
Land Information Systems Network in the Puget Sound Region

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Abstract: *Many public and private organizations are generating land information and maintaining land records with little awareness of each others' activities and responsibilities. Although this current institutional arrangement is caused by separate mandates, it nonetheless leads to a duplication of efforts and inconsistent data. This paper examines the problems and potential for implementing a "land information systems network" (LISN) in the Puget Sound Region of Washington State.*

Although many local agencies collect information about land, e.g., land descriptions, value, ownership, parcel size, location, use, restrictions, and zoning, land managers continue to face major problems with managing land information. The Larsen Report (1976), which is best known for its estimation of costs of land information, also provides an extensive list of problems concerning the management of land information:

- Accessibility
- Availability
- Duplication
- Aggregation
- Integrability
- Confidentiality
- Institutional

A variety of land-records management procedures have evolved in response to organizations' needs and mandates for information. "The irrationality that characterizes our present land records system is not the result of irrational behavior; it is the outfall of rational, but uncoordinated behavior." (Portner and Niemann 1984, p. 96)

Many current land records systems and operations have evolved in response to inefficient manual data collection and storage methods. However, today's versatile software and affordable hardware is making automated systems more widespread and efficient, making them more practical and accessible for local governments and organizations (Dueker 1987).

An unfortunate result of the rapid computer automation is the creation of multiple, separate systems and record collection procedures that are incompatible with each other (Comptroller General 1982); mostly because they follow organizational perspectives of the past. There is a need for a systematic and more holistic approach to land records modernization; otherwise continued financial commitments in isolated single-purpose systems will make integration and information sharing less likely.

In the past few years, several concepts have been proposed that should help ameliorate land records management

problems. Among these are: the multipurpose cadastre (MPC), geographic information systems (GIS), land information systems (LIS), and the concept of land information systems networks (LISN).

A MPC is defined by McLaughlin (1984) as "a large-scale community oriented land records system designed to serve both public and private agencies, and individual citizens by: 1) employing a land parcel as the fundamental unit of spatial organization; 2) relating a series of land information records to this parcel; and 3) providing ready and efficient access to these records."

A GIS is defined by Dueker and Kjerne (1989) as "a system of hardware, software, data, people, organizations, and institutional arrangements for collecting, storing, analyzing, and disseminating information about areas of the earth."

Dueker and Kjerne define a LIS as "a geographic information system having, as its main focus, data concerning land records."

Finally a LISN is defined by Palmer (1984) as a confederation of LISs that work together for the benefit of each, and for the benefit of the whole, without having to be in the same organizational unit, e.g., local government. In summary, a MPC is implemented using LISs and GISs linked together in a LISN.

A LISN would rely primarily on institutional, organizational, and cooperative arrangements in order to take advantage of rapidly developing

LIS/GIS technology. Consequently, the nature of a LISN results from the needs, experience, and intuition of the involved organizations.

The purpose of this paper is to examine the potential for a LISN in the Puget Sound Region. For some years, members of several local organizations have talked about a regional database. A LISN addresses that interest. The paper's goals are:

- 1) Explore the regional interest level in the LISN concept.
- 2) Assess available resources among possible participants.
- 3) Identify the major problems that need to be overcome.
- 4) Provide recommendations for the implementation of a successful LISN in the Puget Sound Region.

RESEARCH APPROACH

Determining which organizations to include in this project was a multi-step process. A list of potential participants was compiled by consulting literature sources such as the National Research Council Report of 1980, and the Geographic Information Management Systems Standards (GIMS) report, 1988.

The next task was determining how to contact appropriate respondents within each organization. Mailing lists from the now-defunct Washington State Mapping Advisory Committee (SMAC) and Northwest Computer-Aided Mapping Association (NWCAMA) were used to contact likely participants; then questionnaires were mailed. This process took six

weeks. The questionnaire determined:

- 1) The extent to which organizations and agencies have automated (or plan to automate) their land records systems;
- 2) Which groups produce and utilize land information by type;
- 3) Which groups are interested in additional land information.

