THE SOCIAL AND POLITICAL IMPACT OF APPLIED TECHNOLOGY: THE CASE OF REMOTE SENSING

*William R. Daniel and Joseph S. Leeper**

Virtually every policy analysis textbook contains statements regarding the vast amount of information needed in order to make effective decisions in our modern, complex society. This "need for data" has generated major technological advances in the fields of information gathering, storage, and retrieval systems. One such advance has involved the development and refinement of a sophisticated "remote sensing" technology.

Remote sensing is a new and rapidly growing technology which, in the not too distant future, may have a profound impact on society as we know it. While the actual use of remote sensing instruments is nothing new, accelerated development and expansion of the capabilities and uses of remote sensing technology are a by-product of the United States' space program of the 1960's. Since that time, a number of satellites with sophisticated "sensing" instruments on board have been launched for the express purpose of providing scientists, educators, political decision makers, private industry, and others with a vast array of new knowledge about the earth's surface. New developments in terms of instruments, data processing, and dissemination of information are occurring on an almost daily

**Dr. Daniel is Professor of Political Science at Humboldt State University; Dr. Leeper is Professor of Geography and Chairman of the Geography Department at Humboldt State University.*

basis, to the extent perhaps that "pure" technology is outstripping our ability to use it. That some experts consider remote sensing to be a powerful data gathering tool with broad applicability is best exemplified by remarks of Dr. Robert Colwell at the first annual Conference of Remote Sensing Education: "Within a few years there will be very substantial progress toward a globally uniform information system, based primarily on remote sensing data."[1]

"Pushers" of remote sensing argue that the technology offers tremendous benefits for mankind. Remote sensing, it is argued, will be invaluable to public agencies (local, state, national, and international) and private industry as well, in areas ranging from the discovery of new sources of oil to urban land use planning. While remote sensing technology may well offer potential benefits, one must ask (as one must with any technological advance) are there potential harmful consequences connected with the use of remote sensing? If so, are these consequences controllable? If uncontrollable, does potential harm outweigh potential benefits? What is the potential impact of remote sensing technology on political and social organizations, or on individuals? Given the high degree of probability of extensive use of remote sensing technology, the answers to these questions become exceedingly crucial; for we are reminded that "The development and application of a new technology without a careful assessment of its impact poses a grave threat to the quality of life as we know it."[2] Unfortunately, these and similar questions are not being asked. The major orientation of those knowledgeable in the area focus almost exclusively on the technical aspects of gathering of quality data for use in rational decision making.

Thus the emphasis is placed on information gathering and analysis, and possible latent functions of extensive use of remote sensing tend to be ignored. There is a substantial volume of literature dealing with the "scientific aspects" of remote sensing as well as a body of material, proclaiming the virtues of the technology, which borders on propaganda. Also, there exist a number of applications of cost benefit analysis regarding the use of satellite remote sensing compared to other methods of data collection.[3] These applications tend to exhibit a problem common to many cost/benefit analyses in that they largely ignore potential "social" costs. In short, little attention is given to the potential impact of the introduction of a powerful new technology on society. Among the first to recognize possible dangers to individual rights of privacy posed by remote sensing, as well as to make tentative suggestions regarding use of remotely sensed data, was Samuel D. Estep. Additionaly, Estep realized that collection and distribution of data obtained from foreign nations via satellite might have international ramifications,[4] but his article, prepared in 1969, has not stimulated further analysis. Before irrevocable actions are taken, such considerations should be addressed.

