Northern Exposure! The Awesomeness of Managing the Minnesota DOT’s Statewide LRS

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Yes! Minnesota has moose!
Florida has alligators!
Both have golf!

Question: Which would you rather run into on a golf course???
Minnesota is snowy!

77” of snow
39” in February alone!
Minnesota is a kinda BIG!

LRS Team manages the statewide road layer
- ALL the roads in MN
- 139,500 Centerline Miles
- 287,000 Lane Miles
- Most important dataset!
And diverse!
And diverse!

- Lakes
- Iron Range
- North Shore of Lake Superior
- Big Rivers
- Coulee Region
- ???
Statutory Routes

Article 14 grants authority to own highways

First 70 routes defined (Constitutional Routes) cannot be severely altered/eliminated

Highways may not exceed 12,200 centerline miles

Exceptions for situations like the American Recovery & Reinvestment Act (ARRA)

Legislative routes may be altered by Legislature

ARTICLE XIV
PUBLIC HIGHWAY SYSTEM

Section 1. Authority of state; participation of political subdivisions. The state may construct, improve and maintain public highways, may assist political subdivisions in this work and by law may authorize any political subdivision to aid in highway work within its boundaries.

Sec. 2. Trunk highway system. There is hereby created a trunk highway system which shall be constructed, improved and maintained as public highways by the state. The highways shall extend as nearly as possible along the routes number 1 through 70 described in the constitutional amendment adopted November 2, 1920, and the routes described in any act of the legislature which has made or hereafter makes a route a part of the trunk highway system.

The legislature may add by law new routes to the trunk highway system. The trunk highway system may not exceed 12,200 miles in extent, except the legislature may add trunk highways in excess of the mileage limitation as necessary or expedient to take advantage of any federal aid made available by the United States to the state of Minnesota.

Any route added by the legislature to the trunk highway system may be relocated or removed from the system as provided by law. The definite location of trunk highways numbered 1 through 70 may be relocated as provided by law but no relocation shall cause a deviation from the starting points or terminals nor cause any deviation from the various villages and cities through which the routes are to pass under the constitutional amendment adopted November 2, 1920. The location of routes may be determined by boards, officers or tribunals in the manner prescribed by law.
1992-1994

+40 Feet

Dates ranged from the 1950’s on

Using corners as control
1992-1994

4x5 Digitizing Tablet

Dual Screen CAD
1994-1996

- Porting of CAD to GIS
- Stitching together of quadrangles
- Edge Matching
- Creation of routes on trunk highway system
- Plotting of Events from Transportation Information System (TIS)
1996 – BaseMap 1.0
MnDOT chooses ESRI Roads and Highways to manage state-wide Linear Referencing Systems

- Several years of implementation –
- 2014 - Frozen SDW Data
- 2016 – Fully deployed in production
- 2016 - Status plus backlog years to update
- 2017 – SDW was implemented to consume LRS (central repository for MnDOT Data)
- 2017 – Business System Integration began
- 2018 – Data to Minnesota Geospatial Commons
- 2018 – All local status information updated
2010 - Present

Still dealing with some of the decisions. +-40 ft... but it is a model.
Dynamic Segmentation

• If you have tabular data that is calibrated then you can map it to the Routes.

<table>
<thead>
<tr>
<th>Route</th>
<th>From</th>
<th>To</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>I-90</td>
<td>0.000</td>
<td>0.500</td>
<td>Bit(Black)</td>
</tr>
<tr>
<td>I-90</td>
<td>0.500</td>
<td>1.500</td>
<td>Conc(Yellow)</td>
</tr>
<tr>
<td>I-90</td>
<td>1,500</td>
<td>2.000</td>
<td>Bit(Black)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Route</th>
<th>At</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>I-90</td>
<td>0.250</td>
<td>Crash1(Square)</td>
</tr>
<tr>
<td>I-90</td>
<td>1.100</td>
<td>Crash2(Triangle)</td>
</tr>
<tr>
<td>I-90</td>
<td>1,750</td>
<td>Crash3(Circle)</td>
</tr>
</tbody>
</table>
Length & Calibration

True Miles

View from the side:

0.000

Cartographic Length

View on map:

0.000 0.950

1.000
Dual Routes

- Separate Increasing & Decreasing routes for two way roads
- Separate measures for both routes
Roadway Characteristics

LRS Events System
- ID-D Shoulder Unpaved Right
- ID-D Shoulder Paved Right
- ID-D Travel Width
- ID-D Basic Pavement Type
- ID-D Through Lanes

ID-D

11.100

ID-I

11.000

ID-I Shoulder Unpaved Right
ID-I Shoulder Paved Right
ID-I Travel Width
ID-I Basic Pavement Type
ID-I Through Lanes
LRS/SDW Structure

TGP (Transactional Geodatabase in Production)

Linear Referencing System (LRS)

- Default Database
- Master Database

Editors Use Roads & Highways (R&H) and Roadway Characteristic Editor (RCE)

- LRS Editor 1 (Versioned Database)
- LRS Editor 2 (Versioned Database)

Spatial Data Warehouse (SDW)

- Rail
- Land Mgmt
- TREND
- Other

Application Databases

Manual Script

GIS User

APP User

Mgmt TREND Other

Rail

Internal

External

Aero

Rest Area

Other

Manual Script

APP User
TGP= Transactional Geodatabase Production
LRS = Linear Referencing System
SDW = Spatial Data Warehouse
ASDW = Application Spatial Data Warehouse