The next step included interviews with key survey respondents. It was felt that in-person interviews could add background on both existing land record management systems, as well as those being planned. An additional set of questions was asked to determine the most important issue involved with land information sharing.

SURVEY RESULTS

The survey results confirmed that the major problem to be overcome before and during LISN development encompass complex institutional, economic, and technical issues. Although the issues and problems can not always be placed into a single category, three categories provide a convenient framework for discussion.

Institutional Issues and Problems.

Many survey participants identified a lack of coordination and cooperation among land information-using agencies. This is a serious obstacle to the development of a LISN. The term *cooperation* basically describes "one-on-one" ventures between organizations. Often this coop-

eration is a result of good intentions by individual agencies. *Coordination* refers to a method of "managing cooperation," to insure that many organizations are cooperating with one another in a more efficient manner.

Insufficient cooperation among organizations collecting, using, and storing similar land information results in duplication of efforts. Lack of a means to coordinate and share land information, and distribute the associated costs, hinders cooperation and coordination. Confidentiality and liability constraints also tend to reinforce separation of land information activities.

Cooperation within the Region Cooperative ventures are by no means a new idea in the Puget Sound Region. Of the 40 organizations responding to the questionnaire, 88 percent stated that they are presently engaged in some type of data-sharing arrangement involving the exchange of land-related information. Clearly, government agencies are creating links where needs exist, and agreements can be forged. However, almost all respondents indicated they could benefit from cooperating with more organizations.

Coordination within the Region Perhaps the greatest obstacle to large-scale coordination among organizations is a difficulty in finding commonality among organizational mandates. Also, there are no organizations that have within their mandate, a specific responsibility to di-

rectly coordinate information sharing within the region.

Coordination often evolves out of the need for a solution to a specific problem. Several survey respondents stated that many potential cooperative agreements probably do not materialize because organizations know too little about their counterparts. With this in mind, increased coordination of efforts (as well as information and/or application development sharing) may be more likely to evolve if it is established which organizations in the region engage in similar land information applications (see Table 1).

The primary advantage of such a grouping is probably "application sharing" because applications may be similar even if geographic areas are not overlapping. The possible exchange of ideas and discussion of issues relating to new or improved applications could also lead to more coordination of efforts within the region.

Although a grouping of organizations by application category obscures the details of individual organizations, some common data interests can be determined. "Application-categories" that utilize similar land information are documented in Table 2.

Groups that promote data, cost, and application sharing, as well as educating others of the needs and advantages for integrated land information systems in the Puget Sound region are listed in Table 3. These common interest and coordination groups could become the focal point for the creation of new arrangements as well.

Confidentiality and Liability Constraints Seventy percent of participants reported that they do not produce or use any information that is not available to the public. These organizations feel they have no "confidentiality" constraints that would hamper their ability to enter data-sharing arrangements.

The related issue of "liability for information provided" is a more sensitive topic. Although no survey participant reports any recent problems involving liability issues with their data-sharing agreements, several individuals believe that a methodology for resolving potential incidents, especially in regard to digital data, is needed.

Economic Issues and Problems.

The following list contains the most frequently mentioned economic "hurdles" that must be cleared before LISN development can be initiated successfully.

- 1) Availability of Funding for LISN Development
- 2) Cost of Additional Geodetic Control
- 3) Need to Justify Automation/Integration Costs

LISN Funding Availability

The major economic issue concerning LISN development is the problem of how to obtain adequate funding for conversion to digital methods in a coordinated manner. In order to acquire funding for new cooperative projects, decision-makers must be convinced of the importance of such projects, especially if there are extra costs as-

TABLE 1.
Respondent Organizations Listed by Organizational Focus

RESOURCE MANAGEMENT

USGS: Water Resources Div
WA Dept of Natural Res
WA Dept of Wildlife
WA Dept of Ecology
Puget Sound Water Qual. Auth.