Use by State and Local Government

The directors of the National Aeronautics and Space Administration (NASA) Remote Sensing Program are convinced that state and local governments provide a fertile field for expanded use of remote sensing technology, especially Landsat technology. However, at this point in time NASA officials have been somewhat disappointed in the limited acceptance and use of remote sensing by state and local governments. As of 1978, states and localities accounted for only 2% of the total usage of Landsat data; comparatively, the federal government accounted for 23%, colleges and universities 10%, foreign governments 23%, and private entities 42%.[5] Several factors may account for this relatively low usage by state and local governments. Respondents to a 1978 Governmental Sciences Engineering and Technology Advisory Panel (ISETAP) survey listed the following factors as contraints on the use of Landsat remote sensing technology: lack of a federal commitment to data continuity and compatibility, data timeliness, inadequate federal technology transfer, ill-defined federal agency responsibilities, failure of federal agencies to use and encourage the use of Landsat data, and state constraints including political fragmentation, lack of trained personnel, bureaucratic inertia, and lack of funding.[6] Yet another perspective is provided by Ida Hoos, who asserts that:

> Of the more commonly encountered perspectives which delineate our spatial relations with remote sensing is the *get a horse* syndrome; this maintains a pessimistic posture on any new technological advance. It is derived from the choice given Henry Ford by the skeptics. Sometimes impediments are more subtle, as when current practice is valued because "it is the way we always have done things," or because new methods upset the comfortable though archaic horse-and-buggy ways.[7]

Since gathering, dissemination, and analysis of remote sensing data is primarily a bureaucratic function; and since, as will be argued below, the introduction of a new and powerful technology may necessitate organizational changes in bureaucratic structures, bureaucratic inertia may be a major factor in the rather slow acceptance of remote sensing technology by state and local governments.

Despite impediments, a number of state and local agencies are now using "remotely sensed" data in a number of policy areas. Landsat data has been used for one purpose or another in forty-eight of the fifty states. Furthermore, seventy-six local governments and regional agencies have used Landsat data. According to the ISETAP report:

> Thirty-three states have institutional mechanisms which could facilitate Landsat use. Ten states have purchased, budgeted, or ordered analysis equipment. Twelve states have Landsat programs which are legislatively recognized...Nearly eighteen million dollars have been invested in Landsat Technology...Nearly fifteen hundred personnel have at least some training in the use of Landsat data...From a capability standpoint, even states are said to have independent ongoing operational Landsat analysis and

> application abilities; twelve states have completed, or nearly completed demonstration projects, and are close to deciding the applicability of Landsat to their ongoing data needs; and sixteen states are in the early phases of demonstration programs to assess the applicability of Landsat to their needs.[8]

Currently the major uses of Landsat in the states are: land cover inventory for resource management (18 states), water quality assessment and planning (18 states), wildlife habitat inventory (9 states), lineament mapping (9 states), surface water inventory (7 states), crop inventory (7 states), geologic mapping (6 states), and forest inventory (6 states).[9]

Although it appears that current utilization is low, the groundwork for much more extensive future usage is being laid. Indeed, a substantial case can be made for the assertion that remote sensing data gleaned from satellites will be widely utilized by state and local governments before the year 2000. For the first time in U.S. history, the public "world view" must recognize that we are entering an age of scarce and limited resources. We are told that in order to survive on this planet, man must be extremely wise regarding the management and utilization of the earth's resources. Though this reality may be a bitter pill to swallow, our political system is moving in the direction of planned management. Because wise planning and careful implementation require very complex and difficult decisions at all levels of government, the collection, dissemination, and analysis of huge volumes of data has become crucial. Clearly, abundant information is now of paramount importance in our society; unfortunately, necessary information also seems ever more costly to obtain. Yet, in light of the much discussed taxpayers revolt, politicians have found that economic resources are not unlimited either. The perceived "fiscal crisis" has initiated a new wave of cost consciousness among policy makers, thus enhancing the status of cost/benefit analysis as a tool for judging and ultimately selecting alternative courses of action.

