WASHINGTON CHAPTER OF URISA

ANNUAL PROFESSIONAL CONFERENCE
BELLEVUE INN, BELLEVUE, WASHINGTON

February 7th and 8th, 2002

Table of Contents

At A Glance

Speakers and Brief Abstracts

Locate the date and time for the session to learn more about the speakers and presented topics.

Please note that some papers may not be included in the content of the proceedings and may be available only during that particular presentation. Please contact speakers directly to obtain a copy of the notes and/or handouts. Thank you.

THURSDAY, 7TH

8:45AM TO 9:00AM

PRESIDENT'S WELCOME MESSAGE

By Kimberly Dietz of the City of Redmond, Comprehensive Planning Division

(425) 556-2415

kdietz@ci.redmond.wa.us

9:00AM TO 12:15PM

KEYNOTE SPEAKERS

Kenneth Dueker of Portland State University shares "Edgar Horwood and URISA: URISA's Role in the Evolving Forms of Geographic Data"

Michael Renslow of Spencer B. Gross, Inc. presents "The Usefulness of LiDAR for GIS Applications"

12:15PM TO 1:15PM

BUFFET LUNCH

1:15PM TO 2:45PM

YARROW POINT

Strategic IT Planning in a Medium-Sized Public Utility by Dick Thomas of Sammamish Plateau Water and Sewer District and Steven Sonnen of Pacific Technolgies, Inc.

HUNT'S POINT

SnoCan: Sharing Transportation Improvement Information, a joint presentation by Chris Hansen of Terralogic, Dan Rude of Perteet and John Davis of Snohomish County

EVERGREEN POINT

Demonstrations by Triathlon, E-Terra and GeoNorth

NEWPORT

Working with ArcGIS Developer Samples by Jeff Barrette of ESRI

MEDINA

King County Transportation Network Development Efforts and Maintenance Consortium by Michael Berman of KCDOT, A Conceptual Framwork for Real Estate Development in Urban Models by Summer Adamietz of Foster Wheeler Env. Corp., and Field Data Collection and Inspection Using PDA's and GPS by Anton Kozhevnikov of Pierce County

SAHALEE

Dr's. Office with Lizard Tech

2:45PM TO 3:00PM

BREAK

3:00PM TO 4:30PM

YARROW POINT

EOC Management with GIS by Buzzard, Applications of GIS in Emergency Management by Jaime Crawford of ESRI

HUNT'S POINT

The Role of IS in Wastewater by Edward Speer of CDM, Inc., Inflow & Infiltration: How KC GIS is Helping Make Our Sewer System More Efficient by Mary Barrett of KCDNR, Enterprise GIS for Utility Based Organizations by John Joseph of eTerra

EVERGREEN POINT

Demonstrations by GeoNorth and Lizard Tech

MEDINA

Digital Imaging Platform: Is There a DIP In Your Future by Roger Chapell of WST2 Center, Complimenting Off the Shelf LiDAR Data With Traditional Photogrammetry by David Brown of Walker and Associates, Comprehensive Land Cover Mapping: High and Low Resolution Multi-Spectral Imagery by Kristin Gerhart of Marshall and Associates, Inc., Location Based Image Database for Trees and Plants by Rex Sandwith of Living Database

THURSDAY EVENING, 7TH

5:00PM TO 10:00PM

RECEPTION/MAP CONTEST IN HUNTS POINT AND EVERGREEN POINT

FEMA Region X GIS and Hazus by Joe Toland and Tim Rood of FEMA.

Bill Gentes of URISA Headquarters to discuss the Proposed Professional Certification Program for GIS

Sponsor & Vendor Activities

Hor d'oeuvres and no-host bar

FRIDAY, 8TH

8:00AM TO 9:30AM

YARROW POINT

Tracking Sex Offenders On-Line by Jared Erickson of Pierce County, GIS Infrastructure for Crime Analysis by William Brodie of The Brodie Group Inc., and Mapping the Macabre: GPS Tailing and GIS Analysis of Child Murder & Serial Killer in Spokane by Ian Von Essen & John Bottelli of Spokane County GIS

HUNT'S POINT

Cadastral Development Workshop by Zollman and Schrock

NEWPORT

Remote Sensing & Imagery by Eugene Martin of CommenSpace

MEDINA

GIS Needs Assessments and Implementing Plans for Local Governments by Amanda Taub of Douglas County, The Interdisciplinary Consortium, A New Cooperative Model for GIS by Jerry Harless of Puget Sound Regional Council, and Coming to Grips with Parcel Tabular Data by Karl Johansen, c/o City of Kirkland

9:35AM TO 11:05AM

YARROW POINT

King County GIS Reorganization for Success—2002 Update by Greg Babinski, Arnold Waters, Greg Stought, and Dennis Higgins of KCGIS

HUNT'S POINT

Cadastral Development Workshop by Zollman and Schrock

EVERGREEN POINT

Demonstrations by E-Terra, Triathlon and Marshall and Associates

NEWPORT

Introduction to the Geodatabase Data Model by Jeff Barrette of ESRI

MEDINA

Crystal Mountain DEIS by Christopher L. Denton of SE Group, GIS for Conservancy by McCoy, and Bellevue Streams GIS/GPS by Deborah Napier of City of Bellevue