SERVICE MANAGEMENT

Seattle Police Department
Tacoma Police Department
Seattle Fire Department
Tacoma Fire Department
King Co. Emergency Medical Serv
METRO (Transportation Div)

FACILITIES MANAGEMENT

Port Authority of Tacoma
Port Authority of Seattle
WA Dept of Transportation

Public Works Departments

King County
Pierce County
Snohomish County
Thurston County

Bellevue
Everett
Kent
Renton

Seattle
Tacoma

Public Utilities

METRO (Water Quality Div)
Seattle City Light

Seattle City Water

Private Utilities

Viacom TV Cable
US West Communications
Puget Power Electric

Washington Natural Gas
US West/Cellular Phone Division

DEMOGRAPHICS

U.S. Bureau of the Census
King Co. Dept of Election

Puget Sound Council of Govts
METRO (Transportation Division)s

PLANNING

Municipal

Seattle
Everett
Tacoma

County

King Co.

Regional

Puget Sound Council of Gov'ts

LAND TAXATION/EVALUATION

King County Assessor

Stewart Title Company

LAND USE AND DEVELOPMENT

King Co. Land Development Information System
King Co. Building and Land Development
Seattle Master Builders Association
King and Snohomish Multiple Listing Service

ADMINISTRATIVE

City of Seattle Administrative Services
City of Tacoma Data Processing Department
King County System Services

sociated with coordination and cooperation.

Most Puget Sound government agencies have the ability to augment dedicated funds

for mandated systems with "general funds" for cooperative projects. General funds can be approved by municipal or county councils, as well as the state legislature, for the promo-

tion of coordinated, non-duplicative data-sharing projects. The use of general funds also eliminates the difficult problem of attempting to divide the costs of a cooperative project between individual user agencies. However, general funds are difficult to justify and obtain and user-fee financing is frequently used.

"User fees" is a financing alternative that charges users in proportion to benefits received. Quasi-user fees are property taxes and property transfer taxes used to create digital parcel layers. Property owners and purchasers are deemed to be users of the system. This last approach would require new legislation and political support however.

Survey participants also listed possible incentives to LISN development. This list included: new market mechanisms and new state legislation allowing an LISN to be built profitably, the further development of federal and state standards to provide goals to shoot for, and a "data-giveaway" scheme to promote application-development sharing.

Costs for Additional Geodetic

Control The lack of adequate geodetic control to spatially register the region's land information databases is an often mentioned roadblock to LISN development. Cooperative arrangements are needed to distribute and share the associated costs of the improved geodetic control.

Geodetic control network-development time is also an issue. Organizations with lower accuracy requirements

may not be willing to wait or pay to construct a digital database acceptable for those with the highest accuracy requirements. Yet, geodetic control is crucial to register separately collected data.

Justifying Automation/Integration Costs The success of a proposal to improve land information systems in an organization depends heavily on the priority level it attains compared to other projects competing for the same tax dollars. In the United States, some of the most successful proposed or operating LISNs are the state of Minnesota (Robinette, 1984), Lane County, Oregon (Carlson and Bates, 1986) and the city of Indianapolis (Montgomery, 1990). Successful LISNs are born when systems are coordinated and supported by a wide variety of proponents.

Survey results confirm literature findings (Godschalk et al. 1985) that the major costs in constructing and eventually linking land information systems are in four major categories:

- 1) Investments in hardware and software
- 2) Conversion of data
- 3) Personnel
- 4) Operations and data maintenance

Survey participants reported the following **tangible benefits**:

- 1) Time savings in map production and map updating
- 2) Improved facility management and government administration
- 3) Quicker access to information
- 4) More current information available