In light of the above, planners, managers, and legislators need a tremendous amount of information obtained by cost/beneficial methods. Compelling evidence suggests that in many policy areas remote sensing data from satellites meets the need for cost/beneficial information. As Figures 1 and 2 indicate, state and local "users" surveyed by a National Conference of State Leislatures (NCSL) argue that Landsat data is cheaper to obtain than other types of data[10] Furthermore, these users indicate that in certain areas, Landsat data is of a higher quality than other data.[11] The ISETAP task force concludes not only that Landsat is now cost effective for a number of applications, but also that it will become more cost effective for an increasing number of applications. Twenty-three states responding to the ISETAP survey indicated that they were utilizing Landsat because it is more cost effective than other techniques.[12]

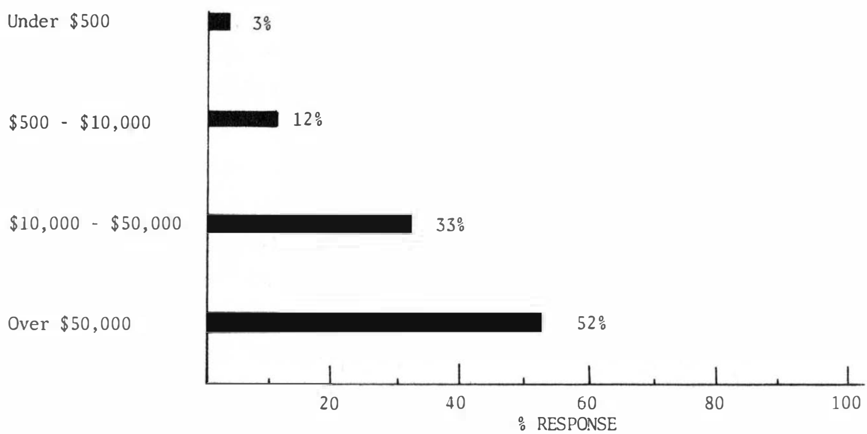

Figure 1 Approximate Cost of Data Collection Effort Without the Use of Satellite Remote Sensing

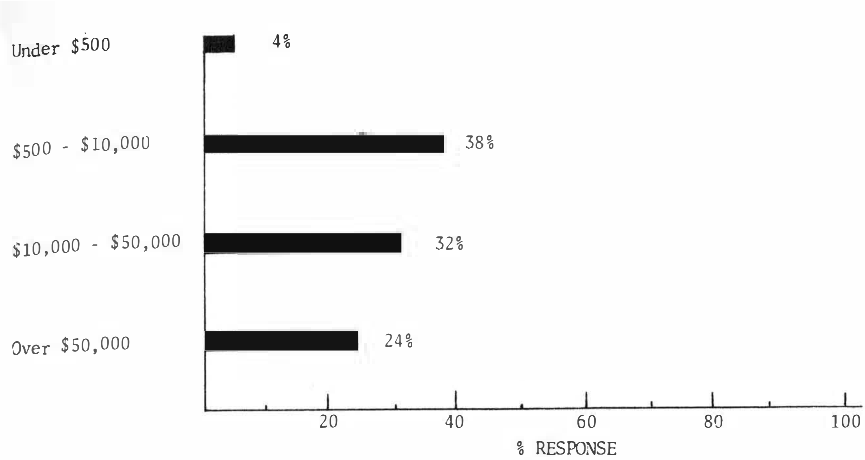

Figure 2 Approximate Cost With Satellite Remote Sensing

In addition to cost effectiveness, Landsat may be regarded as valuable because its repetitive coverage permits frequent monitoring of change occuring over large areas. Landsat's multispectral and synoptic characteristics provide a totally new means of viewing the environment and obtain information virtually impossible to acquire with conventional techniques. Also, Landsat provides uniform, standardized data in all-digital format which is easily incorporated into computerized information systems. Furthermore, recent innovations show promise of reducing turnaround time, one of the impediments concerning Landsat usage. Since April, 1979, users have been able to obtain Landsat imagery less than five days old, as compared to a previous average turnaround time of five weeks. Enhanced accessibility has been gained by a new NASA system which links RCA's Domestic Communications satellite (Domsat) with receiving stations at the Goddard Space Flight Center as well as with the Department of Interior's EROS Data Center. In addition, NASA spokesmen claim that new instrumentation aboard Landsat-D, launched in 1981, now provides information 2½ times more accurate and precise than earlier Landsat information.[13]

