines are dependent upon it
- estimates by country or world-wide of (a) the number of practitioners of the discipline, (b) institutional costs of training a practioner, and (c) annual institutional budget to enable a full-time practioner to practise effectively. Where such information is available, it is scattered through a large number of publications. This is irrelevant to the practitioner of any particular discipline, whose education slowly gives him the mastery of a very smalt portion of this literature by which the dependence of society on his expertise in guaranteed. But, to protect such dependence, the distinction is not made between (a) knowledge of the key aspects of disciplines (noted above) which should be widely available, at least within a policy environment, and (b) knowledge of how to use and manipulate them, which is the special skill of the practitioner. The information available in specialized encyclopaedias and dictionaries is either too diffuse, too detailed or inadequately ordered, in order to facilitate understanding of the relevance to development processes.

Technologies

There is no framework within which is collected together, and systematically ordered :

- the succinct « primitive », description of each technology, whether « outdated ». modern or advanced.
- its special relevance, if known, to particular stages in development processes and problems.
- the interdependence between one technology and another in terms of (a) operations, (b) maintenance, and (c) substitution (whether by more advanced, less advanced, or same level),
- dependence of the technology on the expertise of practitioners of particular disciplines,
- the negative consequences to the economic, social and cultural environment which are unique to that technology as perceived by others and the excesses to which it may give rise if uncontrolled by other factors.
- estimates by country or world-wide of (a) the number of users of the technology, (b) institutional costs of training users, and (c) annual institutional budget to operate and maintain the technology.
- level of education required to operate and maintain the technology (specially in terms of the concepts and laws of a discipline with which familiarity is necessary).

Without systematically ordered information such as this, rational policy formulation is distorted by ignorance and lack or readily accessible overviews.

Development processes

There is no framework within which is distinguished and Systematically ordered :

- the succinct description of each development process
- the interdependence of development processes
- indications of the negative consequences of underdevelopment or over development of that process, or of its relationship to other processes
- the dependence of the process on technology or various forms of infrastructure.

Application processes

There is no framework within which is collected together and systematically ordered the succinct description of the different organizational or other instruments whereby science and technology may be applied to development processes, with an indication of their unique advantages and disadvantages in different developing country situations.

Part 3:

INFORMATION SELECTION AND PRESENTATION

In the field of information processing. documentation and classification there is an almost universal bias towards text and terms, since publications have titles and normally contain text. This is a very persuasive argument in favour of word oriented computers and classification schemes. It is associated with the generation of a plethora of costly bibliographical tools, abstracts, directories and encyclopaedias (39).

But even if ait items in the total body of literature were identifiable and available at low cost (which is the aim of those who favour this approach), there still remains the problem of how to improve the relevance of the questions asked to the problem complex faced by the policy-making process. Retrieval is not the problem, it merely aggravates this more fundamental problem. Retrieval systems focus queries in the light of the user's existing knowledge and biases. They do not orient the policy-oriented user to knowledge and issues with which he should also be concerned in relation to his current preoccupations (in the light of qualified or alternative opinions). They do not bring to his attention where his preoccupation may fit in relation to other preoccupations. He is given no sense of scale, proportion or orientation - he merely gets what he asked for however much difficulty he has in formulating his question in appropriate words.

Explanatory power of diagrams

It is ironical that within any book or article, whenever the point to be made is too complex to be expressed in words, the author resorts to a diagram of some kind. This ensures that various elements are brought into appropriate relationship within a whole of which the reader has an overview. From that overview the reader can then select (a) how he wishes to explore the elements interrelated therein, and (b) those he considers significant as meriting further examination. Yet existing information systems are completely incapable of producing or manipulating diagrams as an aid to policy-making.

Computer-generated diagrams

The exceptions, to this statement are interesting as indications of the kinds of technology not available to policy-making in relation to the development process :

- air-traffic control radar display screens
- computer-aided architectural and engineering design displays
- factory process control flow displays
- electronic circuit analysis and design displays.