11:05AM TO 11:15AM

BREAK

11:15AM TO 12:15PM

YARROW POINT

Projection Management by Jennifer Landaas and David Spalding of Roy F. Weston, Inc., and Correcting The Spatial Accuracy of a Land Base by Jurek Kolman and Chris Schaefer of ESU

HUNT'S POINT

Development and Implementation of a Water Main Shutdown Notification Application by Keith Palmer of Roy F. Weston, Inc., and Integration of GIS Data and Tools in Water Distribution System Modeling by David Stangel of CH2M Hill

NEWPORT

Applying Internet-Based Technologies to Create a GIS/Document Management System by Gregg Selby and Keith Anderson of Roy F. Weston, Inc.

MEDINA

Using DHTML Techniques in Conjunction with Raster Based Web Services by Paul Miller of Carter & Burgess, Inc., and Implementing a Successful Local Government ArcIMS Site at the City of Albany, OR by Marshall and Associates, Inc.

12:15PM TO 1:15PM

BUFFET LUNCH

HAZUS: FEMA's Loss Estimation Model Discussion and Demonstration by Ed Quarles of Washington State EMD

1:15PM TO 2:00PM

PRESIDENT'S MESSAGE AND ASSOCIATION'S PRESENTATIONS

Glenn Brook and Lisa Stuebing share their message for the upcoming year with respect to Chapter goals, programs and highlights.

Steve Rush on the GITA Association

Tjaart Van den Berg on the British Columbia Chapter of URISA

2:00PM TO 4:00PM

HOT APPLICATIONS AND WEB DEMONSTRATIONS

Bellevue MapGuide—"Mapster" True-Life Stories of Rapid Application Development Methods in Intranet GIS by Brook Durant of City of Bellevue, GIS Day 2001 Video by Nicole McCoy of Kittitas County Conservation District, Implementing a Successful Local Government ArcIMS Site at the City of Albany, OR by Marshall and Associates, Inc., School Bus Dispatch with GIS for Central Valley School District by Deb Holmes and Susan Silva

President's Welcome and Message

Welcome to the 2002 Annual Conference of the Washington Chapter of URISA.

In this, the 40th anniversary year of the International URISA association, we are truly excited to offer today's event to you as a celebration of this chapter's continued success and growth.

While events and economics may not allow the numbers to fully and accurately represent themselves on paper and in attendance this year, we know from experience, communication with each of you and in demonstrated enthusiasm that this chapter is moving in positive directions and will continue to do so with your support and encouragement.

Many words of appreciation should be shared for the 2001-2002 calendar. First and foremost, the Executive Board made up of Glenn Brooks, Lisa Stuebing, Rick Lortz, Mike Onzay and myself have volunteered endless hours, including a few weekends, to bring to you a powerful and valuable message through events such as this conference, the Autumn Workshop, the Chapter Web Site and newsletters. I send sincere graciousness to each of the Executive Board Members for their time, perseverance and kindness in support of this association.

As Glenn and Lisa embark on the path of leadership, I wish them thoughtful encouragement so that they may continue to utilize their creativity and partnership in a nurturing manner while providing innovative methods for sharing the educational goals of the Chapter.

As well, we offer a very special word of thanks to our sponsors and vendors from 2001-2002. Their continued support allows for the full array of services that this association provides and hopes to expand throughout the coming years. To share this message and to show your appreciation of the sponsors and vendors, please join us this evening for the first mid-conference reception of this association. We hope that you will spend a few minutes at the vendor booths so that you may get to know the energetic personalities and friendly smiles that reside on the other end of the phone line each time you work with these organizations.

We also wish to specifically thank Karen Zollman of URS Corporation. Karen continues to support this association by sharing educational instruction, referrals, and professional guidance. On Friday, February 8th, Karen will partner with Gavin Shrock of the City of Seattle to provide another educational series on Cadastral Development. Hopefully, you will have an opportunity to attend this session or to meet with Karen individually during this conference.

And, a heartfelt word of appreciation for his thoughtful words, his dedication of time and energy and for his distant travels, we offer to Bill Gentes of URISA Headquarters. We have found ourselves truly inspired from the time that we spent in getting to know Bill and in utilizing his creative approaches to Chapter management. Thank you Bill for moving URISA and the regional chapters in a new, positive direction that the membership will benefit from for many years to come.

Finally, the entire Executive Board wishes to thank each of you. Without your encouragement, suggestions, and even small doses of time throughout the year, this association would not be experiencing it's current success. Wonderful examples of your support are demonstrated during Central Puget Sound User Group Meeting at which WAURISA is always considered and offered time for announcements and sharing.

We sincerely thank you all for continuing to participate as a member of Washington URISA and look forward to serving you for many years into the future.

And, I hope to cross your path again very soon in this enriching community we all know as GIS.