TABLE 2.
Land Information by Application Category

	Resource Mgmt	Service Mgmt	Facilities Mgmt	Planning	Land Tax	Administration
Parcel Boundaries	X	X	#	#	#	#
Street Centerlines		#	#	#	#	#
Hydrography	#	X	X	X		
Right of Ways			#	#	#	#
Transportation	X	#	#	#		
Contour lines	#		X	X		X
Subdivision Boundaries			#	#	#	#
Zoned Boundaries		#	X	#		#
Building Footprints		#	#	#		X
Physical Geography	X	X		X		X
Benchmarks, Control	X		#	X		
Sewer Pipes			#			
Utility Poles			#	X		X
Storm Sewers			#	X		
Edge of Pavement			#			X
Easements			#	#	#	
Water Pipes			X			
Spot Elevations			X			
Soils	#					
Parcel Centroids	X	X				
Sidewalks			#			
Manholes			X			
Electric Lines			#			
Gas Lines			#			
Telephone Lines			X			
Other Planimetric				X		
Address Ranges		#				

= 50% or more of organizations in the category use this information
x = 25 - 50% of organizations in the user category use this information

Intangible benefits also were mentioned, but are less quantifiable:

- 1) Improved decision-making
- 2) Improved community planning
- 3) Less time devoted to projects
- 4) Increased spatial modelling possibilities

Survey participants also were asked to respond to a broad question, "Can you provide a rough estimate of the costs necessary to accomplish your mandate in regard to land information?" Responses indicate that approximately 18 mil-

lion dollars will be spent for the management and automation of land information in the region over the next five to ten years. If these dollars are to be spent wisely on automation projects, the need to identify duplicative efforts, and possibly reduce the duplication through some form of LISN, should be important to those spending the money, and those paying the costs.

Data Layer Supply and Demand Several studies suggest

TABLE 3.
Land Information-Oriented Professional Organizations

Northwest Coumputer Aided Mapping Association (NWCAMA)
Washington State Geographic Information Council (WA-GIC)
Northwest Land Information Systems Group (NWLIS)
GPS Users Group
ACSM/ASPRS State Chapter
Research and Data Interest Group, sponsored by PSCOG
Northwest ARC/INFO Users Group, sponsored by ESRI
Northwest Synercom Users Group, sponsored by Synercom.

TABLE 4.
Most Valuable Data Layers to Provide

WA Dept of Natural Resources—PLSS control information
King Co. Tax Assessor—Current parcel-based maps, parcel ID's, and street address linkage, taxpayer name, and assessed value per site
King Co. Planning/LDIS—Plats, building permits and recently rezoned area information
King Co. Dept of Elections—County-wide, up-to-date address based information
King Co. System Services—County land and building characteristics
King Co. Emergency Med Services—Automated "Geocode System" for recording and modelling service management data
City of Everett Public Works—County-wide "base map" for private utilities
City of Everett Public Works—City-wide infrastructure information

that successful LISNs usually develop on an incremental basis (Godschalk et al. 1985; WLRC 1987). High-priority data-sharing arrangements often evolve from immediate needs. High-priority data layers that organizations could provide are presented in Table 4. On the other hand, high-priority data layers that organizations would like to receive from other organizations are presented in Table 5.

Analysis of Tables 4 and 5 is difficult, but some linkage possibilities seem to emerge:

- There is an indication that county tax assessors, elections departments and administrative departments should attempt to create and link digital parcel and address-based information.
- It appears that municipal service-

management organizations (police, fire, and EMS) should join with planning agencies to obtain digital address-based information, as well as population information. The U.S. Census Bureau's "Tiger files" could act as a framework for address-based information.

- Municipal and county public works departments, in conjunction with public and private utilities, should create linkages between infrastructure databases by means of geodetic control to achieve spatial registration, data transfer standards, and common data models.

Technical Issues and Problems.

Technical Issues The study investigated all ongoing land information modernization in the region. Sixty-five projects/pro-

grams/activities, that we characterize as "development phase" are being undertaken within 4 organizations (Table 6). The larger number of development phases than organizations indicates that some organizations are involved in multiple projects, possibly at different stages of development.