In each such case there are complex problems of choice and decision analogous to those in a policy-making situation. The examples are given to show that a technology is in use to manipulate such information. Unfortunately, however, that technology cannot yet be used satisfactorily in relation to development processes because the information is in the wrong form. The information available to policy-makers is contained in a multitude of lengthy reports supported by tables and diagrams. These can of course be put straight onto sophisticated computer systems in toto. But the basic problem still remains how to ask the question relevant to the policy process - it is not a retrieval problem. Information systems give no assistance in this respect.

Media-oriented techniques

To go to another extreme, those concerned with facilitating understanding of complex issues by the public (and this may well include decision-makers) use media-oriented techniques. Great emphasis was placed on films at the UN Human Settlements Conference. Books attempting to describe social change make much use of mcluhanesque illustrations (40). But despite the gain in visual interest and emotional appeal, the value of such superficial displays for policy-making itself must be questioned. Aesthetic constraints too frequently conceal important issues.

Mathematical models

Another extreme is provided by the computer-based mathematical model interrelating hundreds or thousands of equations. These may be satisfactory where no policy problems have been avoided in constructing the model and there is consensus that it reflects the social reality it purports to model. This is rarely the case. Furthermore such modela tend to be incomprehensible to all but their creators and critics. Again they do not help the policy maker to determine which questions to ask, but only answer those he chooses to ask (many « answers » having been built into the design of the model anyway).

Graphic models

An intermediate approach involves the use of graphic, two-dimensional, non-mathematical models. Such models are a symbolic representation of the various aspects of a complex event or situation, and their interrelationships (41). They are analogies which policy-makers may use to clarify their thinking about a relatively complex situation. They range from organization charts through to systems flow charts, including the many kinds of schematic diagram that are prepared on flip-charts or slides for presentation purposes. They are widely and successfully used. Their main disadvantage is that only a limited number of elements and relationships can be incorporated in the model if their comprehensibility is not to be lost - the extreme case being the complex system or circuit diagram only comprehensible to the expert. None of these approaches is immediately relevant to improving the information problem in relation to the development processes, Each of them indicates constraints and

Notes

(1) The author has been concerned with various aspects of this problem as director

of a project which produced the Yearbook of World Problems and Human Potential, Brussels, Union of International Assocations and Mankind 2000, 1976, 1136 pages (which discusses a number of points with extensive bibliographies)

(2) The author has explored the background to these criteria in the publication cited

in (1) and in:

- Criteria for a meta-model. (Paper presented to a session of the 4th Conference on General Systems Education. Connecticut, 1971) 4 p.
- Relationships between elements of knowledge (Working paper for the Committee on Conceptual and Terminological Analysis) 1971, 150 p.
- Knowledge-representation in a computer-supported environment. International Classiification, 4, 1977, 2, pp. 76-81.
- Computer-aided visualization of psycho-social structures (Paper presented to a symposium of the American Academy for the Advancement of Science. Philadelphia. 1971).

(3) In the Final Report of the Unesco Consultation on Science and Technology Policies in the Caribbean Region, Georgetown, 1977 (UNESCO/NS/ROU/408, para

82), the: « Unesco representative stated that he had taken note of the CSC Secretariat's interest in entering this field. He mentioned that within the context of preparations for the Conference of Ministers of African Member States responsible for the Application of Science and Technology to Development (CASTAFRTCA), convened by Unesco in Dakar on 21-30 January 1974, a vast operation of

this sort had been carried out by Unesco, according to a methodology which had been provided well ahead of time to all CAST AFRICA national liaision officers. The

« mappin g » - a term which

(3a) Arie A. Manten. A suggested growth model of science and implications for information tranfser. Journal of Research Communications Studies, 1, 1973, pp. 83-98.

(4) Items from : Georges Anderla. Information in 1985 : a forecasting study of information needs and resources. Paris OECD, 1973.

(4a) Over 1000 entries are already contained in: A Bibliography on the 1979 UN Science and Technology Conference. Lund, Research Policy Program. University of Lund, 1977 (and supplements to May 1979).

