Transportation Asset Management

Background for perspective

Historical roots

Philosophy of change

Transportation Asset Management and the future

Nebraska Transportation Asset Management systems

National perspective

It’s still all about people

So, Where does this leave us?
Subtitle
A Performance-based Transportation agency = measurable, repeatable, evidence-based decision-making.

Subtitle
So, do you have the evidence to support a decision?
Background For Perspective
You lead people and manage things and it’s all about people.

But if you can’t measure it, you can’t manage it.

But, it’s still all about people.

John L. Craig
At its base society requires two components to work: Mobility and Communications

“Transportation is about connecting people”
Safe, reliable, secure mobility

USDOT’s philosophy for reauthorization is for safer, simpler and smarter transportation
I wear two hats!

• Director, Nebraska Department of Roads
• Leader of Transportation for the State of Nebraska
Historical Roots
History

So, how can we become more multi-dimensional? Technology provides a means to make this happen.
Historical view of transportation system: concrete, asphalt, steel; technology enables optimizing operation of the system.
- Something about Nebraska: **Rural** – 50% population in three counties
- To mitigate the negative impacts of geographic dispersion and improve the economy and quality of life, mobility and telecommunications has real relevance.

**Persons/Sq. Mile**

- 1 - 11
- 12 - 29
- 44 - 98
- 298 - 510
- 1401 - 1401

*Source: Census 2000*

Approx. 485 miles across. Prepared with American FactFinder
Philosophy of Change
The Great American Philosopher

Yogi Berra said,

“If you do what you have always done—you will get what you have always gotten.”
Thus:
We must change, if we want different results—

Sigmoid Curve
Technology can be an engine of this change, including the ability to integrate systems, but more importantly to integrate people.

Second Curve

- You lead people and manage things and it’s all about people; but if you don’t measure it, you can’t manage it.

This second wave will require data integration and systems management.
Bottom line up front:

“Technology enables new ways of thinking and in different terms.”
(Adage: “If you can imagine it you can build it”)

(1) In the military this is a force multiplier, but technology is also at the heart of change management. Technology and its good use requires leadership

(2) Thinking is **hard work!** Technology offers a mechanism to refine our institutions and improve our products and services.

(3) - Automating something is valuable but
  - Technology offers to completely improve transportation in all its aspects
    - e.g. Nano technology
      - Miniaturize
      - Change properties
    - Systems Management

(4) - How far we have come, technology is just the recent wave.
  e.g. –e-mail, internet, etc., etc.
Segue into Systems Management:
1. Asset Management
2. Operations
“The future of transportation is technology”
-Thus: communications (and related technology) are as important as concrete, asphalt and steel.

Nebraska Department of Roads Communications Network

• Enhances communications within Nebraska Department of Roads
• Sets the initial architecture to “spring board” and integrate other technology and linkages (Planning, Project Development and Design, Construction, Maintenance, Management Information Systems for operations and asset management, State Joint Operations Center, District Operation Centers, High Plains Coalition, Automated State/Regional/National Permits, 511, Transportation Portal, etc.)
Transportation Asset Management and The Future
Systems Management has the ability to enable optimizing inherently complex things.
Typical State Surface Transportation Assets

Highways
- Pavements (some ways to consider - construction, maintenance, preventative maintenance, pavement preservation)
- Structures (e.g. bridges, etc.)
- Hardware (guardrail, signs, lighting, barriers, impact attenuators, electronic surveillance and monitoring equipment, and operating facilities, etc.)

Rail
- Structures (e.g. viaducts, etc.)
- Hardware (signs, signals, barriers, electronic surveillance and monitoring equipment, and operating facilities, etc.)

Public Transportation
- Vehicles
- Hardware (electronic surveillance and monitoring equipment, and operating facilities)

Other Assets
- Human Resources
- Construction and maintenance equipment
- Vehicles
- Real estate (buildings, property, roadside and right-of-way)
- Materials (e.g. oils, asphalt, concrete, sand, salt, paint, etc.)
- Corporate data and information (i.e. knowledge management)
- Time
- Money
- Others

(and this is not inclusive.)
Traditional Objectives of Government Transportation Agencies

(In any specific decision it is unlikely that we can simultaneously satisfy more than one of these objectives)

1. Minimize cost
2. Maximize the benefit-cost ratio
3. Minimize risk of loss (i.e. liability)
4. Maximize safety
5. Maximize quality of service
6. Maximize level of service
7. Maximize service to community needs by providing both money and people
8. Maximize economic, physical, and psychological security of employees by challenging roles, generous wages and benefits, counseling services, recreational facilities and so forth.
9. Create an optimal public image
To produce user benefits, a project must result in user costs that are less than project users would be willing to pay. To be economically acceptable, a project must produce user benefits that meet or exceed the cost of providing those benefits.