TABLE 1: SATELLITE DATA APPLICABILITY TO TYPICAL STATE AGENCY TASKS

	Perceived Satellite Data Applicability*				Perceived Landsat Follow-Up Applicability*			
	H	M	L		H	M	L	
a. Urban Growth Monitoring	32%	32%	10%	High/Mod	71%	23%	3%	High
b. Urban Flight Detection	1%	15%	51%	Low	3%	23%	58%	Low
c. Wetlands Mapping	42%	24%	8%	High	45%	45%	3%	High/Mod
d. Inner Urban Land Use Analysis	5%	8%	53%	Low	3%	41%	41%	Mod/Low
e. Drainage Basin Studies	31%	34%	3%	High/Mod	58%	29%	3%	High
f. Population Density Mapping	7%	22%	42%	Low	13%	45%	29%	Mod
g. Statewide Land Use/ Land Cover Mapping	51%	20%	3%	High	81%	13%	10%	High
h. Crop Monitoring	36%	29%	14%	High/Mod	45%	29%	10%	High
i. Critical Environmental Areas Mapping	22%	42%	7%	Moderate	29%	48%	16%	Moderate
j. Utilities Site Selection	3%	27%	41%	Low	6%	35%	45%	Low
k. Recreation Planning	5%	32%	37%	Low/Mod	3%	41%	39%	Mod/Low
l. Transportation Planning	8%	29%	34%	Mod/Low	13%	58%	19%	Mod
m. Water Resources Development	5%	42%	20%	Moderate	35%	41%	10%	Moderate
n. Coastal Zone Planning	15%	32%	14%	Moderate	29%	41%	13%	Moderate
o. Mineral Resources Development	8%	39%	22%	Moderate	13%	51%	23%	Moderate
p. Open Space Planning	10%	36%	27%	Moderate	23%	45%	23%	Moderate
q. Surface Mined Areas Mapping	31%	29%	14%	High/Mod	48%	32%	16%	High
r. Decisions Regarding Construction Materials Availability	0	20%	49%	Low	6%	19%	58%	Low
s. Floodprone Areas Mapping	24%	32%	15%	Moderate	39%	35%	19%	High/Mod
t. Snow Cover Monitoring	25%	17%	24%	—————	45%	26%	13%	High
u. Lake Trophic Levels Monitoring	12%	31%	24%	Moderate	23%	39%	19%	Moderate
v. Earthen Dam Condition Survey	5%	12%	58%	Low	3%	13%	65%	Low

OTHERS SUGGESTED BY RESPONDENTS:

Forest Inventory
Range Inventory
Noxious Weed Inventory
Geologic Hazards Inventory and Assessment
Game Management

Vegetative (Wildland) Health Trends
Abandoned Surface Mined Land - Unreclaimed
Timber Harvest
Rural Residential Development
Wildlife Habitat Mapping

* Response of participants in rounded percentages of total survey responses

In sum, the need for cost/beneficial data which can be provided by Landsat remote sensing technology, when coupled with current and planned improvements in the Landsat information system, provides compelling evidence that obstacles concerning the use of the technology will be overcome and that extensive use by state and local governments is, indeed, likely. If expanded usage is likely, in what areas will it occur? Table 1, provided by the NCSL task force survey, provides a possible answer.[14] Thus it would appear that the most likely areas of expanded use are urban growth monitoring, surface mined areas mapping, and snow cover monitoring. As higher resolution sensors are employed on satellites, more discriminating large-scale projects will likely appear, including wetlands mapping and drainage basin studies as shown on Table 1.

Impact of Use

If remote sensing technology does become a major tool used by state and local decision makers, what are the most likely consequences for society? This is a difficult, though important, question. As previously noted, lack of systematic research regarding the potential impact of Landsat technology makes the analysis presented here incomplete, speculative, and tentative in nature.