With Warmest Regards,

Kimberly S. Dietz
Chapter President 2001-2002

Keynote Speakers

Edgar Horwood and URISA: URISA's Role in the Evolving Forms of Geographic Data

BY KENNETH J. DUEKER OF PORTLAND STATE UNIVERSITY

Introduction

Typically, persons drawn to URISA live outside the box, they are misfits in the world of single-purpose or stovepipe systems. They are dreamers or schemers who promote more crosscutting systems and solutions, as was the founder of URISA, Edgar Horwood, He was a maverick. He envisioned URISA as an interest association of geographers, planners, public administrators, and data processors, rather than a professional society overly focused on accreditation.

Within this heritage, URISA members have been at the forefront of efforts to shift from layer-based computer-aided drafting and design (CADD) systems for computer-aided mapping to topologically-structured data and polygonal data to support spatial analysis. Similarly, another paradigm shift is underway, as we move away from spatial objects toward real-world objects that may have multiple spatial representations.

The shift is from geometry or linework to spatially-enabled databases is occurring as we move from project-oriented GIS applications to on-going Information Technology programs. The development of framework layers for the NSDI is confronting a tradeoff of spatial accuracy with a focus on the "best available (linework) data" and temporal accuracy with a focus on a transaction-updating of transportation objects.

My presentation will draw on experience with the development a Transportation Framework in the states of Oregon and Washington. Conflation of spatial data from various sources is proving problematic, as is integrating segment-oriented databases, and enriching already integrated databases, such as TIGER. Finding the appropriate vehicle for the sharing of transportation data is a challenge that I will explore.

URISA: The Horwood Legacy

Edgar Horwood, Professor of Civil Engineering and Urban Planning at the University of Washington, was instrumental in the founding of URISA in 1966. This founding followed several short courses in computer applications in urban planning held in 1962-1965, and several Urban Planning Information Conferences held in 1963-1966. Initially, the conferences targeted alumni of the short courses for follow-up education and discussion of issues in applying computers to urban planning.

The application of computers to urban planning began in 1961 with a Community Renewal Plan (CRP) project in the City of Spokane, and a software development project at the University of Washington. The CRP created a demand for analysis and mapping of 1960 Census of Population and Housing data, and the creation of a parcel-level database. The software development process responded to these needs. A suite of four programs was programmed in Fortran for the IBM 709 computer. The first two programs were designed for small data sets of 10 to 100 areal units for mapping data at the census tract level. The second two programs were designed for large data sets of 1000 to 10,000 areal units, represented as points for mapping data at the census block level.

The first two programs were called the ARRAY and the CARD MAPPING. The ARRAY program rank ordered values for a census tract variable and drew for each tract a bar proportional to the value of the variable. These arrays were used to identify natural breaks in the data that were used to establish ranges for mapping of census tract data using the CARD MAPPING program. The CARD MAPPING program produced a choropleth map using standard printers. Users specified parameters to select variables from the punch cards and performed calculations to produce arrays and maps.

The second two programs were called the DISTRIBUTION and the TAPE MAPPING. The DISTRIBUTION program served to aid in the identification of mapping ranges for a larger number of observations. The TAPE MAPPING program produced symbol maps to represent the value ranges for census block data.

Horwood was an early requester of digital data from the Bureau of the Census, which led to heavy involvement of Census in URISA and in the development of the their data user access program. But in 1961 the census block data were not yet published, not did Horwood want to keypunch the data again. So he requested from the U. S. Bureau of the Census the Spokane block data. What he received was data on a magnetic tape in a UNIVAC code that was unreadable on the IBM 709. Consequently, he was forced to invest heavily in time and resources to convert the data for use by the DISTRIBUTION and TAPE MAPPING programs.

Clark Rogers, Arnold Rom, and Bill Clark were key players in the development of the software, data, urban planning application, and supporting educational program. Arnold Rom wrote the four programs, Clark Rogers took the lead on the application and education

components, and Bill Clark decoded the tapes from the Bureau of the Census. Clark Rogers and Bill Clark were also principal instructors with Horwood in the offering of a short course in Los Angeles in 1962, several offerings in 1963, Pittsburgh, Berkeley, Evanston, New Haven, and the first conference in Los Angeles. Clark Rogers left for the University of Pittsburgh in 1963 and Ken Dueker joined Horwoods staff. In 1964 Horwood conducted a month long summer institute version of the short course that was supported by the National Science Foundation. Also in 1964 Clark Rogers organized the next conference on Urban Planning Information Systems and Programs in Pittsburgh. In 1964 Dueker moved to Northwestern University where he and Bill Garrison organized the 1965 conference. Horwood and Dueker also conducted the last of the short courses at the University of Michigan in 1965.

During this period there was a shift in emphasis from software development with a supporting educational program aimed at the planning community, to the provision of analytical services. First, it was recognized that the short courses were insufficient to get people up and running, and several requested follow-up assistance. Performing this function proved difficult within the University and Horwood, Bill Clark, Ken Dueker, Charles Graves, and Hugh Calkins formed a firm called Applied Computer Research Corporation to service out-of-state clients. This thrust precluded further development of the four programs and their porting to new platforms, such as the IBM 360. Others did not pick up and develop the software because Horwood and Bill Clark did not want to lose control by release of the source code. Consequently, the initial software development and training program thrust lost momentum and Horwood moved in the direction of new software developments, such as the Street Address Conversion System led by Bob Dial, and its application at the National Capitol Commission in Ottawa and the Dominion Bureau of Statistics (now Statistics Canada).