So, who pays the cost and who gets the benefit?

- John L. Craig
Traditional Benefits of Highway Projects include cost savings from:

1. Reduced travel distance, as with shorter routes
2. Reduced travel time, as with shorter routes, higher speeds or elimination of stops
3. Reduced vehicle wear and tear, as with improved road surfaces, reduced grade or reduced curvature
4. Reduced congestion, as with additional lanes
5. Reduced accident costs, as with improved guardrails, restricted access or elimination of intersections

From Road-User Benefits Analysis for Highway Improvements, American Association of State Highway Officials, Washington, D.C. 1960

Note: These or similar benefits are applicable to rail and public transportation as well
<table>
<thead>
<tr>
<th>Proposal</th>
<th>Possible benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Time</td>
</tr>
<tr>
<td>Eliminate stop with an overpass</td>
<td>+</td>
</tr>
<tr>
<td>Restricted rather than unrestricted access</td>
<td></td>
</tr>
<tr>
<td>Provision of a shorter route</td>
<td>+</td>
</tr>
<tr>
<td>Improve surface</td>
<td>+</td>
</tr>
<tr>
<td>Improve alignment</td>
<td>+</td>
</tr>
<tr>
<td>Improve Congested Condition</td>
<td>+</td>
</tr>
<tr>
<td>“Flatten” grades—Improve sight distance</td>
<td>+</td>
</tr>
<tr>
<td>Replace intersection with cloverleaf</td>
<td></td>
</tr>
</tbody>
</table>

From Engineering Economy: Analysis of Capital Expenditures
By Gerald W. Smith, The Iowa University Press, 1979

Note: These or similar benefits are applicable to rail and public transportation as well
A practical “transportation system” question that technology has the ability to enable. . .

What is the optimal allocation of our transportation resources?
Resource Allocation

Historically

What did you spend last Year?
What’s most important now?

Future

What’s the optimal allocation
of all resources?
Is it evidence based?
A Way to Think About Asset Management
Transportation Asset Management "Umbrella"

Asset Management enables the optimal allocation of resources

Transportation System Development "Umbrella"

Performance Measures

Transportation System Operations "Umbrella"

Incident Management
Emergency Management
Disaster Preparedness
Traffic Signal Management
Security

Operations
Real-Time and Near Public Safety Regional System Management

Centers
Real Time Information Arterial Management Measurement
Freeway Management Weather Preparedness
Travel Time Reliability Event Management

Railgrade Crossing Management
Public Transportation Management
Weather Monitoring

Resource Allocation

Traffic Control Devices
Traveler Information (511)
Transportation Portal (web site) Kiosks In Vehicle Devices Media

Asset Management enables the optimal performance of the transportation system.
How can we optimize the development of the transportation System?
A Way to Think About System Development

How do we optimize the development of our system?

There are two ways to view asset management:
1. Internal business management and investment
2. External transportation system investment

- Right of Way Management System
- Financial Management System
- Nebraska Information System (payroll, etc.)
- Pavement Management System
- Project Scheduling Management System
- Bid Analysis Management System
- Bridge Management System
- Workforce Management System
- Scales
- Construction Management System
- Capital Facilities Management System
- Safety Management System
- Maintenance Management System
- Research Management System
- Equipment Management System

Potential Benefits:
- Equipment expenses reduced by 1 million dollars a year.
- Rock salt expenses reduced by 1 million dollars a year.
- Mowing expenses reduced by 1 million dollars a year.

