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SHARING INFORMATION
IN THIRD WORLD PLANNING AGENCIES

Perspectives on the Impact of GIS

by

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ABSTRACT

This paper explores the 'information-sharing' paradigm which is rapidly emerging in mature organizations where information technology is being heavily used for communications and decision-making. The particular emphasis in the paper is not upon the ways in which the paradigm is being exploited in developed societies and economies but on the ways in which it might be used in geographic information systems in the Third World. First, typical approaches to learning about such systems are presented, based on comparative studies and case histories and then the meaning of information in its widest sense is discussed. The sharing paradigm is then developed and its applicability to situations where network infrastructures are not well-developed such as those in developing countries is presented. The paper elaborates the argument with some speculations on how the sharing paradigm might aid our understanding of the development of GIS in the Third World; and by way of conclusion, some speculations on the research agenda now needed in this domain are outlined.

ACKNOWLEDGEMENTS

I. INTRODUCTION: THE CRITICAL ISSUES

Serious and sustained studies of the impact of information systems on society are hardly in their infancy but almost every paper seems to chart a new beginning. It would seem that there are as many approaches and views of this subject matter as there are researchers speculating upon these impacts, thus reinforcing the unpalatable 'truth' that such is the nature of social systems and social science. In fact there is nothing intellectually amiss with this situation for social systems by definition admit novelty and innovation. The future is unknowable and these intrinsic limits to prediction continually force us to accept that the nature of knowledge in this domain will forever be uncertain. Although ideas and theories do not withstand the passage of time in the physical sciences as was so cogently demonstrated by Kuhn (1962) a generation ago, in the social sciences and in those areas which deal with the impact of technology on society, our approaches must be continuously refreshed in order to enrich our research in coping with new perspectives and new twists in the nature of our subject matter. Nevertheless, in a world in which the popular view of science is still one of physical determinism, it is hard to break out of the straightjacket which reinforces the predominant view that there are universals yet to be discovered in the social world.

The fact that the human world has in principle control over its own destiny means that a science of human affairs is unlikely to be fashioned on historicism or determinism. Therefore, the way we study the impact of science on society will always be contingent upon what might appear to be popular fashion although in this essay we will argue that such shifting perspectives must be seen as increasing rather than obfuscating or decreasing our understanding of social systems. The examples we can quote are legion. 50 years or more ago, economic policy based on Keynesian intervention in the economy by government was based on theories which were entirely appropriate to those economic systems of that time. Today however such systems have evolved and changed so radically that such classical theories are no longer appropriate.

The same is true of our own concern here. The ways we studied the impact of information systems on planning and decision-making twenty years ago and which were then seen as enriching our understanding are no longer relevant for new paradigms and perspectives which mirror the changing nature of information technology and its uses are of much greater relevance. In North America in particular, the idea of studying the impact of information on decision-making through the paradigm of 'sharing' has suddenly come into vogue, largely because information technology has matured to the point in advanced western societies where the idea of sharing information in terms of its data, technology and use seems highly relevant to organizations which are concerned with generating best decision-making practices. In this essay we will explore the impact of this paradigm on organizations which use geographic information in their decision-making with an emphasis on learning from cross-cultural comparisons particularly those involving the use of information and its technology in the context of the Third World -in developing countries.

Two interrelated themes run through this paper. First there is the question of the impact of technological change. The technology of computation which in itself can be defined as information processing is still evolving rapidly. A generation ago, information systems were concerned with 'transactions processing' (Manheim, 1987). They were part and parcel of the 'mainframe' computer environment which began to change during the 1960s when management information systems developed. The process of miniaturization and the coming of the personal computer heralded an the development of more personalized and localized information systems, interactive and more tuned to the decision-makers needs than ever before and it is these systems which are now fashioned as decision support and expert systems.

The second theme of some importance to the new paradigm of information-sharing depends upon the shift from industrial to postindustrial society with its increasing emphasis on abstract uses of computation. This shift which has been brought about largely through the development of automated control systems which in turn are based on the miniaturization of computer hardware, is changing the way we view information and computation. Ever more information is becoming available and our powers to manipulate it are growing daily. The relevance of much of this

available information however is still questionable and thus many of the old problems identified in the 1960s when information systems for decision-making first came onto the agenda, remain. Moreover, the impacts of the social change which have accompanied these new technologies clearly have different effects in and on different cultures. In the Third World for example, the process of using new forms of computation although lagged a little behind their use in the West, shows similar problems to those which we confront here although the fact that we associate this new technology with a postindustrial context coming after industrial is too simple a distinction to apply to developing countries. A better way of examining these changes globally and detecting their differences relates to the changing patterns of dependence between developed and developing countries and in this paper we will be concerned with charting these and their impact on the paradigm of 'sharing'.

The model then of the impact of information systems on society which we will adopt here sees our study of information evolving more like a spiral than a simple linear progression. In a sense, advances in our knowledge about the impact of such systems is increasing but slowly rather than rapidly as old problems are revisited and reworked as we learn more about the way information systems are being assimilated by society. At the outset then, we must recognize that the study of information systems and their impacts is one of learning about the problem from different perspectives which are continually changing as they are enriched by new insights. Information systems themselves are quickly evolving and this means that our perspectives on such change must change too, sometimes implying that what has been found earlier is rapidly becoming obsolete.

This we will challenge for although we assume here that the insights we have from past studies are becoming less relevant to current concerns, these insights reflect the fact that systems are continually changing and that they represent views of a phenomenon which in turn have been instrumental in changing that phenomenon. Herbert Simon (1983) argued a decade ago that in management science for example, it was extremely difficult to study the impact of new management methods on management practice for management practice itself was continually changing in response to these new methods. New professionals trained in these new techniques and

the science of management decision in themselves change the practice of management without necessarily using the new methods explicitly. The same is true of the impact of all professional knowledge on decision-making and the fact that we have been involved in information system thinking for a generation makes our study of the impact of new systems on practice difficulty to unravel.