It is also interesting to note that a total of 72 percent of the activity is in local government (municipal—46 percent, and county—26 percent). The type of system developments are listed in Table 7. Most are in the planning or design stage, though a large proportion are operational. Thirty-four (85 percent) of the 40 responding organizations say that they already have or are planning to automate their land information functions.

A question about collection units resulted in *parcels* being listed as the most common unit (Table 8). However, only 31 percent of the organizations reported the parcel unit as their most important unit of information collection. These results reinforce the need for a geodetic geo-reference framework, and an LISN's need for linkages capable of dealing with a large variety of possible analysis units. Chrisman and Niemann (1985) also argue that positional overlay is superior using parcel units for data integration.

Technical Problems Although the most difficult roadblocks to LISN development are probably institutional and economic problems, there are also several technical problems that must

TABLE 5.
Highest Priority Data Layers to Receive

WA Dept of Natural Resources —Rural transportation and hydrography
King Co. Tax Assessor —Linkage to county construction and development permit issuance
King Co. Planning/LDIS —Census tract population and housing information.
King Co. Dept of Elections —Direct updates of annexations, jurisdictional and school district boundary changes
King Co. System Services —County levy and bond information in automated form and parcel number-address linkages
King Co. Emergency Med Serv —Population information
Snohomish Co. Public Works —Improved geodetic control
City of Everett Public Works —Snohomish Co. assessor maps
Seattle Police Dept —Up-to-date address-based information
Puget Power —"Land Base" of Puget Sound Region, with land features and geodetic control
Washington Natural Gas —Multi-layer, underground construction map, including all utilities

considered. The respondents cited the following:

- 1) Spatial data transfer
- 2) Digital map compilation
- 3) Methods for creating digital databases
- 4) Need for standards and guidelines

Because the region is served by land information systems from several vendors, spatial data transfer is a problem. A solution to this problem as developed by the Digital Cartographic Data Standards Task Force (DCDSTF 1988) is known as the national Spatial Data Transfer Specification (SDTS).

SDTS "...is an attempt to meet the recognized requirement for easy transfer of spatial data from one spatial data handling system to another with both systems possibly residing on computer hardware and operating software of different makes" (DCDSTF 1988, p. 17). The SDTS was submitted to the National Institute for Standards and Technology in May 1990.

The technical aspect of digital base-map compilation is an area of concern to many organizations that wish to share data. Although a base map for facilities management contains many of the same layers necessary for a base map useful for other applications, some organizations are not willing to pay the higher costs associated with an engineering-quality base map which requires positional accuracy equal to one to five feet (with respect to true measured position on the earth). Yet sharing of data requires that the data be compiled with equivalent positional accuracy. These issues of accuracies can be handled by documenting the needs of organizations and searching for similarity. The paper takes a step in this direction by documenting the range of map-scales used by participant organizations (see Figure 1).

There was nearly unanimous agreement among the surveyed participants on the need for national or at least statewide

TABLE 6.
System Development-By Institution
(Number of reported development phases by organizations within the following institutional frameworks)

Institution	Stages	Reported
National	3	(5%)
State	8	(12%)
County	17	(26%)
Municipal	30	(46%)
Private	7	(11%)
Total	65	(100%)
(Total Participant Organizations = 40)		

TABLE 7.
Type of System Development
in the Region

1) Planning	31%
2) Design	15%
3) Acquisition	7%
4) Implementation	8%
5) Operation	29%
6) Enhancement	10%
	100%
(Total developmental phases included = 65)	

TABLE 8.
Basic Units of Information Collection
(Number and percentage of organizations using each unit)

Parcels	15	31%
Address	6	13%
Street Segments	5	10%
Quarter Sections	6	13%
"Arbitrary" Grid	7	14%
Other	9	19%
Total	48	100%