(5) Sir Robert Jackson prefaces his major Capacity Study of the United Nations Development System (New York, United Nations, 1969) with the phrase : « Few Ministers will have time to read this Report... » (p. VIII).
The Joint Inspection Unit of the United Nations notes : « ... the very usefulness of this documentation was jeopardized, since most governments could not read and digest more than a very small proportion of what they received and were finding it increasingly difficult to coordinate the views of interested departments and brief their representatives for a meaningful participation in the discussions » (A/839. 2 June 1971. para 26).

(6) This would imply a considerable waste of resources in the production of studies in

this domain.

(7) These problems have been reviewed by the author in :

- International Organizations and the Generation of the Will to Change; information systems required. Brussels, Union of International Associations, 1970.
- Acquisition and organization of international documentation. (Introductory report to an International symposium on documentation of the United Nations and other intergovernmental organizations. Geneva, UNITAR, 1972.)

Even at the most general level in relation to the UNISIST system, development of the Broad System of Ordering prepared by the Interntional Federation for Documentation has been blocked by recent controversy.
The Macrothesaurus published by the OECD, with the collaboration of many intergovernmental agencies, has not prevented the individual agencies from ignoring its guidelines and introducing conflicting terms.

In producing the UNESCO Thesaurus (Paris, Unesco, 1977), « an unstructured list of descriptors was compiled of terms from the Macrothesaurus and from basic Unesco documents. In the course of indexing many terms were added and others deleted » (p. IX). It is not clear what relation the two now bear to each other. Similarly the Unesco SPINES Thesaurus (Paris, Unesco, 1976) « was published too late to be uses as a major source… although some terms.. were added after brief pre-publication access...» (p. XI). Again, it is not clear what relationship these bear to the Unesco computer permuted list of terms on which its retrieval system is based.

(8) See previous paragraph (note 7). In the proposed International Standard Nomenclature of Fields of Science and Technology (UNESCO/NS/ROU/257 rev 1) reproduced in Unesco's Method for priority determination in science and technology (Paris, Unesco, 1978) and in the CASTAFRICA study (see note 3), no indication is given of what fields have been omitted, whether the list is complete, or what relationship it bears to the Unesco thesauri (see note 7).

(9) Consider the relationship between the OECD Macrothesaurus and the categories of the UNEP Information Referral System.

ICSU/Unesco Central Committee was that UNISIST should devote us primary effort to the basic sciences... and at the same time be sympathetic to a progressive inclusion of the applied and engineering sciences - and eventually the social sciences - on an equal footing with the former » (UNISIST Report, p. 135-6). But me Unesco Statistical Yearbook (1976) includes as « fields of science » the « social sciences » and « humanities » (p. 609). The SPINES Thesaurus does not

« Research work in the social sciences and humanities should be included within the scope of R and D activity. Most European countries do in fact use the term « science » to embrace the whole range of human knowledge, and not in the more

posed standard practice for surveys of research and development. Paris, OECD. 1962, p. 19).

(11) «...science is many-sided, and each tends to regard it from the standpoint of his

own particular experience and interests ». Scientific Thought, Paris, Unesco, 1972, p. V.

(12) See : La Science et La Diversité des Cultures. Paris, Unesco. 1974.

(13) The Development of Development Thinking. Paris, OECD, 1977 (Liaison Bulletin, No 1).

Johannes A., Heising. Entwiklung: was ist das? Analysen und Prognosen. 55, Januar 1978, pp. 27-30.

comparative analysis. New York. Oxford University Press, 1973.

(14) In preparing the section on 1800 « Intellectual Disciplines and Sciences » of the Yearbook of World Problems and Human Potential (Brussels, 1976), the author

(15) Many books on development fail to identify « development processes ». The following identities 10 « basic processes ». H. Chancery and M. Syrguin. Patterns of Development 1950-1970. Oxford University Press (for the World Sank). 1975.

ysis.

(17) See Georges Gusdorf. Past, present and future of interdisciplinary research. International Social Science Journal, 29. 4, 1977, pp. 580-600.

(18) See note 17.