In the 1960s, our concern with information systems was largely in terms of the data which such systems could store, process and rapidly retrieve and the sorts of quantitative models which could be used to transform such 'data' to information. In the decades since then, our concern with data has shifted to information as the machines and tools needed in their processing have quickly evolved. The lens which we are now focussing on information systems is no longer based on the first adoption of such systems in practice but upon the types of systems being used and the tools which are most useful. To some extent our concern here with geographic information is giving the field a clearer and sharper focus than it has ever had before. There is little doubt that the field is becoming more coherent as geographic information systems (GIS) are being adopted, largely we would argue because such systems are associated directly with basic tools and methods which enable their uses to engage directly in simple and relatively unambiguous transformations of data required in decision-making. This was never the case a generation ago. The tools used in the large scale systems of the 1960s and 1970s were controversial, complex and difficult to implement where now, the tools of GIS are more widely agreed upon. Thus by focussing our lens on geographic information and by recognizing that a large number of users and their organizations agree upon the value of such systems, this enables us to turn our focus on the questions of the infrastructure of information systems in general and GIS in particular and to concentrate upon notions which involve the 'sharing' of information between relatively mature users. To a large extent, these are the reasons why the paradigm is becoming popular and why ways of studying information systems which have dominated the past are now seen as less useful.

The emphasis here on 'sharing information' can be developed in both positive and normative terms although there are as yet unlikely very many examples or case where the behavior of users

and organizations has been radically influenced by the new opportunities available for such sharing. One of the major ways in which we might detect the existence as well as the potential for such sharing involves making cross-cultural comparisons through a variety of different types of case study. Such comparisons will be developed at this meeting in terms of examples from North America, and to a lesser extent Europe where such ideas are comparatively well established. But progress in learning about the problems and pitfalls of information-sharing are not likely to come exclusively from studies of the same cultural context. It is our contention here that the new paradigm of sharing must be complemented by studies of very different cultural contexts on a global basis. It is likely that ideas about sharing will be different in different contexts which depend in turn upon differences in resources, cultures, social structures and economic dependences. As yet we do not have any real sense as to how easy or difficult it might be to develop sharing in this multitude of contexts. It may, for example, be easier to establish the need for sharing in Third World planning agencies than in North American ones or more likely, ways of sharing might be quite different in these different contexts leading to concentration on different types of communication between users in these different situations.

Although it is widely agreed that GIS developments have given the application of computers to spatial decision-making a real twist and edge in the West, there is substantial evidence that the development of such systems has had as much if not greater impact in the Third World. The problems are clearly different both in terms of degree and type although the speed at which the Third World is embracing GIS is as fast, if not faster than the growth of such applications here. For example, a series of studies of the adoption and diffusion of information systems in urban, regional and development planning agencies in developing countries mainly in Asia was begun a decade ago by the United Nations Center for Regional Development (UNCRD) in Japan (Sazanami, 1986; 1988; 1990). This program has recently switched to a study of the impact of GIS in the Third World and preliminary findings suggest that GIS is having as great if not greater impact on decision-making there than here in the West (Brail and Harris, 1990). This is perhaps because so many planning problems in the Third World have obvious geographical or spatial applications or it may be because the technology for such applications has suddenly fallen to a cost threshold which

admits widespread use of such systems. Whatever the set of issues, these developments are worth speculating upon for they will enrich our view of the impacts of such systems.

There is also another issue relating to the development of GIS in developing countries and this relates to the patterns of economic dependence between the West and the Third World. This in itself is likely to mean that the types of sharing which are likely to pervade relatively mature and stable organizations in the West are not likely to be reflected in the same way in developing countries. The particular role of donors and vendors is somewhat different in developing countries from Europe and North America and thus the key issues in the diffusion, adoption and development of GISs are likely to be different. Moreover because the paradigm of data sharing is comparatively new even within developed countries, this essay will be very much a series of a speculations on what might be happening and what is likely to happen rather than what is actually happening. In it we will argue that there is an urgent need for some conceptual clarity in this focus both here and elsewhere and that we are perhaps in a somewhat unique position in that we are might be able to anticipate trends in the development and use of GIS in a multi-agency, multi-cultural contexts. This should enable us to gain a better view of the problems and potential of information-sharing than we have of previous developments in information systems technology.

To this end, we will organize this paper into five substantive sections. We will first launch into a discussion of an approach to information systems research which we feel is most appropriate. This will be based on comparative analysis and the development of case studies and case histories. This approach is already being used as the major vehicle to pursue such research although we will speculate on how far it is possible to generalize case study findings to the wider domain. We also need to be clear not only about the idea of 'sharing' but the ideas and methods and systems which are to be shared and thus after our discussion of case studies, we will examine the nature of information and the related systems which are the subject of such sharing. To anticipate our argument, we will take a catholic definition of 'information' which is considerably more than mere 'data', and we will follow this by some discussion of the information-sharing concept. This, too, we will broaden to encompass a variety of communications between users and organizations. Our next

section will deal with the model of sharing we adopt in a Third World context, and we will follow this with a discussion of what is known about the impact of information systems in Third World planning agencies. Several surveys have been done during the last decade but many of these are less than useful in that they are a highly derivative and remote from their context in terms of the material they portray. Finally, we pull these threads together and attempt to complement the discussion of information-sharing in a developed countries context with what we need to learn about the developing world.

II. COMPARATIVE STUDIES AND CASE HISTORIES

In this section, we reveal our approach to the study of information systems along two related dimensions: first the development of comparative studies, cross-cultural in every sense; and second, the development of our knowledge about the impacts of information systems through various types of case study or case history. In this we will argue that both comparative studies and case histories represent the most obvious and useful mode of increasing our understanding and developing our learning with respect to the impact of information systems on society more generally and the effect of GIS on decision-making more specifically.

We will emphasize two issues here which relate to sharing information. The first reflects the notion that organizations now exist in developed countries in which the conditions are 'right' for much more extensive communication of common ideas and tasks than was ever possible hitherto. In short, much of the infrastructure in the form of machines, networks, software, data and skilled users is in place and this in itself opens to door to extensive cooperation between agencies on a scale never before anticipated. In contrast, agencies and users in other parts of the world are not in the same situation due to the absence of some of the infrastructure required to enable data and information-sharing. In short, in developing countries the lack of infrastructure is a major impediment to information-sharing although in such situations the benefits of greater sharing may

far exceed those benefits that might accrue to better resourced organizations. In this sense then a focus on the Third World enriches our understanding of the First.