Resource Allocation

Asset Management enables the optimal development of our system.
Examples of Tools for Optimizing System Development

- Pavement Management
- Bridge Management
- Preventive Maintenance
- Construction Management
- Project Scheduling
- Right of Way Management
How can we optimize the performance of the transportation system?
A Way to Think About System Operations

Transportation Operations "Umbrella"

Ways to view operations:
1. Travel Time
2. Response Time
3. Safety-Security

Potential Benefits:
- Travel time reduced 13-48%
- Travel speed increased 16-62%
- Freeway capacity increased 8-25%
- Total accidents decreased 24-50%
- Fuel consumption decreased 41%

Asset Management enables optimal performance of the transportation system.
Examples of Tools for Optimizing System Operations

Equipment

Rock Salt

Rest Areas

Bridge De-icing Systems

Mowing

Traffic Signal Timing

Media

511

Transportation Portal

Dynamic Message Signs
Nebraska Transportation Asset Management systems
Financial Management Systems

- **(RBS)** – Roads Billing System
- **(RPS)** – Roads Payment System
- **(CST)** – Cost Accounting System
- **(GLS)** – General Ledger System
- **(MJE)** – Miscellaneous Journal Entries
- **(RFE)** – Road’s Financial Edit System
- **(VRS)** – Voucher Register System
- **(BIS)** – Budget Information System
- **(PFS)** – Project Finance System
- **(NIS-FA)** – Nebraska Information System – Finance and Accounting
- **(CFS)** – Cash Flow Analysis/Modeling
Highway Inventory Systems

(ADT) – Average Daily Traffic
(CRV) – Straight Line Curve & Gradation
(IAI) – Intersections & Interchanges
(LOC) – Location Boundaries
(RCS) – Roadway Condition
(RRC) – Railroad/Highway Grade Crossings
(SPZ) – Speed Zones
(CLS) – Roadway Classifications
(HSN) – Highway Sections Inventory
(LNE) – Pavement Inventory
(MDN) – Medians
(RDC) – Roadway Condition Reporting
(SGN) – Traffic Signs
**Transportation Asset Management Systems**

**Engineering Applications**
- (BRG) – Bridge Design & Analysis Applications
- (ENV) – Environmental Applications
- (RDS) – Roadway Design Applications
- (CCS) – Concrete Control System
- (GEO) – Roadway Design Geometric Applications
- (SRV) – Survey Applications

**Workforce Management Systems**
- (PDS) – Payroll Detail System
- (NIS-HR) – Personnel Information System
- (EAR) – Employee Accident System

**Preconstruction Management Systems**
- (PSS) – Preconstruction Scheduling System
- (UTL) – Utility Management System
- (ROW) – Right-of-Way Management System
- (SRD) – Secondary Roads Project Status System
- (UOP) – User Occupancy Permits
- (PRP) – People/Property Relocations Inventory
- (PCB) – Project Control System
Transportation Asset Management Systems

Construction Management Systems
- (AGR) – Agreement Monitoring System
- (CTR) – Contractor Management System
- (CON) – Construction Management System
- (SiteManager) – Construction Management System

Safety Management Systems
- (ARR) – Accident Records System
- (HLA) – Hazardous Location Analysis
- (SRE) – Sight Restriction Inventory
- (HSI) – Highway Safety Information System

Roadway Operations Management Systems
- (JOC) – Joint Operations Center System
- (DOC) – District Operations Center System
- (TIS) – Traveler Information Systems
  - 511 System
  - RCRS – Road Conditions Reporting System

Bridge Management Systems
- (BIR) – Bridge Inventory & Rating System
- (BMS) – Bridge Management System
Transportation Asset Management Systems

- Pavement Management System (PMS)
- Capital Facilities Management Systems (RLP, CFM)
- Equipment Management Systems (EMI)
- Highway Maintenance Management System (MMS)

- Pavement Management System
- Real Property System (RLP)
- Capital Facilities Management (CFM)
- Equipment Management Information System (EMI)
- Fleet Management System (FMS)
- Highway Maintenance Management System (MMS)
National Perspective
Transportation Asset Management
AASHTO
Strategic Plan

The plan provides a structured approach for advancing the state-of-the-practice within AASHTO, the Federal Highway Administration, and the departments of transportation across the country.

Mission
Champion concepts and practices that integrate transportation investment decisions regarding operation, preservation, and improvement of transportation systems for member agencies.

Vision
Support AASHTO’s vision through the incorporation of asset management as an accepted method for managing the nation’s transportation system.