That applied technology has a profound effect on the way we live is a truism not likely to stimulate a great deal of debate. For present purposes, it can be argued that the application of a new technology will have both manifest and latent consequences for society. In the case at hand, providing scientists, private corporations, and public decision-makers with a wealth of cost/beneficial data would constitute a manifest consequence of the application of Landsat technology. Unplanned or unforeseen latent consequences of Landsat technology might involve either the development of new bureaucratic organizations or upsetting the distribution of power in old ones. A technology may also have "spin off" effects, as products developed for a particular use are applied in other areas. One of the by-products of the space program, for example, has been mass production for private consumption of inexpensive pocket calculators. That spin offs, too, may carry latent consequences is exemplified by the many educators who speculate on the effect which use of pocket calculators may have on children's ability to learn basic mathematical concepts. NASA, in "selling" its programs, has produced abundant material proclaiming the "spin off" benefits that have accrued to mankind. In so doing, NASA has, even as with remote sensing itself, concentrated on manifest consequences and largely ignored possible latent consequences. Though it is not difficult to conceive of many possible "spin offs" from satellite remote sensing technology, discussion here will be limited to analysis of two potential latent consequences, specifically, possible effects on political organization and structures, and possible effects on individuals' right to privacy.

Political Organization and Structures

That technology has had an enormous effect on political systems has been recognized for centuries and is a particularly prominent theme in the writings of Karl Marx. Yet one need not be a Marxist to recognize the inter-relatedness of technology and politics. In an excellent analysis of CIA failures and successes, for example, Patrick McGarvey provides an informative account of how institutional functions as well as the balance of power within the organization shifted as a result of development and use of sophisticated surveillance devices.[15] In the same vein, Ida Hoos notes that the needs of institutions are often dictated by the capabilities of the technology used to fulfill the purposes of the institution, and thus there is a tendency for an organization to adapt to the needs of a particular technology, rather than adapting technology to meet the needs of an organization.[16] These are but two of many accounts relating the effects of technology on organizations.

Advocates of Landsat technology already indicate that some reorganization of our political system is necessary if we are to take full advantage of the benefits of remote sensing. Hence, we are told that "For state and local governments to realize the full social and economic value of Landsat, an operational Landsat information system must be developed."[17] The nature of the information system is explained thusly. "A Landsat information system would involve international as well as national issues and requires a private and public sector team effort that is multidisciplinary, inter-governmental, and multi-institutional."[18] Finally, we are warned that "Whether the benefits from practical uses of Landsat will ever approach full realization depends on an ability as a nation to organize ourselves to capitalize on these new capabilities."[19]

What impact, then, would one expect remote sensing technology to have on state and local government in the United States? While the eventual outcome is far from certain, at least two consequences may be the creation of new and powerful bureaucratic agencies and the centralization of political power.

Presently, many NASA officials are concerned about the overall success of their technology transfer program. They cannot understand why state and local governments haven't jumped at the chance to take advantage of a beautiful new technology which could solve many data acquisition problems. Apart from the problem of convincing elected officials of Landsat's necessity, a student of public administration might suspect that bureaucratic inertia is a major factor impeding the progress of the technology transfer program. In its attempt to build a clientele, NASA seems intent on working within existing bureaucratic structures. Yet scholars now recognize the role which needs of individuals within an organization may play in determining the behavior of that organization. Eugene Lewis argues rather effectively, for example, that individuals who develop a new expertise within an organization often find their status aspirations frustrated because their expertise tends to be viewed as a threat to the status of superordinates;[20] and Simon, et al., have recognized the incongruity of status, hierarchy, and specialization, long considered as perennial features of bureaucratic organizations.[21] What happens when individuals' needs cannot be satisfied within a given organization? If a need for their expertise can be demonstrated, new agencies may be formed. Thus if NASA is successful in training personnel who rise to middle management levels, it would not be unreasonable to assume that these technologists will eventually serve as a catalyst for creation of new agencies which will fit the mold of the multidisciplinary, inter-governmental, multi-institutional Landsat information system described above.