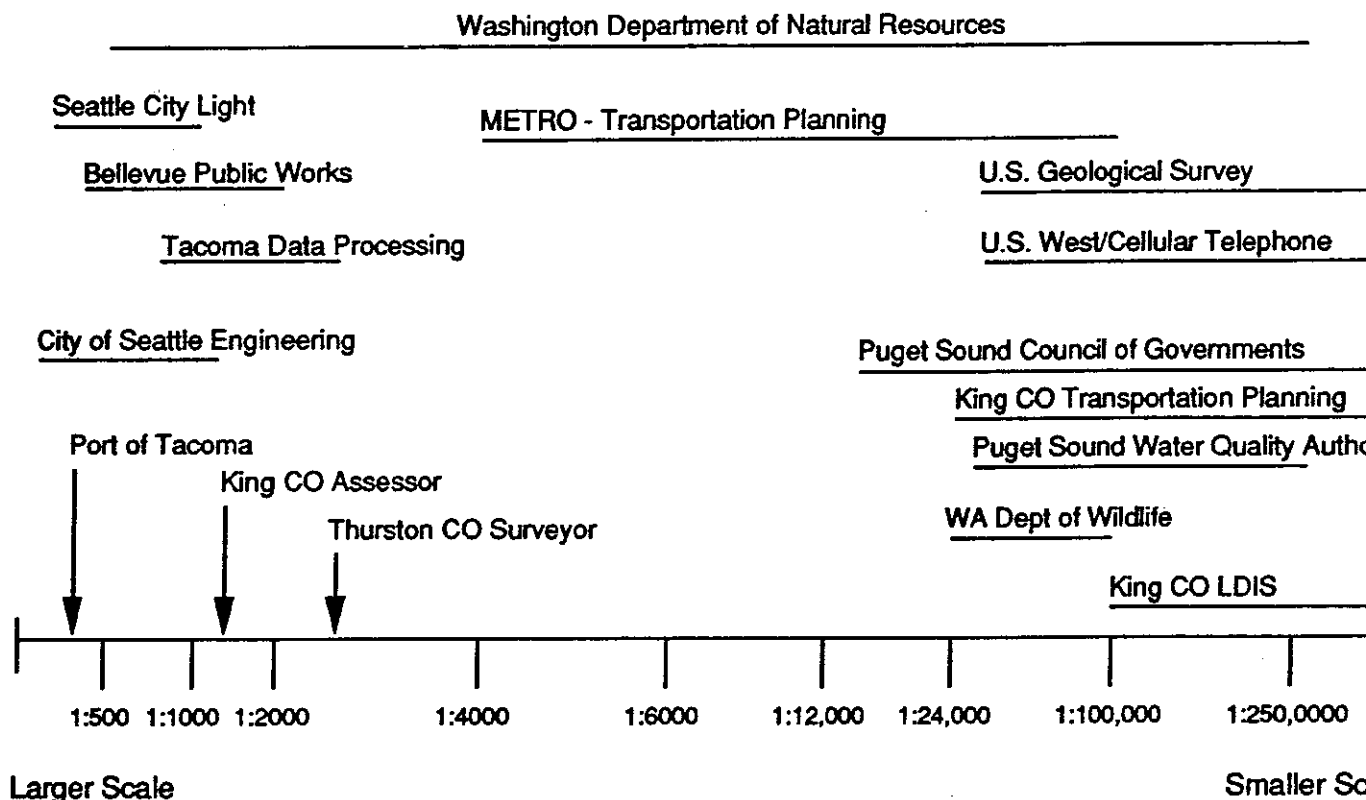
standards and guidelines for digital mapping. The situation in the United States is somewhat paradoxical in that:

...the U.S. is near the bottom of the world list for developing policies and guidelines for large-scale mapping and land records maintenance, ...while at the same time, the U.S. leads the world in the development of the technologies which might

FIGURE 1.
Source Material and Product Map Scales.

Engineering and Assessment

Planning and Resource Management



reasonably be employed to address the problem. (Clapp et al. 1985, p. 3).