Research into the impact of information systems so far has almost unwittingly moved away from the traditional scientific method which begins with hypothesis and seeks confirmation or in Popper's (1959) view falsification. The concept of strengthening our knowledge of these impacts through generalizing from observations however is still strong although some doubt has been cast upon this strategy as the idea of detailed case studies from which it is difficult to generalize has gained ground. The problem with the traditional model which attempts to amass as many examples as possible and generalize from these is that the more a social situation is studied, the more unique its characteristics appear, and the more difficult it is to generalize. However, unless such situations are studied intensively, material which relates to the hypotheses in question is difficult to unravel. In short then, attempts to confirm or falsify hypotheses relating to the impacts of information systems are frequently weakened as special conditions and auxiliary hypotheses are added as greater differences and unanticipated details emerge. Hypotheses concerning the impact of new technologies therefore are weakened rather than strengthened to the point whereby they are trivially true.

A related problem with the traditional scientific approach is based on the longstanding and deep seated irrationality of induction, that is of amassing as many examples as possible in efforts to derive generalizations through sheer strength of numbers. This is bound to fail for even in quite closely controlled contexts, differences emerge which reduce the applicability of the initial hypotheses. For example, it is likely that in this very meeting, there will be several closely related examples of information-sharing and the impact of GIS on organizations and institutions which are viewed as being very similar. Nevertheless, it is quite likely that their differences will seem more significant than their similarities, hence implying limits on the degree to which common hypotheses can be generalized.

The last issue which suggests that attempts to generalize from studies of the kind associated with information impacts are likely to be flawed relates to the fact that those who attempt to observe the system of interest are likely to alter it through knowledge of the very skills they have which qualify them to observe the phenomenon. So much of the impact of technology on society involves adapting the technology through shared insights that it is doubtful that any strict controls on observations and their reporting are possible. A more preferable approach, which as we implied above is emerging by default, concerns the development of very detailed case studies and histories of the diffusion and adoption of GIS which enable detailed understanding to be matched against our search for generalities and universals. Our confidence in our knowledge of the impact of information systems on organizations and the problems and possibilities for sharing in the use and development of such systems therefore depends upon our amassing a wide range of case studies which we can understand best through their classification and matching against ideal types. The value of a meeting such as this one is not simply to attempt to learn, then generalize what we know, but to lay the groundwork for building up an extensive archive of case study material which will enable us to engage in useful classification, thus enabling our understanding of the impact of GIS to be increased through well-reported, hence well-understood and significant case studies.

Case studies are thus essential in developing research into these issues and in enabling us to extend our knowledge and use it both predictively to figure out what future impacts of such systems might be and perhaps prescriptively in the development of information-sharing. In this domain, it is likely that case studies will contrast the effects of resource provision in terms of infrastructure and its skilled use with the structure of the organization, its institutional context and the attitudes and assumptions of those who work the organizations procedures and protocols. To this must be added the types of problem to which information systems are addressed for these too will determine impacts and opportunities. Although the case study is essential, we can only learn about such phenomenon by engendering meaningful comparisons and in these terms, such developments are likely to open a veritable pandora's box of possibilities.

Comparative research involves developing comparisons across a very wide range of dimensions. The types of organization, their institutional context, their political mandates, the levels of professional and technical skill they require, the resources they have at their disposal in terms of capital, the procedures they are charged to execute, all these and many more serve to define the range of situations over which useful comparisons can be made. Moreover for good comparative research in which we can have confidence that the right types of dimension for comparison have been identified, the range of case studies should not be so large as to include widely contrasting situations unlikely to exist together, nor should the comparisons be too narrow, thus generating trivial conclusions.

Although we have implied so far that cross-cultural comparisons are essential in developing our knowledge of the applicability of information systems to decision-making in the spatial or geographic domain, comparisons should be strictly controlled in terms which appear likely to generate essential differences. For example, comparing organizations which are heavily networked and have a longstanding history of using state-of-the-art hardware and software together with the requisite skills and mandates for this use, should not be compared with organizations in the Third World which may be involved in the same ultimate decision-making but which do not and are not likely to be able to acquire equivalent infrastructure in the short or medium term. Even within the North American context, there will be agencies and organizations dedicated to the development of information systems generally and GIS in particular which cannot be compared in the same terms.

When we turn to the more specific focus of this meeting on information-sharing, the task of comparative research becomes more complex and cultural issues come to the fore. There are situations where the use of information systems may be very different in that some organizations use information directly to enable explicit decision-making whereas there are others that use such information in non-decision (Crenson, 1973). The balance between these types of decision-making must be strictly identified for although this research initiative is founded on the notion that sharing information is likely to lead to better decision-making, there are many instances where the negative or opposite in terms of the sharing of information for non-decision-making is also true. All this

discussion serves to do is to raise awareness about these issues but it also reinforces the view that it is those factors which often contribute to the more unique and specific characteristics of an organization that come to the fore when the impact of information systems is discussed, particularly when the idea of sharing or communicating information between organizations is broached.

Let us develop a simple example of cross-cultural differences within the developed world to establish the difficulty of researching the tasks we have identified. In the United States, very large data bases exist which record personal debt and credit and these data bases are 'shared' or rather sold to organizations which wish to use the information to increase their market share, withdraw credit facilities and related types of transaction. Notwithstanding any ethical limits to such sharing or selling, the data undoubtedly benefits decision-making. In Europe however, most governments forbid similar organizations to compile information concerning credit; defaulters are recorded on similar lists but there is no geographically diverse list of credit levels within the population. The implications of these two types of data set are clear. In North America, the population receives unsolicited information to an order of magnitude greater than in Europe because such lists are less valuable to organizations in Europe who might wish to use this information to better their decision-making. The differences relate to political institutions, to historical traditions, and of course to long standing cultural norms which are never immediately explicable or comparable. In these types of situation, possibilities and opportunities for sharing information will differ dramatically, as will the costs and benefits of engaging in such sharing. We could repeat these comparisons ad nauseam but the point is that differences in culture and history make a substantial difference in the type of sharing and the way it might develop, certainly between organizations which are rooted in different cultural and political contexts. Issues of political and social legitimacy as well as political and social practice are thus to the fore in making such cross-cultural comparisons.