In addition to the creation of new Bureaucratic agencies, the widespread use of Landsat technology will, along with numerous other factors, probably contribute to centralization of political decision-making in the United States. These assertions are based on analysis of Landsat capabilities, costs of the system, and the assumed subtle impact of data on perceptions of those who view it.

Regarding current and pending capabilities, Landsat is geared toward larger geographical areas than those covered by many of our fragmented local governments. Furthermore, current and planned resolution (the size of the smallest area that instruments can "see") is not entirely suitable for functions normally performed by the smaller local governments. The data produced may be invaluable to such functions as metropolitan land-use planning, however. Secondly, to make use of data, an entity must have both trained personnel and adequate computer facilities, conditions which portend prohibitive costs for many smaller units of government. Finally, mosaics produced by Landsat are powerful, indeed. They provide viewers a much better sense of the integrated nature of covered areas than does conventional data. Though there is no basis for suggesting that people who view the data will suddenly adopt holistic orientations, it is not unreasonable to expect that over time, as data becomes more widely used, the holistic view it presents will have an impact on the way decision makers view the world in which we live.

Given these conditions, enhanced use of Landsat technology will most likely be accomplished through regional agencies, such as the numerous Councils of Governments (COGs) which have been created in the past decade. At first, such agencies would probably assist constituent governments in data acquisition and analysis. In time as they develop an expansion-minded bureaucracy, COGs could play a more active role in the development of regional, land-use plans, and might eventually assume jurisdiction over a number of implementation programs. At the same time, it seems likely that the technology could serve as a catalyst for development of statewide land-use plans. The development of satellite remote sensing technology has made production of large-scale, land cover maps feasible in the sense that such maps can now be produced more quickly and cheaply than through use of conventional methods. Beyond production of land-cover maps and development of statewide plans, Landsat technology could aid in the implementation phase and enhance state control as it provides an effective means for state agencies to monitor the actions of local governments on a repetitive basis. Furthermore, given the intergovernmental nature of an integrated Landsat information system, extensive federal involvement seems inevitable. In fact, the ISETAP report strongly urges the designation of a federal lead agency which would have overall fiscal and policy responsibilities for the space system, data processing and distribution, training, technology transfer, planning and management, and which would be budgeted directly for these functions. Whether the creation of such a superagency is possible in our political system is subject to some doubt, but close federal supervision, whether by one or several agencies, seems a likely development. In a nutshell, what is envisioned here is the development of an intergovernmental remote sensing bureaucracy which will have a profound influence on decision makers in a broad number of areas.

Individuals' Right to Privacy

> The intensity and complexity of life, attendant upon advancing civilization, have rendered necessary some retreat from the world, and man, under the refining influence of culture, has become more sensitive to publicity so that solitude and privacy have become more essential to the community; but modern enterprise and invention, through invasion of his privacy, have subjected him to mental pain and distress far greater than could be inflicted by mere bodily injury.[22]

This statement, made nearly ninety years ago by Warren A. Brandeis (before he became a justice on the U.S. Supreme Court), exemplifies a problem inherent in any new information gathering and dissemination technology: how does one weigh the need for information against one of the more universal needs of mankind, the need to be let alone? This dilemma is addressed by a more recent statement directed specifically at remote sensing:

> There is nothing inherently immoral in gathering remote sensing information, but the potential exists for abuse of this information. The problem is one of controlling information generation and dissemination without restricting its significant use and application. One thing is clear from modern technology. *There is no privacy* from a well financed, technically adept person or agency determined to gain personal information about an individual, group or country.[23]

Given the presence of a technology which can detect a farmer's overplanting a cotton crop, which can determine if a building is properly insulated, or which can detect industrial pollution of waterways, serious questions are raised about the proper use of that technology. Thus we must ask, what are the current standards regarding the right to privacy? Will remote sensing technology cause these standards to be changed? Exactly what is the nature of the danger posed by Landsat to rights of privacy? Do there currently exist sufficient legislative and judicial protections against invasion of privacy by satellite remote sensing devices? These are important as well as difficult questions; and up to this point, little attention has been paid to them. Although this is not the place for extended treatment of the right to privacy, a brief analysis of the problem is in order.