(18a) « No scientist will admit that voting plays a role in his subject... Scientists, espe-

cially physicians, frequently come to different results so that it is up to relatives

of the sick person for the inhabitants of a certain area) to decide by vote about me procedure to be adopted ».
Paul Feyerabend. Against Method. London, Verso, 1977. pp. 302-307.

(19) Yearbook of International Organization. Brussels, Union of International Associations, 1978, 17th edition.

(20) David Horton Smith has estimated there are some 5 million voluntary bodies in the USA.

(21) Lee Thayer. Communication and Communication Systems in Organization, Management, and Interpersonal Delations. Homewood. Irwin, 1968, p. 202.

(22) Winston Churchill made it very clear that all issues should be put to him on a single sheet of paper.

(23) Little investigation of attention span has been made in relation to policy information, despite its crucial importance.

(24) In a recent Assessment of Future National and International Problem Areas for the US National Science Foundation (1977), 1000 initial problems are subject to various filtration processes to reduce them to « six critical future problems ».

(25) The editors pf the « World Problems » section of the Yearbook of World Problems and Human Potential (1976) discuss this phemonenon.

(26) Method for Priority Determination in Science and Technology. Paris, Unesco. 1978, para 2.4.3.
Early research is reported in the paper; George Miller. The magical number seven, plus or minus two: some limits on our capacity for processing information. Psychological Review, 63, 1956, pp. 81-97.

(27) The stage at which national government required more than 6-8 ministries should mark an important evolution in the governability of the country.
Aspects of this question are examined in Anthony Jay. The Corporate Man. London.

(28) Harold D. Lasswell. The transition toward more sophisticated procedures. In : Davis B. Borow and J.L. Schwartz (Ed). Computers and the Policy-making Community; applications to International relations. Prentice-Hall, 1908, p. 307-314.
« Why do we put so much emphasis on audio-visual means. Partly because so

many valuable participants in decision-making have dramatizing imaginations ».

(29) See: Rudolf Arnheim. Visual Thinking. London, Faber, 1970, p. 306-312.

(30) «... what exists today is inter-Agency rivalry for projects ». Capacity Study of the UN Development System. 1969. 1, p. 76.

(31) For an exception, see Sir Peter Smithers. Governmental Control; prerequisite for effective relations between the United Nations and non-UN regional organizations. New York, UNITAR, 1972.

(32) Consider the lack of relationship between the Unesco SPINES Theeaurus produced by the Science Policy Division and Unesco's valuable Classification of

research and development activities in terms of development objectives produced by its Office of Statistics.

(33) See note 7.

(34) Points made by Georges Gusdorf (see note 17), particularly in an article on Interdisciplinarity for the French-language Encyclopedia Universalis.

(35) Investigated by W. T. Jones with respect to the long-standing debate on the « romantic period » and then applied to various sciences : The Romantic Syndrome; toward a new method in cultural anthropology and history of ideas. The Hague, Mouton, 1961. He distinguishes seven axes of bias which determine ore-logical

positions and then govern the subsequent positions taken in any « rational » or « logical » debate.

(36) See note 12. Also: Johan Galtung: A first guide to teutonic intellectual style (Working paper for the United Nations University GPID Project, January 1978).

(37) Jean Ladriere. The Challenges presented to Culture by Science and Technology. Paris. Unesco. 1977.

(38) The number of such reference tools is now so great that reference guide are required to them.

(40) Don Fabun. Dimensions of Change. Glencoe Press, 1971.
Frederic Vester. Unsere Welt: ein vemetztes System. Stuttgart, Ernst Klett, 1978.

(41) Gordon Lippitt. Visualizing Change; model building and the change process.
Fairfax, NTL Learning Resources Corporation, 1973.
Walter Herdeg. Diagrams. Zurich, Graphic Press, 1974.
Jacques Bertin. Semiologie Graphique; les diagrammes, les réseaux, les cartes. Paris. Mouton. 1967.

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2. Harold L. Wilensky. Organizational Intelligence: knowledge and policy in government and industry. New York. Basic BOOKS. 1967