While Horwood shifted attention from improving mapping software to address computer applications to support planning and administration, and institutional issues of adapting to new technologies, Howard Fisher, who attended the 1963 short course in Evanston assumed the challenge to develop a better card mapping program. In 1964 Fisher released the first version of SYMAP that extended choropleth mapping to contour mapping and used overprint characters to produce solid map symbols. In 1965 he moved from Northwestern University to Harvard where he established the Harvard Computer Graphics Laboratory. Fisher released the source code and emphasized software R&D. ArcInfo descends from the Harvard R&D program.

Horwood authored a paper that is published in the Proceedings of the Third (1965) Conference on Urban Planning Information Systems and Programs titled, Association Needs for the Urban Information Systems Field that called for the creation of what was formed in 1966, the Urban and Regional Information Systems Association. He patterned URISA after the Regional Science Association, an inclusive interest association, not an exclusive professional society overly concerned with credentials.

It is instructive to review the tables of contents of early proceedings to understand the range of issues addressed. Unfortunately, there were no published proceedings for the first conference in 1963, although there was a presentation by Ed Hearle on urban data banks that stemmed from his work at the RAND Corp. that called for the use of parcel-level data for planning and management. The 1964 proceedings contain a number of papers that examine various aspects of information requirements of the then emerging land use models. The 1965 proceedings introduce applications of remote sensing to urban analysis and stress the importance of small area data, and a landmark paper by Nathan Grundstein on Urban Information Systems and Urban Management Decisions. The 1966 conference was where URISA was formed. The 1967 proceedings reflect a high degree of involvement of the Bureau of the Census in terms of digital data access, and the application of small area data in the Census Use Study in New Haven, led by Caby Smith, and staffed by George Farnsworth, Don Cooke, Bill Maxfield, and George Leyland. The 1968 conference is of note for originating the USAC project of integrated urban information systems.

After serving as URISA'a first president Horwood encouraged his students, Clark Rogers, Ken Dueker, Hugh Calkins, and Charlie Barb to play leadership roles in the Association. Actually, he had a broad interpretation of "his students" and many considered him a mentor. He had a major impact on the association, and he was more amused than disturbed by the constant struggle for leadership and power within the organization between the data processing and public administration interests of USAC and the spatial analysis interests of Census and planners that occurred throughout the 1970s.

This struggle for power in the organization was defused somewhat by the creation of special interest groups (SIGs) that allowed for diversity of interests. Charlie Barb was particularly influential in this regard as he was responsible for organizing several SIGs, geocoding, education, and microcomputers.

Meanwhile, Horwood was being pulled in various directions, but he relied on students as extenders to enable him to pursue many interests simultaneously. While Charlie Barb and Hugh Calkins were his urban and regional information systems extenders at the UW in the late 1960s and early 1970s, He had other students working in transportation planning software development, Bob Dial, Matt Rapp. He was also evaluating rail transit proposals for the World Bank and revising the undergraduate engineering curriculum. He entrusted his students with responsibility and enjoyed watching them grow in the process.

Charlie Barb writes that

> "Ed's influence upon URISA and the field (was) his personality, intellect and off-center insight. He was so big that there was a recognizable "Horwood School" that we and many others were proud members -- how may people have such an impact, influence or point of view. There were his memorable baffoonish antics, like hiding under the head table at a URISA conference while he was being introduced -- he really lacked conventional pride and a preoccupation with self-importance.

While preparing an eulogy for Ed at a memorial held at the University, I asked other students who had worked with him what set him apart. Mat Rapp'scomment was the most insightful and memorable: his compassion -- which, in its unique paternalistic fashion, was what set him apart and endeared him to his students. He was a gold standard "professor" and I think that we knew it. (He was a) creative intellect. A characteristic of it was his simultaneous grasp of an issue or topic from multiple perspectives, including the reverse. He was a great challenge to conventional wisdom and politically correctness. During his years, there really wasn't anyone in URISA that commanded his respect and at the same time, affection. He needs to be described to the URISA membership from this human perspective because there are so many in URISA past and present that still miss him, a person who, uniquely, is missed -- these 16-17 years after his death. I hope you can some way include these dimensions into the meaning of Ed Horwood to URISA." (Barb, Charles, e-mail to Ken Dueker, December 27, 2001)

Many remember Horwood's Short Laws of Data Processing and Information Systems.

1. Good data is the data you already have.
2. Bad data drives out good.
3. The data you have for the present crisis was collected to relate to the previous one.
4. The respectability of existing data grows with elapsed time and distance from the data source to the investigator.
5. Data can be moved from one office to another but it cannot be created or destroyed.
6. If you have the right data you have the wrong problem and vice versa.
7. The important thing is not what you do but how you measure it.
8. In complex systems there is no relationship between information gathered and the decision made.
9. Acquisition from knowledge is an exception.
10. Knowledge flows at half the rate at which academic courses proliferate.