The United States Supreme Court recognizes that a right to privacy does exist,[24] and the bill of rights in several states includes a "right to privacy" clause. Unforturnately, there exists no extensive listing of actions which might be labeled as acts beyond the touch of government or private individuals. Alan Westin suggests that there is a felt need for at least some privacy in almost every modern society and lists two universals which fit under the rubric of privacy—performing the sexual act, and the need for personal space. Beyond these needs what is "private" and what is "public" is a product of societal norms which differ from society to society.[25] Common "wisdom" regarding privacy in the United States holds that the right to privacy exists in those areas where the actions of individuals do not affect significant "other parties." One might argue, therefore, that acts which do not affect other parties, or even acts involving two consenting adults, where others are not affected, might be regarded as "private" acts subject to protection. On the other hand, there should be little argument against the conclusion that dumping of toxic substances into waterways near populated areas directly affects significant "other parties." There exists, however, a huge grey area between these extremes. For example, does an individual's refusal to insulate his home constitute an act which affects other parties? Rather than listing specific private acts, judicial determinations regarding privacy tend to hinge on the question of whether an individual in performing a given act, has a reasonable expectation of privacy, and whether an individual actually intended his act to be private.[26] These guidelines tend to be rather unique and are subject to change as social mores and technological skills change.

What dangers are posed by Landsat? We may tentatively answer this question only if we assume that privacy is a multidimensional concept. Two possible dimensions of privacy involve the gathering and use of information and a psychological dimension including the perception that one, indeed, has privacy at certain points in time.

An analysis of Landsat capabilities allows us to address the question with respect to the first dimension of privacy. At present an individual need not fear Landsat "detection" of activities which are not continuous in nature and which occur within a small area. The earlier Landsat can "see" an area approximately 80 by 80 meters, while Landsat-D has a resolution of approximately 30 meters by 30 meters; Landsat cannot, of course, see through buildings. Thus, the sexual act is safe for the moment. Currently, only those activities which occur out of doors, which are continuous in nature, and which require a large land area are subject to detection. Capabilities are, however, subject to change; and one must assume that as technological advances are made with respect to resolution, frequency of observation, and turnaround time for data analysis, the list of activities subject to detection will expand dramatically.

Even so, gathering information and being able to use it are two different things. There is such a thing as gathering too much data. McGarvey's account of CIA difficulties is appropriate, for he argues that the CIA has become so proficient at collecting information that the agency cannot possibly evaluate its usefulness and make intelligent decisions thereupon.[27] Engineers refer to such a problem as "systems overload." In recognition of this problem, NASA officials cancelled plans to use certain instruments because they would provide more data than existing hardware could process. Given this constraint on data processing, it is unlikely that law enforcement officials, for example, would use Landsat data for "fishing expeditions." In order to make use of Landsat data for law enforcement, officials would have to be reasonably sure when and where an activity was taking place; and even then they would probably find other methods of detection more suitable. It should be stressed again, though, that this assertion is based on assessment of present capabilities. Advances in computer technology are occurring so rapidly that the "protection" afforded by ability to deal with only limited amounts of data may soon be dramatically eroded.

Thus the problem of whether sufficient judicial and legislative protections exist is of paramount importance, and according to some observers they do not. Estep, for example, argued in 1969 that existing state and federal legislation did not cover the types of activities connected with remote sensing.[28] No evidence suggests the situation has changed since then. Every state has laws against trespass, but trespass involves, by and large, a physical intrusion. It hardly seems conceivable that a court would regard a "passive" system more than five hundred miles from the scene of an activity as "physical intrusion." The same may not be true for "active" systems which might "shoot" beams, radar, for example, into a given area and acquire information from the reflected beams. Yet Westin effectively argues that the danger posed by machines may be greater than the danger posed by persons, for individuals may take steps to avoid persons. There is no way to avoid a machine, however, and often an individual may be unaware that he is being monitored.[29]