There is one last issue that we must introduce before we change tack and launch into a discussion of the meaning of the information we are alluding to in sharing. As the case study approach has gained ground in the social sciences during the last 30 years at the expense of more positivist scientific approaches, it has become clear that case studies can be conducted on very

different levels and that the results from these levels may substantially differ. In fact, there might almost be an ecological fallacy associated with the differences which can result from a rather broad brush case study and the same study conducted in a much more detailed participatory fashion. In short, case studies in which the observer participates living through the experience which is being reported and understood can reveal diametrically opposite conclusions from those that are conducted more quickly at arms length and from secondary and other forms of 'filtered' data.

There are excellent examples of this in the studies which have been reported with respect to the impact of information systems in Third World planning contexts. Some three years or so ago, we undertook an analysis of the various case studies of the use of information systems in local and regional planning which had been reported in a series of papers to conference and workshops organized by UNCRD (Sazanami, 1990; Elam, 1990; Batty, 1990). The information used was not only of a secondary source nature but it had clearly been filtered and distorted in the first instance, in that many of the papers were quite inexplicit as to the extent to which information systems had been implemented. By cross-checking papers given on the same case study but at different times by different experts, it quickly became clear that many of the case studies really represented what their proponents wanted to do rather than what had been done. This suggested that many of the case studies were of little use in that they represented intentions, no doubt laudable in themselves, hence understandable, yet of little use in charting impacts and generating positive suggestions for their improvement.

This story can be repeated time and again. When the author first became involved in his research field of land use-transportation modeling in the late 1960s, many of the articles which were written then about the development of such models in North America and elsewhere were really what their authors wanted to do rather than what was done. Brewer's (1973) magnificent expose of the problems and pitfalls of such developments showed clearly how the early reports of such models biased the field into believing that much more was ongoing and much more was possible than was actually happening. To summarize, case studies which are reported experiences given at conferences are no substitute for detailed, painstaking, participatory ground work of the most

mundane kind. Such studies are beginning but it is our view here, that such studies are essential if real progress on understanding the impacts of GIS and sharing geographic information are to be made. As Einstein so cogently remarked "......do not believe what a scientist tells you about his work, study his behavior and actions". In the history of scientific endeavor, trails are obscured and the written record is always post hoc rationalization. The same is true or even more so of our own field where there is less consensus and greater contrasts between styles of work.

III. THE MEANING OF INFORMATION

At the beginning of this paper, we noted that in this field, every distinct research effort at increasing our understanding of the field represented, in some sense, a new beginning; due in part to the nature of the field and the way it is continually changing. This paper is no exception but of particular importance is the issue of what it is that is to be shared as well as the nature of the sharing process. Doubtless the meeting will firm up on this as the various presentations unfold. Thus at this point it is worth spending a little time on speculating as to the meaning of information in this context. Information can have a wide or a narrow definition and as we have already implied, our preference here is for the wider, more catholic definition. Our focus though is upon geographic or spatial information, that is information which has some use in processes of spatial decision-making. This need not imply that the information be represented spatially per se although most of that which we allude to is likely to have this restriction.

Information is not data. Indeed, it was Martin Shubik (1979) who argued that: "We live in a data-rich but information-poor society", thus establishing the point that although we might be overwhelmed with data, whether or not this is informative to us in some way and for some tasks will depend on the nature of the data, the way it is collected, the way it is processed and reprocessed and perhaps most of all, the theories and methods we have which enable us to use it to some purpose. Here we will adopt the idea that information is any set of tools and methods which enable us to make sense of the problem we intend to use the information in addressing. This means that the

raw data however it is defined, the ways in which it is preprocessed, the information systems, both hardware and software which are use in its manipulation and transformation, the skills and roles of those involved in the process, the procedures and protocols which are used, and even the decisions which eventually emerge are part of our definition of information. Thus information-sharing might involve the sharing of any of these dimensions to the information systems problem.

We will also introduce the fairly widely accepted idea that new information is created by processing previously specified information and that it is the process of such transformation rather than the material subject to such change that must be the focus of our concern. We will refer to this process as the 'information pipeline' and we will imply that the starting point of the pipeline is rarely an issue in that whenever information is explicitly or informally used in decision-making, this information has already been the subject of several transformations. The idea of raw data is thus put into some perspective by this approach in that if it is the methods and ideas used in transforming one set of information into another that is the focus, then it is those methods and ideas whether they be implicit or explicit which become the substance of concern. In this view, because all our ideas and observations are rooted in theories which govern our interest and behavior, there is no such thing as raw data, only information that we begin with from some external source and which we fashion to our purposes. For example, much of the data which we have to work with we have no control over in terms of its collection or definition. The way such data has been defined depends upon the concepts and purposes for which it was originally collected and this limits its general use and the ways in which it can be transformed and used for the purpose in hand.

The pipeline in this sense might be circular in that frequently the decisions which have to be made recur on a regular cycle but we will assume that the process is linear to an extent in that information is transformed from one state to another, from one purpose to another which is the motivation for its transformation. Thus our information pipeline will begin with basic data collection and ordering, will proceed through analysis and problem definition, through predictive modeling to a variety of decision-making incorporating policy-making, planning, management, control and design. All of these foci serve to bound the types of decision-making task which we

will embrace here. One particular feature of the pipeline is that the ultimate decision, however it be represented, can be seen as the ultimate form of the information as it has been transformed throughout the problem-solving-planning-design process. Thus information gains focus, use and value as it is processed towards decision. In this sense, then whatever information we work with is theory-laden and processed to a form which implies some clear purpose or mandate.

In the 1960s, decision-making was examined in terms of the information processing model mainly in psychology and to a lesser extent in early forms of artificial intelligence but in the 1990s and beyond the information processing model has taken on a new lease of life. In planning and policy-making, the traditional process has been based on variants of the rational decision model which is structured as a process which begins with goal formulation and ends with decision and implementation. The various methods and models used in physical planning, for example, to enable the process to move forward, relate to the armory of spatial analysis and modeling techniques and decision aids such as cost-benefit analysis which link the various stages of the process together. Since then, the focus on the planning process has changed to reflect a more incremental, less rationally structured process which accepts that parts of the process such as information and analysis are much better structured than the processes which govern decision-making. As such the idea of a pipeline in which information is progressively refined to some explicit end is a better and somewhat more flexible way of articulating the use of information for decision-making.