As suggested by Horwood's Laws and the quote from Charlie Barb, he loved to poke fun at people who took themselves too seriously. Yet, he undertook to create a serious interest association of professionals, but not a professional society. He defined a professional society as one who was more interested in keeping people out, by accreditation. I wonder what he would say about the debate about accreditation of GIS professionals?

He would engage in such a debate with insights and humor that would cut to the heart of the issue. Although he was concerned with "charlatans" in the field, he preferred to unmask them with challenges and ridicule. He appreciated good work and was quick to praise it. Similarly, he was quick to challenge sloppy work and thought; sometimes by interruptions with humorous comments.

Horwood would be a strong proponent of metadata and the NSDI spatial data infrastructure concept. However, he would be critical of associated hype and claims. He would be suspicious of the strong federalization of spatial data infrastructure. He would be a proponent of fostering local governments to develop enterprise-wide data models. Consequently, I am going to move to present an approach for spatial data infrastructure that he would approve (I am still seeking the approval of my major professor).

The following section describes an approach to the Transportation Framework that stresses update and maintenance that involves local government to make it more response to the needs of local government. The development of framework layers for the NSDI is confronting a tradeoff of spatial accuracy with a focus on the "best available (linework) data" and temporal accuracy with a focus on a transaction-updating of transportation objects that will make it more useful to local government.

The Transportation Framework Concept

Figure 1 is an illustration of the component parts of the Transportation Framework (Roads) and its inputs and outputs. There are two major components of the Transportation Framework (Roads). The first, labeled A, is a complete, consistent, and current representation of Roads, and the second, labeled B, is a Clearinghouse of new or changed Roads. The diagram illustrates the compiling or building from GIS source material to create the initial Roads database. This database could be updated quarterly or annually from the data collected in the interim from the Clearinghouse. In addition, there would be check-out procedures for more extensive and complete upgrading for selected regions as warranted. This complete representation of the Road system would be of use for GIS analysis by organizations who wish to use road data, but who do not want to maintain a roads database. On the other hand, there are organizations that want to maintain one or more roads databases for their region of interest, but who find it difficult to obtain current data from other organizations that are responsible for maintaining roads within the same region. These organizations need only query the Clearinghouse for jurisdictions within their region of interest, for transportation feture types of interest, and for thetime period of interest, a more direct way to obtain data on roads that are new or have undergone change. The diagram shows how transportation organizations input data to the Clearinghouse for new and changes to roads for which they are responsible. At the same time they are users of the Clearinghouse for new or change to roads that are maintained by others within their region of interest. Figure 2 illustrates this exchange of data more clearly.

Figure 1. Building and Maintaining the Transportation Framework (Roads)