Furthermore, protections offered by the U.S. Supreme Court as well as by state courts may be inadequate. In dealing with the right to privacy, the U.S. Supreme Court relies on interpretation of the First, Fourth, Fifth, and/or Fourteenth Amendments to the U.S. Constitution. State courts rely on similar provisions in state constitutions. These interpretations are procedural in nature and deal with the use of information; they do not protect the right of privacy per se. The procedural orientation of judicial decisions and the heavy reliance on analysis of these decisions by "privacy" scholars almost totally neglects the psychological dimension of privacy. The lack of research in the area precludes a detailed analysis of either the spectrum of dangers or what constitutes adequate protection from the dangers to individual rights of privacy posed by increased use of "the eye in the sky." Here we begin to touch on the psychological dimension of privacy, and neither the spectrum of dangers nor what constitutes adequate protection can be clearly summarized in the absence of research dealing with the psychological effects imposed on individuals by the "eye in the sky."

Presently, all that can be said is that if a semblance of protection is to be afforded, Congress and state legislatures must propose a list of remote sensing uses that are expressly prohibited; and steps must be taken to make citizens secure in the knowledge that satellite information will be used only for certain specific purposes. Here it should be stressed that the Federal Freedom of Information Act does not prevent gathering of information; rather, it places limits on what can be done with such information and provides an individual the opportunity (not unlimited) to inspect his or her government file. The Federal Privacy Act of 1974 provides some protection to individuals, but this protection is procedural, not preventive, in nature. Furthermore, the act applies to the federal government only, not to intended major users of remote sensing technology, namely state and local governments. Certainly, if sufficient protections are to be provided, not only a more inclusive "Freedom of Information" act must be devised, but also "privacy advocacy" agencies, with full power to investigate activities of governmental and private users of remote sensing data, must be created.

Conclusions

We have attempted to show that in the not-too-distant future it is highly probable that satellite remote sensing technology will be used extensively by state and local governments. Additionally, we have described the current technology transfer program implemented by NASA, and have argued that there exist political, social, and legal ramifications with respect to the application of the technology. Clearly, enormous potential benefit to mankind may accrue from application of remote sensing technology; but if these benefits are to be fully realized, steps must be taken to assess and remedy potential negative consequences. At a minimum, a thorough analysis of societal impacts should be conducted before making decisions which foreclose policy options. Perhaps the best way to conclude this essay is to relate part of a statement of philosophy developed at a 1977 Conference in Remote Sensing held at Humboldt State University:

> (W)e should appreciate the uses and potential of new technology for dealing with environment of earth and our evolving way of life upon the earth. At the same time, we must not allow technology to limit our vision of what values and purposes our earthly environment and way of life should serve.[30]

NOTES

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3. *Proceedings* of the First Conference on the Economics of Remote Sensing Information Systems, San Jose State University: Department of Economics, January 19-21, 1977, pp. 12-22.
4. Samuel D. Estep, "Legal and Social Policy Ramifications of Remote Sensing Technology," *The Surveillant Science: Remote Sensing of the Environment,* ed. Robert K. Holy (Boston: Houghton Mifflin Co., 1973), pp. 362-365.
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16. Ida Hoos, op. cit.
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18. Ibid.
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22. Warren A. Brandeis, "The Right to Privacy," 4 *Harvard Law Review* (1890), pp. 193-196.
23. Holy, op. cit., p. 361.
24. See, for example, *Griswold v. Connecticut* 381 (1965).
25. Alan Westin, "Surveillance and the Future of Privacy,"

address before the Center for Study of Democratic Institutions, Santa Barbara, Calif. (1975).
26. See *Katz v. United States* 388 US 420 (1968).
27. McGarvey, op. cit.
28. Estep, op. cit., p. 368
29. Westin, Address, op. cit.
30. "Exploring the Use of Aerospace Technology in Solving Some Resource Based Problems in Northwestern California," *Summary of Remote Sensing Conference*, Humboldt State University: Center for Community Development, April 6-8, 1977, p. 1.