Goals
• Develop partnerships with public and private entities having an interest in and commitment to asset management.
• Develop and document an understanding of asset management and how it can be used by member states.
• Promote the development of asset management tools, analysis methods, and research topics.
• Communicate with and inform member states how to utilize asset management.
• Assist member states in assessing and implementing asset management principles.
A Generic Asset Management System

**System Components**

- Goals and Policies (Reflects Customer Input)
- Asset Inventory
- Condition Assessment and Performance Modeling
- Alternatives Evaluation and Program Optimization
- Budget/Allocations
- Short- and Long-Range Plans (Project Selection)
- Program Implementation
- Performance Monitoring (Feedback)

**Key Questions**

- What is our mission? What are our goals and policies?
- What is included in our inventory of assets?
- What is the value of our assets? What are their functions? What services do they provide?
- What was the past condition and performance of our assets? What is the current and predicted future condition and performance of our assets?
- How can we preserve, maintain, or improve our assets to ensure the maximum useful life and provide acceptable service to the public?
- What resources are available? What is the budget level? What is the projected level of future funding?
- What investment options may be identified within and among asset component classes? What are their associated costs and benefits?
- Which option, or combination of options, is “optimal?”
- What are the consequences of not maintaining our assets? How can we communicate the impact of the condition and performance of our assets on the system and end user?
- How do we monitor the impact of our decisions? How do we adjust our decision-making framework when indicated?
- How can we best manage our assets in order to least inconvenience the monitoring public when we repair or replace these facilities?

Source: Asset Management Primer

Generic Asset Management System Components and Key Questions

Nebraska Department of Roads
Transportation Asset Management Products and Services

AASHTO Strategic Plan (2001)

Website: transportation.org (2002)

          FHWA Guide to Roadside Asset Management (2004?)
          FHWA Synthesis Of Best Practices For Integrated Data and
          Information Management (2004?)
          NCHRP Project 19-04 A Review of Compliance with GASB 34 (2004?)
          NCHRP Project 20-57 Analytical Tools for Asset Management (2004?)
          NCHRP Project 20-60 Performance Measures (2004?)

Training: Transportation Asset Management Guide Training Course (2003?)

Asset Management Institute (2004?)

5th National Asset Management Workshop (2003?)
It’s Still All About People
Fragmented industry suboptimizes efforts.

Current Transportation Industry

- Private
- Counties
- Associations
- News Media
- American Council of Engineering Companies
- Societies
- American Association of State Highway and Transportation Officials
- State Agencies
- Associated General Contractors
- Suppliers
- Federal Agencies
- American Automobile Association
- Public
- Municipalities
- Academia

NDOR
Nebraska Department of Roads
Coalitions enable optimizing efforts.

Future Transportation Industry

Private Sector
Manufacturers
American Automobile Association
Insurance

Associations & Societies
Truckers
Engineers
Architects
Highway Associations
American Automobile Association
American Association of State Highway and Transportation Officials
American Council of Engineering Companies
Associated General Contractors
Intelligent Transportation Systems

Operational Focus
- Local (District Operations Centers)
- State (Pioneer Net) (Nebraska Transportation Center)
- Regional (High Plains Coalition)
- National (511)

Academia

Government
Federal
State
County
Local

Owners
State
County
City
Private

NDOR
Nebraska Department of Roads
So, Where Does That Leave Us?
Functional and Economic Analysis and Investment Tools and Terms (Optimization Not Profit)

- Net Cost
- Life–Cycle Cost
- Amortization
- The Time Value of Money
  - Present Value
  - Future Value
  - Present Cost
  - Future Cost
- Net Asset Value
- Cost – Benefit Ratio
- Return On Investment/Rate Of Return
- Structural Life
- Functional Life
- User Costs
- Depreciation/Appreciation
- Fixed Costs & Variable Costs
- Environmental Costs/Benefits
- Operations & Maintenance Costs
- Debt & Debt Service
- Cash Flow
- Traveler Information
- Response Time To Return System To Normal
- Programs
- User Costs
- Economic Value
- Safety Costs/Benefits
- Break Even Point

Analysis formulas available in financial analysis and engineering economics references e.g. Engineering Economy: Financial Analysis
*Formulas do not exist or are in development
Transportation Asset Management

“Cutting the Gordian knot”

Systems Management = or ≠ optimal allocation of resources?
What is the level of service desired and how do you get it?

Life Cycle
Net Cost
Amortization
Present Value
Future Value
Present Cost
Future Cost

Safety
Planning
Design

Construction
Maintenance
Operations

Workforce

$79 million

$336 million

$50 million+

$386 million+

(Planning)+(Design)+(Construction)+
(Maintenance)+(Operations)=
Surface Transportation Program

(P)^2 + (D) + (C) + (M)^2 + (O)^2 = Program

(P)^2 =
D =
C =
(M)^2 =
(O)^2 =
In short, technology enables us to think in different terms, and to move from being a closed system to a much more open system and relevant to the traveler.
What is the future we want and are we ready?