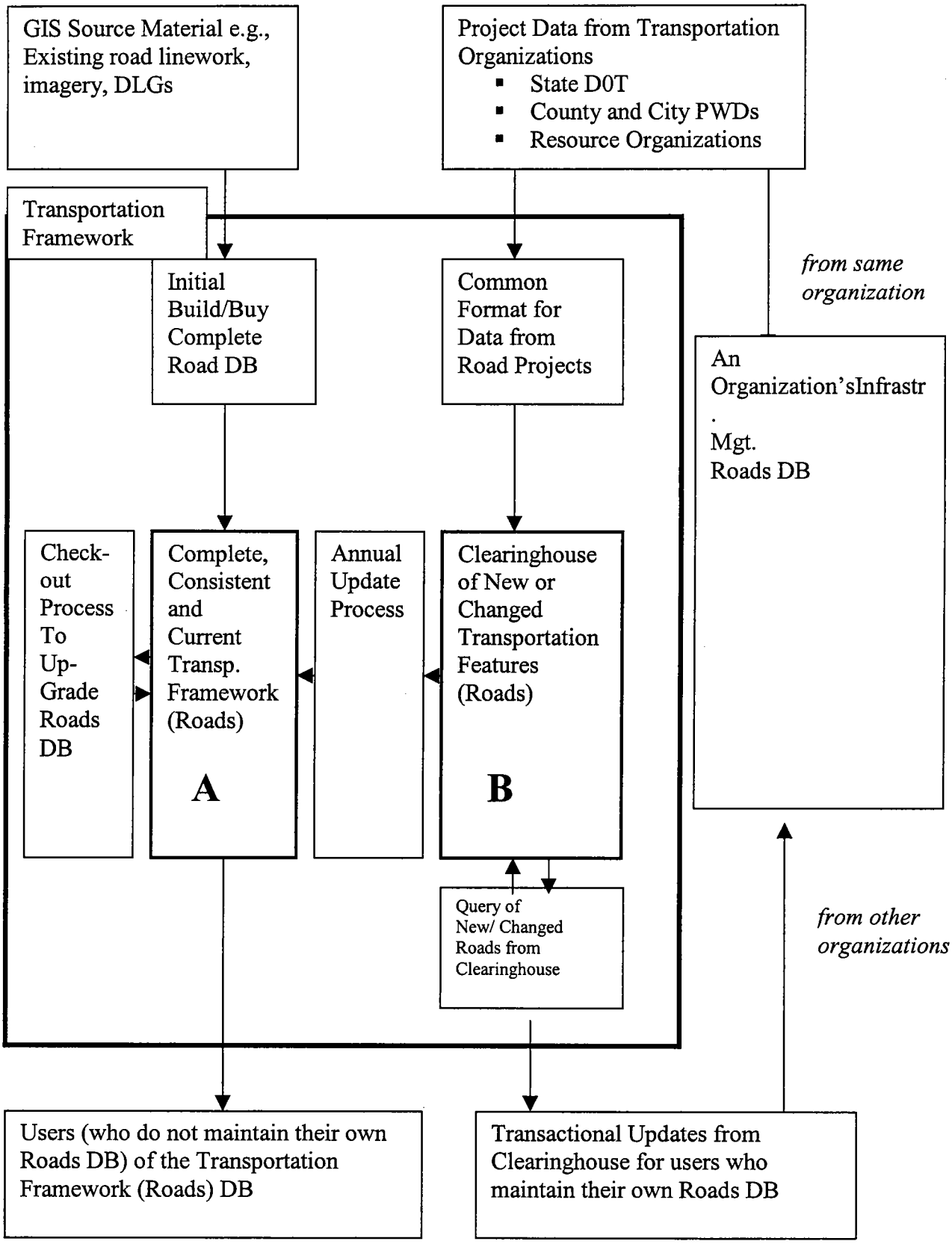


Figure 2 illustrates the user community for the Transportation Framework (Roads) by an example for King County, WA. Some of the organizations within King County that own and maintain roads are listed. They provide data to the Clearinghouse and to other parts of their own organization on roads they have built or changed by means of projects, work orders, or permits. In addition, they withdraw data from the Clearinghouse for roads within their area of interest that have been built or changed by actions of other road organizations. Similarly, there are organizations such as PSRC, and private road database vendors, such as GDT and Thomas Bros., who maintain road databases, but who do not maintain roads. Also, there are organizations who maintain neither roads nor road databases, but who need a roads database for GIS analyses. IRICC falls into this category. E911 emergency dispatch organizations are a special case. If road updates from the Clearinghouse are timely enough to meet their needs they could be a potential user of the clearinghouse. If not they might be a contributor of data for new roads, particularly if the reporting of road data from transportation organizations is not well recorded or reported.

Given that there are so many projects, permits, and work orders, there is a need for a design of a "transaction" that would be used to update transportation features. The transaction should have before and after values to facilitate the measurement and reporting of change. The before value could come from the Roads database or from field measurement in the case where the Roads database has not been build yet or if it is out of date. The format of the transaction would look like:

Transportation Feature ID:
From MP:
To MP:
From Surf date:
To Surf date:

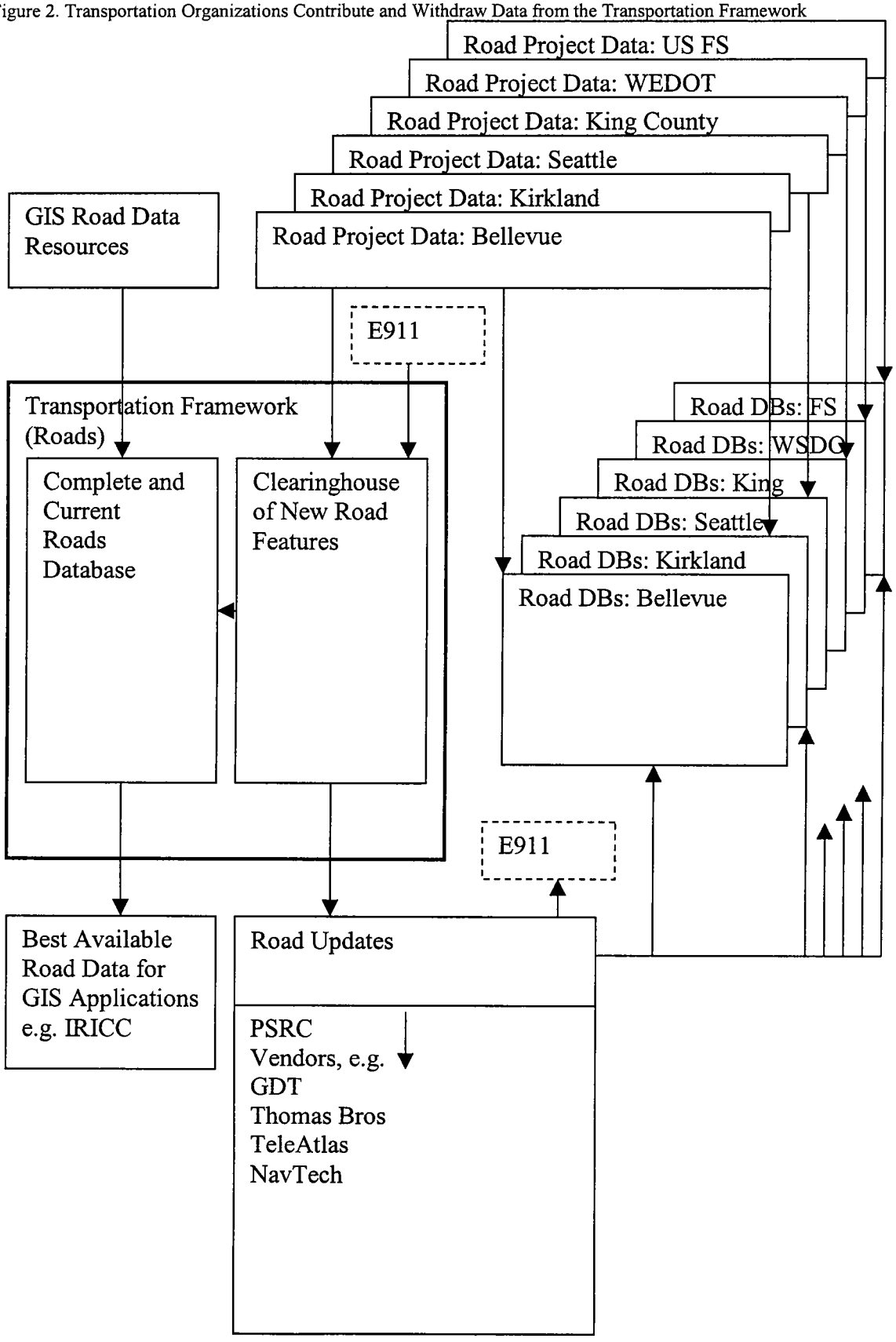
Transportation Feature ID:
From MP:
To MP:
From Lanes Add Direc: 2
To Lanes Add Direc: 3