Here our emphasis is upon spatial or geographic decision-making and those tools and methods for the representation and transformation of spatial data to these ends. The means of transformation are diverse although some structure has recently been put upon this domain through the development of GISs and related procedures such as decision-support systems (DSS) and expert systems (ES) (Densham, 1991). Thus the hardware and software of GIS are important to the pipeline, particularly the functions of the software which are inevitably tailored to the tasks in hand. The emphasis here on GIS is largely a practical matter in that with the present rapid development of such technologies, it is useful to fix upon this focus notwithstanding the fact that relevant techniques and methods, perhaps most, are beyond the strict processing functions of any GIS. This

sharing information in the context of GIS relates directly to a number of easily articulated issues: to questions of hardware and related infrastructure that might be shared, to information processing models embedded in the software of GIS, to the question of the uses to which GIS functionality might be put in the context of applied decision-making, and to the skills needed to ensure an appropriate operation of the technology and its successful dissemination in practice. Of course, the information which is the subject of the process is itself material that can be shared although in this somewhat stricter sense, this is perhaps better reflected in the more commonly used terminology of 'data sharing' (Sieber, 1991).

Before we begin to elucidate the question of 'sharing', it is worth elaborating on the transformation of information in terms of our pipeline model. The model is simply one which continually operates on the information generated so far using the same or different techniques of processing at successive stages. The process begins somewhere in the past or it is restarted with what we might refer to as 'raw data' but it quickly transforms this into information directed at the purpose of the pipeline - the decisions which have to be made at the end of the process. One feature of the recursion which is implied by this process is that the process is one of 'learning' about both the problem and its solutions through decision, which may embrace a reworking of old problems, the discovery of new, and the dissolution or resolution of existing problems. In this sense then it mirrors a variety of planning processes (Batty, 1978).

Schematically the pipeline is shown below. The spiral progression indicates that information is progressively processed towards 'decision' beginning with 'data':

Original Data .... I_1 — I_2 .....I_N .... Decision

with loops labelled P_1, P_2, P_N above.
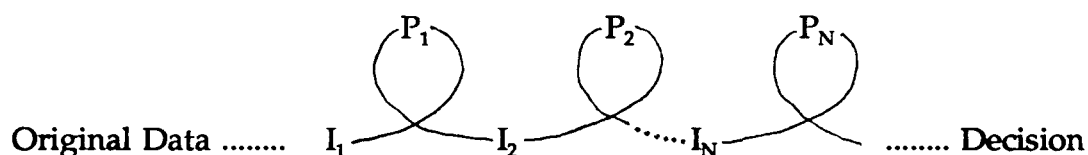
I_N indicates the N'th stage through which information passed as it becomes more relevant to the decision while P_N indicates the N'th stage of processing. Of course, processing might not occur at each stage and the precise configuration of this process may depend on many other issues which although well-known, are outside the immediate concern of this paper.

The pipeline diagram can be elaborated in many ways. One way of examining opportunities for sharing involves comparing different pipelines which pertain to different decision-making processes with a view to linking these processes at various stages. Any of the elements which we have discussed in relation to this model of decision-making might be the subject of sharing. In fact, one way of examining the relationships between different organizations would be through linking their decision-making processes as they exist at present or as they might exist in the future. For example, good organizational design would concentrate on how economies of scale, how better understanding, learning and decision-making might emerge from designing structures in terms of linked pipelines. This of course is not new for it really links to the representation of organizations as networks. What however the new technology of GIS enables is an extension of the ways in which inter-organizational designs might be developed with the emphasis on better collective decision-making or (as we are want to forget) better non-decision-making.

To summarize then, the development of GIS technology now provides an effective way to develop better and more informed decision-making which might result from sharing infrastructure in the form of networks, expertise and also software and related modes of analysis. In a sense, this represents a qualitative change over what has been possible in the past largely because of the evolution of technology rather than the development of better methods and theory per se. Nevertheless, such developments are now a reality and before we speculate on how these ideas might affect such sharing in contexts other than North America and Europe, namely the Third World, we will explore the nature of possible 'sharing' with a view to defining the limits on what is possible and the opportunities that are emerging.

IV. SHARING AND COMMUNICATION

The 'sharing paradigm' as we are referring to it here, has evolved quite quickly during the last decade for a number of important reasons. The notion that scientists need to share data and equipment has been well-established in the physical sciences especially in 'big' science since the development of very large and small scale science at the opposite ends of the spectrum in the early 20th century. The same notion in social science is much more shortlived in that only in the last 10 years has data become available which meets generally recognized standards and is widely applicable as a research base for different and often unconnected groups of scientists. Various archives have been developed for social and economic data and it is these that have become the basis for 'data sharing' during the last decade (Fienberg, Martin and Straf, 1988).

In fact, the conventional image of sharing in domains such as our own is one of sharing the data decision-makers start with rather than any of the other features of the technology which we have pointed to above. However our own focus is much wider than this for data sharing through national sources such as the Bureau of the Census have been available for a long time. It is with the development of the newer technologies of information, not with the raw data that the idea of sharing at this meeting must address. Geographic information is a sufficiently well-defined set of data to enable some consensus over its form to exist while software and related functions are general enough for spatial data to be commonly used by a wide variety of users whose concern is spatial decision-making. In this sense then, it is software, the basic infrastructure, the skills involved in operating such systems and even the actual nature of informed decision-making which might be shared. Moreover, as these elements are often in short supply, the prospect has emerged of remote centers specifically working in cooperative mode providing scarce resources either subsidized or at market cost to potential users. Already there are examples with respect to the Population Census and the related digital data which is necessary for their spatial representation.