KEY CONCEPTS:
1. LRS is a Versioned database with User based children built off Master which is built off Default
2. Default is copied to (A)SDW where users or applications access the data
3. Other data from other transactional environments also gets copied to (A)SDW
4. LRS Editors can use either RCE or R&H to edit their version
KEY CONCEPTS:
1. GIS Users access SDW (Internally) or MN GEOCommons (Externally) for Adhoc data needs

1. Applications access the LRS Data from the Application Databases, which is a copy of SDW modified for easier consumption by applications

1. Other data from other non-TGP environments also gets copied to the App Database

1. SDW data is copied to MN GEOCommons by manually running a script
“Status” Process (ROLLS)

- Office of State Aid
  - Commissioner’s Orders (MSAS and CSAH)
  - Construction Plans
- County Engineers
  - Annual Status returns
- City Engineers
  - Annual Status returns
- Townships
  - Annual Status returns

Yearly Solicitation in December (Letter and PDF Maps)

PDF Maps
- Written on
- Typed on
- Annotated
- Paper
“Status” Process (ROLLS)
LRS Editing and Updating

Not rocket science... but it ain’t easy!

“People think I just point a camera at stuff. But there is a lot more to it than just that!”

- Construction Plans
- Bad aerials
- Many different sources
- Conflicting information
- Dead ends
Single, most hated saying!

Well, can’t you just.....??
RACER

No Need to login to submit a ticket
Track time it takes to complete a ticket
Change status and email submitter
Submitter able to at Priority
Admin gatekeeper
LRS Training Guidelines

- Repeatable
- Rigorous
- Fair
LRS Training Levels and Progression

Level 0
- Introduction
- Terms and Concepts
- Customers (Who, Why important)

Level 1 (RCE)
- WMX
- RCE Training
- Construction Plans
- Retire
- Reconcile and Post

Level 2 (R&H)
- Local Routes
- Basic Tasks
  - Create
  - Extend
  - Retire
  - Lollipop

Level 3 (R&H)
- State Aid Routes
  - Commissioners Orders
- Intermediate Tasks
  - Realign
  - Reassign
  - Reverse

Level 4 (R&H)
- Trunk Highways
  - Reference Posts,
  - Control Sections
  - Statutory Routes
- Advanced Tasks
  - Coincident Routes
  - Stationing
  - Centerline Adjustment (Carto Realign)
Intro to Terms and Concepts

Introductory Video

Introductory PowerPoint Presentation

LEVEL 1 (RCE)

LEVEL 0
LRS Training Guidelines

RCE Training and Progression

- RCE Exercise 1: Navigation
  - Fully Successful
  - YES
  - RCE Exercise 2: Add Roadway Events Basic
    - Fully Successful
    - YES
    - RCE Exercise 3: Modifying Events Basic
      - Fully Successful
      - YES
      - RCE Exercise 4: Add Roadway Events Intermediate
        - Fully Successful
        - YES
        - RCE Exercise 5: Construction Plans - Tasks 1-4
          - Fully Successful
          - NO
          - RCE Exercise 6: Review, Reconcile and Post
            - Fully Successful
            - YES
            - Final Review
              - Fully Successful
              - YES
              - Ready
                - Production
                  - Fully Successful
                  - YES
                  - LEVEL 2 (R&H)
              - Need Work
                - More Training
                  - Fully Successful
                  - YES
                  - LEVEL 1
              - More Training
                - Intro to RCE (PowerPoint Presentation)
                  - YES
                  - RCE Exercise 1: Navigation
                    - Fully Successful
                    - YES
                    - RCE Exercise 2: Add Roadway Events Basic
                      - Fully Successful
                      - YES
                      - RCE Exercise 3: Modifying Events Basic
                        - Fully Successful
                        - YES
                        - RCE Exercise 4: Add Roadway Events Intermediate
                          - Fully Successful
                          - YES
                          - RCE Exercise 5: Construction Plans - Tasks 1-4
                            - Fully Successful
                            - NO
                            - RCE Exercise 6: Review, Reconcile and Post
                              - Fully Successful
                              - YES
                              - Final Review
                                - Fully Successful
                                - YES
                                - Ready
                                  - Production
                                    - Fully Successful
                                    - YES
                                    - LEVEL 2 (R&H)
LRS Training Guidelines

Roads and Highways (R&H) Training and Progression

Intro to LEVEL 2 Roads & Highways (PowerPoint Presentation)

R&H Exercise 1: WMX Setup
- Fully Successful
  - YES
  - NO
  - Yes

R&H Exercise 2: Create Route
- Fully Successful
  - YES
  - NO
  - Yes

R&H Exercise 3: Extend Route
- Fully Successful
  - YES
  - NO
  - Yes

R&H Exercise 4: Retire Route
- Fully Successful
  - YES
  - NO
  - Yes

R&H Exercise 5: Lollipop Route
- Fully Successful
  - YES
  - NO
  - Yes

R&H Exercise 6: Tasks 1-4 Real World Scenarios
- Fully Successful
  - YES
  - NO
  - Yes

RCE Exercise 7: Data Review, Reconcile and Post
- Fully Successful
  - YES
  - NO
  - Yes

Final Review
- Need Work
  - More Training
  - Ready
    - Production
    - Fully Successful
    - YES
    - TBD

LEVEL 2
LRS Road Map!

• Manual QC for completeness
• Intersection Feature Class
  • Event Behavior
• Database Maintenance Schedule
• ArcGIS upgrade to 10.7.1 (next year)
  • Cover Route
  • New RCE application (Portal)
  • QC checks for server to do spatial checks
LRS Road Map!

- Update Status Procedure
- LRS Knowledge Base
- Supervisor Handbook
- ArcGIS Pro (2021)
  - Will be testing extensively before this
    - Amazon Cloud
  - Will need to make training
Thank you again!

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