In addition, there needs to be a typology of transactions. Each type will have a routing to serve as updates to different databases

In Conclusion

Edgar Horwood loved to confront and test the conventional wisdom. If he were here today he would challenge the proponents of accreditation, NSDI, Smart Growth and the assumptions upon which the concepts are based. Most of all he sought to make computer-based analysis and the data upon which it is based, an open and honest process.

Figure 2. Transportation Organizations Contribute and Withdraw Data from the Transportation Framework



The Usefulness of LIDAR for GIS Applications

BY MICHAEL RENSLOW OF SPENCER B. GROSS, INC., PORTLAND, OREGON

Presentation Outline

- Background of LIDAR
- Brief Technical Description
- Quality Control/Assurance Procedures
- LIDAR Data Characteristics
- Processing for First Surface & Bare Ground
- Data Sets & Applications
- Questions and Discussion

Please refer to included slides on following pages.

The Usefulness of LIDAR for GIS Applications

Annual WA URISA Conference

Mike Renslow - Spencer B. Gross, Inc.
Photogrammetric Engineering

PRESENTATION OUTLINE

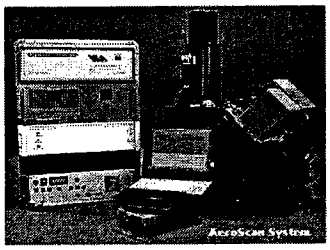
- Background of LIDAR
- Brief Technical Description
- Quality Control/Assurance Procedures
- LIDAR Data Characteristics
- Processing for First Surface & Bare Ground
- Data Sets & Applications
- Questions and Discussion

BACKGROUND

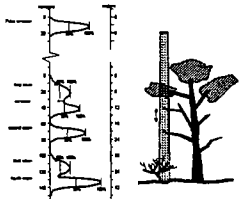
- LIDAR (Light Detection And Ranging)
  - 30 Year Old Technology
  - Became Cost Effective Very Recently
- System Components
  - Laser Scanner, ABGPS, IMU, Precise Clock (Multiple Planes of Reference)
  - Robust Computer Support
  - Requires Calibration (Bore Sighting)

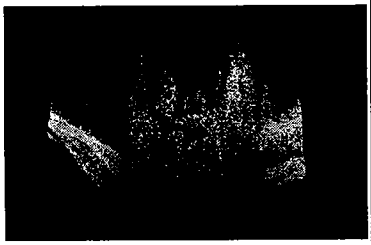
BACKGROUND

- Capacity to Capture Multiple Return Values / Pulse
  - Derive many, many X, Y, Z Values
  - Remarkably Large Data Files
- Accuracy
  - Standard Deviation 7-10 cm Consistently
  - Vertical RMSE at 15 cm on Discrete Points
  - Horizontal Accuracy at 2X the 'Footprint' Size



Multiple Return Schematic





POINT CLOUD OF ALL LIDAR POINTS IN DOUGLAS FIR FOREST

LIDAR &Terrain Interaction

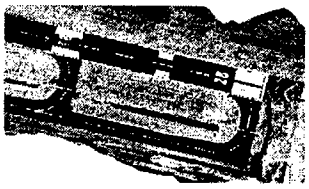
- For example; a calm still lake, will only reflect energy back within a few degrees of the nadir beam of the laser.
- A "wavy" lake on the other hand, will reflect energy back from wider incident angles.
- Diffuse surfaces (ground or tree) reflect energy back omnidirectionaly.