The sharing paradigm is also evolving as a network society emerges in which communications hitherto unenvisaged become possible and as new forms of information

transmission compete with one another in the market place (Batty, 1991). Data with a spatial dimension is continuing to proliferate as new forms of collection and storage gradually take over manual methods and as networks begin to link together. Whereas a decade or more ago, detailed data concerning the location of individuals and households was rarely collected in a form whereby it could be easily retrieved and analyzed, it is now possible at least in principle to obtain remarkably detailed information on individual behavior patterns from a variety of sources. Spatial data is available at a cost from several private sources whose specialist role involves collecting, collating and preprocessing data, thus adding value to it in terms of foreseen and often unforeseen applications.

Of course it is the economics of sharing which are likely to become important in the near future as users begin to foresee distinct advantages through economies of scale which involve pooling data, hardware, software and skills. There are countless instances were the same types of means are used to different ends, and it is in these types of application that information-sharing is becoming a reality. As we hinted at in the previous section, such sharing might even lead to new forms of organization more appropriate to the decision-making tasks which they are mandated to pursue. The idea that very different organizations might have common goals with respect to the sorts of teamwork they might develop in relation to the production of relevant information for their decision-making is making all kinds of 'unholy' liaisons possible. Yet such possibilities also have their darker side in that small differences in common goals might be sufficient to constrain and inhibit sharing, especially in those areas where there is direct competition for resources and ideas. Geographic information systems are useful for identifying how markets can be expanded to the detriment of competitors and such conflicts are often more than enough to lead to identical systems being developed but pursued by competing interests in their own vacuums. Moreover, conflicts between public and private interests which have the same substantive problems to resolve can also lead to massive duplication where information is power. For example, typically in many western countries, there is control of spatial development through zoning and related land management strategies which are developed in the public interest. Such controls are designed to both constrain and attract various types of development and the arguments in their support are invariably

dependent upon geographic information which is best organized and analyzed using GISs. The idea of various competing interests sharing data and related systems as well as skills is unlikely especially in situations where public agencies have control over data while private interest have more control over the acquisition and development of software and their command of professional advice in the market. In such situations, the asymmetry between public and private interest might be resolved by strategies which enable the sharing of common resources. Such situations are often positive sum games in which both or all parties can gain through cooperation. But the traditions for such sharing have hardly begun to be established and it will take time for the interest involved to realize just how much all can gain from cooperative work practices.

While we have been somewhat bullish in arguing that agencies can gain much through sharing, our paradigm must be able to identify situations where sharing would be problematic, hence undesirable. Slight differences in data might be required. For example, public agencies concerned with land development in, say, housing are likely to require somewhat different data from that used by realtors, notwithstanding any superficial similarities. The software used may also contain functions which develop certain aspects of the geographic problem but not others. For example, many GISs are strong on ways in which spatial constraints can be used to identify optimal locations although there are countless situations where the emphasis on such functionality would be irrelevant - in highly developed areas for example where there was little possibility of further development. In short, although sharing might at first sight appear possible in terms of hardware, software and raw data, there are sometimes small differences which render any sharing of little use. Differences in the spatial scale of decision-making, in the skills required to develop geographic information to the point where such information is relevant to decision-making, and the whole question of the proprietary basis of hardware, software, data and skills can all appear to provide dauntless obstacles which inhibit any form of sharing.

There is another issue which relates to our comparative lack of experience in information-sharing so far. Like all new activities, the need to share and the best ways of achieving such sharing have to be learned. Problems which have a common basis in raw data, in the systems used to

process this data and the functions necessary to transforming data into information relevant to specialist decision-making, have to be explored in terms of their commonalities and differences. There is no magic strategy to enable such learning to be accelerated. Much relies at present upon somewhat idiosyncratic and ad hoc recognition of similarities. The need to exploit opportunities for sharing demands particular skills for which an ideal type is difficult to define. Moreover the need for sharing also depends upon a degree of stability and a minimum in networked infrastructure which many agencies and users in the West do not yet have and in this sense, we stand at a threshold in discussing and anticipating strategies for information-sharing which are only just beginning.

In reflecting upon the 'sharing paradigm', we suggest that the terminology be somewhat loosened to embrace a more general style of communicating common problems which have common information processing requirements. Sharing is perhaps too strong a term. It certainly is when contexts outside the heavily networked environment are considered although in such contexts, the idea of pooling resources and pursuing common goals for purely instrumental purposes is hardly new. Increasing communication between interested parties involved in using geographic information will undoubtedly increase opportunities for sharing. Moreover in the context of the Third World to which we will now turn, explicit sharing may not be possible for a long time yet because infrastructures are so poorly developed. Means and ends may closely coincide although the idea of sharing may simply not be possible because the technology of the organization has simply not reached the threshold in terms of the resource base where it makes sense to share information technologies. And there is also the issue that sharing is likely to be very different in developing countries than it will be in North America or in other parts of the West. To this end we will now begin to address our general speculations to planning and policy making in the context of the Third World.

V. SHARING INFORMATION IN THE THIRD WORLD

The basic issue to be broached in making comparisons between developed and developing countries in terms of information-sharing involves the complex pattern of dependence which exists in all relationships between these two worlds. In general, the technology which we are discussing is a product of advanced industrialized societies and the contrasts between the wealth of labor and capital in these two worlds is so great that it is futile to even think that strategies such as information-sharing applicable to one will be relevant to the other. Moreover, the flow of technology is asymmetric in that technology is transferred from developed to developing countries and in-so-far as anything is returned, it is in terms of basic resources such as raw materials and sometimes in poorly-trained labor.

However technology does affect the Third World almost as soon as it becomes available in the West. Some technology related to computing such as the personal computer is transferred instantly and spontaneously, finding uses in fairly basic routine tasks such as word processing and leisure pursuits. The second and more formal route of such transfer is accomplished by donors who are either computer companies or software houses, or who are involved in aid programs and see their role as showing how computers and the new technology can be used to produce better decision-making in the country in question. Such patterns of dependence however are fraught with difficulties which are largely due to the somewhat artificial way in which the transfer takes place. Frequently aid agencies do not provide the relevant support and training and thus once the donor lets go of the project, the new technology is abused or abandoned with the concomitant waste of resources which this implies and which follows in its wake.