Conclusions

The most important conclusion of this study is that there is a large and growing, yet unstructured, interest in sharing geographical information. To accomplish this, there is a recognized need for improved geodetic control in the Puget Sound area. This was documented by a high response ratio to the survey; responses indicate a high level of interest in data sharing.

Yet no single organization is willing to undertake the role of systems integrator.

A solution to contemporary land information sharing problems is the development of a LISN. A LISN approach is decentralized in nature, relying on cooperative arrangements to function. Successful cooperative arrangements usually require information-exchange methodologies where all parties benefit, and no one party is assigned an undue amount of responsibility, without remuneration.

The region has a long way to go before implementing

a LISN based on organizationally independent layers. Although coordinated approaches exist and are expanding at the state and municipal level, only at the very beginnings of a coordinated approach can be found in three (King, Snohomish, and Pierce) of the region's four counties (Thurston being the fourth). Cooperation between public and private sector organizations appears to be quite limited, although interest in public/private ventures is at least being discussed.

Recommendations for Implementation.

This project was conducted to identify the spectrum of problems to be faced and opportunities that are possible if a LISN is implemented in the Puget Sound region. The following recommendations are offered:

No single organization need be created as the "host agency" for coordinating information exchange. Of the agencies involved in this survey, limited budgets are the biggest impediment to creation of a host agency. However, an existing organization must undertake the responsibility for facilitating information exchange.

The identification of such a "focal point" for transmitting land information is essential for the Puget Sound region. Such an organization could also recommend state legislation to insure compatibility. Existing organizations that foster cooperation, such as NWCAMA, Washington State Geographic Information Council and Northwest Land Information Systems Group (NWLIS) may have the potential to take on parts of the role. There is a need for:

- A forum for Land Information Integration ideas to be presented before a cross-section of representatives of the land information community (NWCAMA and WAGI Council).
- A clearinghouse of existing regional digital data along with source, and intended application information (NWLIS). However,

the focus of NWLIS is more on state and federal cooperation, and they have not focused on large-scale and local information coordination.

Existing cooperative arrangements should be enhanced.

Inter-agency committees consisting of public and private sector land information users could focus on developing a "pilot project" illustrating expanded cooperative arrangements. These committees could originate in a professional society.

A cooperative effort should be forged between the National Geodetic Survey (NGS), Washington state Department of Natural Resources (DNR) and the Washington Department of Transportation (DOT) to take the lead in densifying the National Geodetic Reference System. The National Geodetic Survey has a responsibility to assume this task but does not have sufficient funds to do the job alone. The DNR, with a predominantly rural focus, and the DOT, with a more urban focus, in conjunction with the NGS, county and municipal public works departments, and the utilities should all become partners in this effort to improve the geodetic control network.

There is a need to increase the dissemination of information about national standards and guidelines now that they exist. SDTS, GIMS, and Federal Geodetic Control Committee guidelines must be made more understandable and be distributed to regional users. Users need to

become aware of the existence of these standards and then be able to apply the appropriate pressure on vendors that it will take to implement standards and guidelines by means of improved translators and the opening of proprietary formats.

A variety of financing alternatives need to be explored in order to fund LISN development. The use of general funds for aspects of projects that are public goods should be promoted, while user fees should be used to recover costs that can be priced and for which there is a willingness to pay.

There is a need to develop strategies to obtain political support for information integration ideas. Some possible approaches are:

- Promote the need for a more "coordinated" approach to local government as a means to more efficiently deal with problems transcending political boundaries, such as land development, pollution, transportation, crime, and population growth.
- Promote the need for assistance to public officials in making decisions by providing current and comprehensive land information.
- Promote the need for information integration to increase efficiency and effectiveness of day-to-day operations.

Highest priority linkages to be established are probably:

- Tax and parcel information,
- Land use and impact analysis information, and
- Infrastructure information.

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