Returns Over Water

Reflectivity Examples

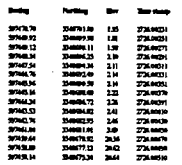
– White Paper	up to 100%
– Snow	80-90%
– Beer Foam	88%
– Toilet Paper	60%
– Deciduous Trees	typically 60%
– Coniferous Trees	typically 30%
– Dry Sand	57%
– Wet Sand	41%
– Asphalt with Pebbles	17%
– Black Neoprene	5%

Laser Intensity Return



LIDAR Data Sample

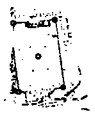
- Simply put, a set of x,y,z ASCII points
- We might also have an 'Intensity Map' of an area



DATA COLLECTION - QC/QA

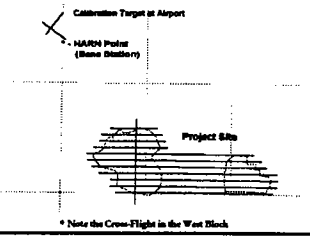
- Well-Defined Flight Plan
  - Flight Lines, Field of View, Scan Rate, Design Post Spacing of Points
- Base Station Referencing
  - Perform GPS Check Survey, File Report
  - Careful Placement of Initialization Stations
- System Performance Verification
  - Check the Bore-Site Calibration On-Site
  - Have or Perform a Ground Check-Survey

The Importance of Calibration

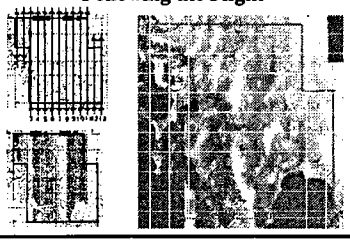


- Control points on a building and other regularly shaped surfaces are acquired
- Results of calibration flights compared to control points to correct for:
  - edge curl
  - pitch
  - timing issues (GPS, IMU)
  - other system biases

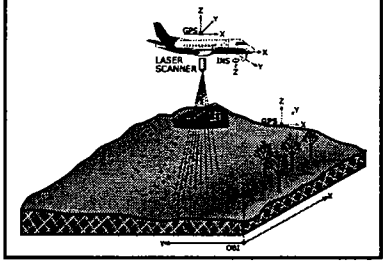
Bore Sight Validation



Verification of LIDAR Coverage Following the Flight



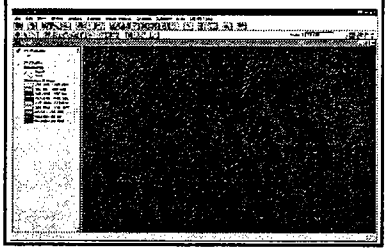
LASER SCANNING



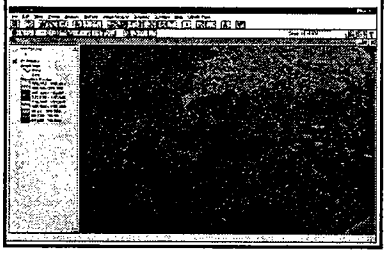
DATA PRE-PROCESSING

- Differential Correction of Data Points
- Remove Noise
- Format Multiple Return Data Sets
- Verify Coverages (Points are Geo-referenced)
- Check Accuracy Against Known Data
  - Existing or New Survey Data
- Archive Data to CD-ROM
- Prepare a 'Report of Survey'

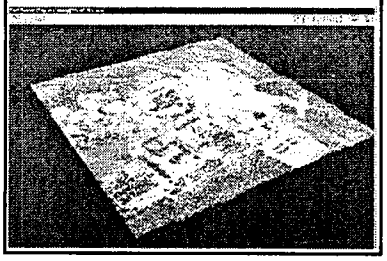
Raw LIDAR Points



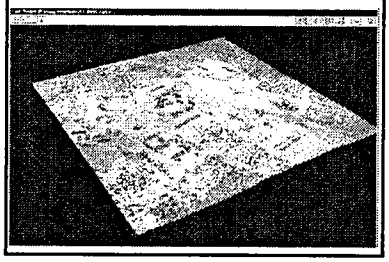
TIN surface of Raw LIDAR Data



'Raw' FIRST Return LIDAR Data



Raw LAST Return LIDAR Data



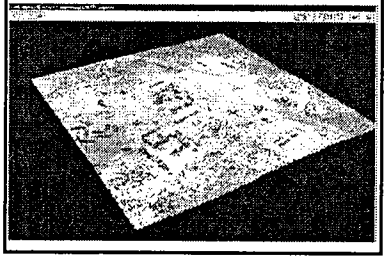
Automatic Vegetation Removal

- Automatic programs begin the noise and vegetation removal process
- These remove approximately 80% of vegetation (depending on the land cover and terrain characteristics)
- This typically uses about 20% of the vegetation removal time budget

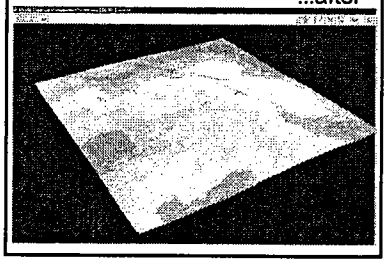
Trend Surface Analysis

Green Points = Vegetation Brown Points = Trend Surface

Before



...after



Manual Editing

- Final vegetation and feature removal requires manual intervention.
- Custom selection routines are used in ArcView to analyze the data and identify target points.
- Accurate interpretation of the LIDAR data requires supporting imagery.
- Removal of the remaining 20% of the vegetation and features will account for about 80% of the time budget