In the Third World, there are already many instances where technology has been transferred into completely unsuitable circumstances and it is worth detailing one which has some parallels with the development of information systems. In the 1960s, when transport planning became formalized in North America, it was quickly disseminated and adopted by the rest of the world. The problem with such dissemination was that the conditions in North America for which such planning

was developed were largely irrelevant in the Third World. Even in North America, the emphasis on the automobile was eventually seen to be misplaced but in a Third World context where the automobile was virtually non-existent and could not be afforded in any case, such planning was totally inappropriate. Moreover, in the West, planners came to realize that traffic systems were considerably more robust and adaptive than they had ever assumed and that the role of public transport was much greater than had been ever perceived. Problems of traffic were extended to deal with energy, pollution and environment and in hindsight, the 1960s which was marked throughout the West as a time when massive freeway building was carried out, now seems to have been misplaced (Dimitriou, 1990).

When such planning and its technological assumptions are applied to the Third World, the results have been devastating. One continuing problem is based on the notion that development equals technology and thus it is difficult to dissuade developing countries to slowly test new technologies rather than rapidly embrace them with open arms as they almost always do. In the case of transport planning, Third World cities were crisscrossed with roadways which were rarely needed and which succeeded in filling up with traffic of almost every variety. Freeways were needed it was argued in the West to accommodate the automobile but in the Third World, there were hardly any automobiles. But the planning process once it was applied and its plans implemented simply encouraged a form of transport which could hardly be afforded, and simply adding to the problems faced.

The diffusion of the new technologies we are concerned with here is also occurring apace in the Third World. In much the same way as in transport, developing countries lack the infrastructure necessary to sustain the network society of which the information-sharing paradigm is founded upon. Although microcomputers are finding the same uses in developing as developed countries, computer systems which depend heavily on communications are highly problematic. In fact, even the proper use of a microcomputer at the most routine level requires support which is often on the end of a telephone line (Harris, 1989) and such systems are rarely used properly because support even at this level is not available. In some parts of the world, telecommunications are so bad that

mobile forms of network infrastructure are beginning to by-pass the traditional fixed lines. For example, in Guandong province in southern China of which Hong Kong is the natural port, industries extending from Hong Kong to the mainland China are depending upon mobile phones because the traditional telecommunications infrastructure is so bad.

Almost every aspect of information-sharing we have identified so far is problematic in the Third World and we must detail these so that the extent to which sharing may be possible in cultures other than the North American becomes clear. First planning and policy organizations rarely have the clarity of purpose that one finds in the West. Organizations positively compete in the most undesirable of ways for power to make and influence decisions and in such a context, sharing is very much the exception rather than the rule. In many contexts, information means power and this brings into train all kinds of 'irrational' and biased decision-making. Furthermore, the raw data upon which sharing must be based is so patchy and inconsistent, its geographic and temporal base so convoluted and its coverage so partial that there is no real staring point for the straightforward development of information systems which are becoming the rule within the West. In short, national priorities in developing countries often stress the need for consistent and timely data collection but this is largely because of the absence of such mechanisms in practice.

The cost of technology in the form of hardware and software is also expensive and can rarely be afforded by Third World planning agencies who rely on dubious copying or upon donors. In fact, one of the most obvious resources of the Third World is the production of software although this demands a style of cooperation and competition which has been difficult to engender so far. As we have indicated, networking of the sort required to share data and software is unlikely to exist in most Third World contexts. If it does as in the case of NICNET in India, it brings its own problems of administration and coordination. A major limitation of course involves the pool of skilled professionals and the ability to train more. Once trained, professionals usually move to realize their comparative advantage and this makes programs for information-sharing difficult to sustain.

There is of course a paradox in all of this. In one sense the problems of the Third World are simply not those likely to be affected by the use of information technology although they emanate from the technological superiority of the West and the consequent global power structure. On the other hand, it is precisely through new modes of communication and cooperation that such information-sharing helps to conserve resources and improve the quality of decision-making. It is somewhat of an irony that Third World planning agencies probably need to share this technology so that they might reach informed conclusions which in turn might suggest that such technological developments are inappropriate in the first place. Nevertheless, the discussion which this meeting is concerned with will doubtless find itself on the agenda of those concerned with information systems in developing countries and thus it would be unrealistic to suggest that the information-sharing paradigm is inappropriate to organizations and culture which have not yet reached a given level of technological infrastructure. The various international agencies might be able to help provide some perspective on these developments and advice to Third World agencies who see that the only way to keep in step with the West is to engage in extensive networking. The magic of new technology is so powerful that these ideas will spread come what may and it is thus important to use such developments to make modest progress in situations where information-sharing may remain a mirage on the horizon for many years to come.

VI. INFORMATION SYSTEMS IN DEVELOPING COUNTRIES

One prospect which provides some optimism in developing the information-sharing paradigm in less technologically advanced contexts is that the paradigm is so new in the West, that by anticipating its eventual spread world-wide, various rules of thumb and intelligence will have been developed in its adoption by the time it begins to make an impact in the Third World. So far in this paper and at this meeting, we have all been guilty of technological determinism in that there is a basic assumption that sharing is likely to lead to better decision-making. In the Third World context, this is unlikely to be generally true as it might divert attention from more basic issues

which involve the collection of improved data, the use of rational procedures, and the coordination of diverse and often contradictory policies.

Some of the opportunities and problems raised by sharing data have been well catalogued in the physical sciences. The need for centrally located archives for large and expensive data sets is widely recognized, for research depends upon these. In our domain though such archives are of less relevance unless they be connected to large data sets collected by one agency. Geographic data for each locality is unique and in terms of better decision-making, this data is only likely to be useful to a small number of agencies and users whose concern is with that geographical area. In science, standards have also been developed with respect to the reporting of data and information in terms of its initial collection and preprocessing. One great advantage of maintaining such standards pertains to the control which can be exercised over the use of the data thus reinforcing good science and avoiding the worst abuses.

However there are problems in maintaining central sources of data and information. Issues of proprietary arise and it is clear that the collection of data and its preprocessing is as much a research problem as any other and thus problems of crediting and financing such ventures are to the fore. Moreover, it is difficult to guard against the abuse of data in the first instance and there are many instances where data sources which have been regarded as exemplary for years are suddenly discredited. However, in the social and physical sciences it is the nature of the enterprise and its costs that make sharing the only logical route to follow. This is by no means the case in applied decision-making. Different problem contexts and the use of the same data at different scales may enable sharing to take place but it is more likely that it is software and professional skills which come to be shared rather than the information per se. In fact, we have been assuming so far that 'sharing' is a somewhat selfless enterprise. Where value is being added to data, this is by no means the case and there is every likelihood that a considerable amount of data will be commonly used but by different agencies purchasing the same data set. This in a sense is as much a part of the sharing paradigm as the pursuit of selfless cooperation between agencies. The success of this kind of quest

and the derivation of a common information set requires as much technology as any of the more obvious methods of sharing which depend upon heavily networked infrastructures.

In the Third World, the development of information systems is probably as deeply entrenched now as it is in the West. However the path of this development has been different in that the cultural and political context, the levels of resources expended on such systems, and the role of outside donors have all combined to lead to a rather different and somewhat volatile adoption of these new technologies. The fact that donors are unable to follow through, the fact that agencies compete for such technology, and the problem of several competing agencies developing their own perspectives on common problems has led to more complex forms of information systems than one finds in many western contexts which appear more stable. A major problem which we have already alluded to is that the reported case histories are often inaccurate and represent intentions rather than achievements while our own personal knowledge of what is happening is so anecdotal and culturally remote that it is difficult to paint a clear picture of the situation with any level of confidence.

Another issue which is of some concern in the West as well as the Third World involves the types of data and information which such computer systems contain. Our assumption so far is that such data is quantitative rather than qualitative. Of course, such systems do not need to be based on quantitative data and in the sense that spatial relations and maps are qualitative, then GISs are able to capture some qualities of the system. Nevertheless the systems to date have mainly been used to store quantitative data and in a Third World context where quantitative data is lacking, then such systems are often underutilized. In such contexts, however, it is the qualitative features of the problem which are so important to detect, and this represents yet another limitation on the development of GIS in developing countries.

We have already commented on our understanding of what has happened in the use and application of information systems in Third World planning agencies. Despite an ongoing program of research by UNCRD (Sazanami, 1988), the effort by UNESCO's General Information Program

(Adam and Rose, 1988), the work of UNCHS in Nairobi (Cartwright, 1990) and the UN Department of Technical Cooperation and the World Bank especially in China, our knowledge through detailed case studies is woefully limited. These various case studies have revealed that in the Third World, like the First, the major problems of information systems development are not technical but organizational and institutional reflecting the power elite, the way donors and aid agencies interact, and the lack of organizations responsible for the most basic tasks such as regular and consistent data collection. Problems of education and training also loom large.

In this context, sharing information may seem somewhat idealistic although there is just the possibility that conscious efforts to enhance such sharing may be more effective in developing than in developed countries. Sharing might be the catalyst which serves to galvanize planning agencies to concerted and effective action. Moreover sharing leads to learning and it may prove to be a way of accelerating the learning required by professionals and organizations in the developing world. Moreover, the learning process cannot be restricted to technological questions but will concern the best organizational design, the way professionals can best interact with one another, the relationships between the technical and political context, and a host of other important issues which make the difference between mediocre and effective decision-making. Last but not least, just as we drew attention earlier in this paper to non-decision-making, we must conclude with some comments on situations where sharing should not be developed. These of course are harder to articulate but in the quest to improve decision-making through the effective sharing of new technologies, there will be many instances where sharing is inappropriate and any considered research program should define such situations.

VII: CONCLUSIONS: FUTURE RESEARCH

Sharing information is still very much a norm that is aspired to, rather than any tangible condition which can be easily observed and measured. There are situations where such sharing is to the fore but these are changing rapidly and like so many new technologies before, these ideas

contain more intentions than actual practices. This meeting has chosen to concentrate on sharing information for better decision-making and this begs the question also of how we might measure the quality of such decision-making. For many years there has been a debate in the social and behavioral sciences which suggests that it is the process rather than the product which should be made explicit and measured for what constitutes 'better' is a rapidly shifting goal as our society gets more complex and as relative prosperity changes.

It is important here to discuss the sorts of framework in which information-sharing can be both studied and encouraged and to this end, this meeting is following a unique and important path. Much of my paper has been anecdotal, necessarily so when so little is known and when the present quest is to decide on relevant approaches and methods. What is already clear is that detailed studies of the development of information systems **in situ** are required and this means painstaking documentary research and detailed participation in those forums and environments where such systems are being developed. In fact, the notion of studying 'sharing' in relative isolation from other aspects of information systems design and development is not likely to be the main focus of this research. Although sharing represents a new development and one that is gaining in importance, such study and research should be part of the wider context of finding out how information systems are impacting on those organizations which are adopting and adapting them.

In increasing our understanding of the role of information systems in general and GIS in particular, it is important to develop intensive case studies. However there is a limit to the detail of observation and participation which any research project can grasp. It is impossible to fight against the law of requisite variety which suggests that the most detailed and fundamental understanding one can gain is by matching one-to-one an observer to that which is observed. Clearly there is detail which will not be picked up but it is essential that the potential difficulties of observation are known in advance and it is meetings such as this one which can enable such difficulties to be articulated. Therein lies the challenge which is made all the more complex by the fact that the issues which require observation and measurement are not stable. In fact, our interest in them is because they are so volatile.

We have also addressed the need for cross-cultural studies and have pointed to the difficulties in developing parallel research in the Third World. GIS is clearly having as a great an impact in the Third World as in the West but the conditions, assumptions, infrastructure and technologies being adopted are somewhat different. It is doubtful if there is anything which can be called an alternative technology relating to computation. If there is, we have had it for well over 3000 years but there are ways in which different mixes of new technology can be transferred from developed to developing countries. This clearly changes the focus, yet in drawing attention to the Third World in this meeting, we are forced to consider cross-cultural comparisons in our own domain and it is by no means clear that information-sharing will necessarily lead to better decision-making in all the contexts in which such sharing is invoked. In fact, these issues are very much tied up with political structures and attitudes to the increasing amounts of data and information coming available. To study these issues comprehensively will require an openness of mind and detachment from the context which represent the highest ideals of social science research.

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