Asset Management Data in a Knowledge Management World: Methods for Treating Data

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TAM Data in a Knowledge Management World

• Data, Information and Knowledge Management Techniques can be implemented together to:
  – Ensure sound asset management decisions
  – Improve asset management practice over time
  – Build and sustain staff capabilities

• Keep in mind that:
  – Having the right data and the right tools to analyze it are important, but…
  – If you don’t focus on the human side of the equation, you won’t get very far and you won’t be able to sustain progress
TAM Data in a Knowledge Management World

Data → Information
- Processing & Analysis

Information → Knowledge
- Learning

Knowledge →
- Good Decisions
- Improved Practices
- Capable Staff
Types of Data, Information & Knowledge for TAM

- **Assets**
  - Inventory & condition
  - Function, use, risk
  - Life cycle
  - Treatment effectiveness & cost
  - Optimal strategies

- **Asset Management Processes**
  - Requirements and deadlines
  - Approaches and activities
  - Key players and roles
  - History/evolution

- **Data/Information**
  - Sources
  - Limitations
  - Analysis methods, tools, expertise
“The idea here is that with real data, you can have a real conversation…. We had the confidence in our data that enabled us to squeeze money off higher-volume roads and put it into the lower-volume roads, which then made a very significant difference on those lower-volume roads…We make much better decisions when we have data that is consistent, repeatable, and available.”

- Former Director, Utah DOT
“As the CEO of a DOT you wake up one day and realize that every hand you shake is connected to a head full of knowledge. Knowledge management collects, shares and puts that knowledge to work over and over again across the entire agency—saving money, saving time, delivering quality projects, and reducing risk.”

- Former Director, Virginia DOT
Data, Information, Knowledge

Justified beliefs – basis for taking action
*Changing our standard will save money and won’t impact safety.*

Relevant, processed, contextualized facts
*No correlation between rut depth and crashes for less than 1” rut depth*

Facts, observations
*Rut depth, crashes*
## AASHTO’s Data Principles

<table>
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<tr>
<th>Data Principle</th>
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<tr>
<td>1. VALUABLE: Data is an asset</td>
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<td>2. AVAILABLE: Data is open, accessible, transparent and shared</td>
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<td>3. RELIABLE: Data quality and extent is fit for a variety of applications</td>
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<td>4. AUTHORIZED: Data is secure and compliant with regulations</td>
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<td>5. CLEAR: There is a common vocabulary and data definition</td>
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<td>6. EFFICIENT: Data is not duplicated</td>
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<td>7. ACCOUNTABLE: Decisions maximize the benefit of the data</td>
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## Seven Laws of Information*

1. Information is infinitely sharable; duplication does not increase its value.

2. The value of information increases with use.

3. Information is perishable – its value decreases over time.

4. The value of information increases with accuracy, but there are diminishing returns.

5. The value of information increases when combined with other information.

6. More information is not necessarily better.

7. Information is not depletable. The more you use it, the more you have.

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Data & Info Challenges

• Deciding what/how much data to collect
  – Weighing cost against value
  – Understanding and reconciling diverse needs for data

• Using available data
  – Findability
  – Quality
  – Skills and tools for translating to information
  – Understanding and integrating external data sources

• Efficiency
  – Avoiding duplication
  – Coordination and consistency
Data to Information: A Changing Landscape

Changing needs and expectations

- Performance Management/Accountability
- Open Government/Open Data
- Real Time Information available anytime from anywhere
- Context-Sensitive Design/Practical Design
- Workforce Dynamics - Institutional Memory

Changing sources and analysis capabilities

- Commercial Traveler Data
- Sensor Data
- Crowd Sourcing
- Social Media
- Text Mining
- Big Data Analytics
“…knowledge is not a result merely of filtering or algorithms…We get to knowledge — especially “actionable” knowledge — by having desires and curiosity, through plotting and play, by being wrong more often than right, by talking with others and forming social bonds, by applying methods and then backing away from them, by calculation and serendipity, by rationality and intuition, by institutional processes and social roles.”

Building Knowledge

Organizational Culture

Expertise

Communities

Data

Analysis Tools
The Knowledge & Information Cycle

Source; NCHRP Report 813, A Guide to Agency-Wide Knowledge Management for State Departments of Transportation
Knowledge Challenges

- Loss of institutional memory
- Shallow bench strength
- Lack of ability to adapt to new situations
- Disconnect between analysts and decision makers (leading to “analysis paralysis”)
- Lack of collaboration
- Lack of awareness of (or motivation to seek) documented information and available expertise
- Culture that values individual experts rather than people who share knowledge and coach others
# Data, Information & Knowledge Management

## Planning & Oversight
- Assessment and Audit
- Principles and Strategies
- Information Governance
- Architecture and Standards

## Analysis and Reporting
- GIS
- Data Integration
- BI/Analytics
- Modeling/Simulation

## Findability
- Search and Navigation
- Metadata & Terminology Management
- Auto-Classification
- Personalization

## People
- Communities of Practice
- Talent & Succession Management
- Mentoring & Shadowing
- Leadership Training
Leveraging GIS for Turning Data into Information
Example: Highway Lighting

WSDOT

• Data: crash, roadway, traffic and illumination system inventory
• Analysis: Relationship between illumination and crashes
• Decisions:
  – LED conversion
  – lighting system removal
  – prioritization of pole replacement after being hit

Source: TRB Safety Data Governance Peer Exchange (2014)
“Technologies, applications, and processes for gathering, storing, accessing, and analyzing data to help users make better decisions.”

- Queries: predefined and ad-hoc (show current conditions)
- Descriptive analytics (produce performance report)
- Exploratory analytics (identify causal factors)
- Predictive analytics (analyze scenarios)
- Prescriptive analytics (recommend an action)
Example: Rail Maintenance
UK Agencies

• Network Rail (UK)
  – Use imaging data from moving trains to identify maintenance issues such as loose bolts

• London Underground
  – Online dashboard monitoring equipment status, ability to deploy nearest maintenance staff and equipment
  – Predictive analytics to identify indicators of future equipment failure – let to replacement of escalator mechanical parts in pairs
Sensemaking:
• an organizational process of continuous insight generation

Business Intelligence & Sense Making

Ongoing Input
Access current, real time information; current info feeds trend info

Retrospection
Data Gathering & Preparation – to review historical events in relation to the current situation

Plausible Scenarios
Predictive Analytics – exploration of the range of possible outcomes

Communities
Collaborative BI – collective learning, interaction, information sharing in communities of experts

Defined Purpose
Clear alignment between information provision and business processes and concerns

Users
Individuals with skills, attitudes, motivations and time to do analysis

Implementation
Skillful implementation to ensure credibility, fit with need, personalize to uses, etc.

Adapted from: Namvar, Morteza; Cybulski, Jacob L.; and Perera, Luckmika (2016) "Using Business Intelligence to Support the Process of Organizational Sensemaking," Communications of the Association for Information Systems: Vol. 38, Article 20. Available at: http://aisel.aisnet.org/cais/vol38/iss1/20
Key Points

- Data, Information and Knowledge are integral to Asset Management – for decisions, processes and capabilities
- There are well established, separate but overlapping disciplines for information management (IM) and knowledge management (KM)
- These techniques involve managing data, information and knowledge as assets themselves
- KM in particular focuses on the human side of the equation – maximizing value of information and enabling renewal of knowledge assets as employees come and go
- BI/Analytics is a promising area for further application in asset management – skillful implementation supports transformation of data to information to build (and apply) knowledge
Selected Resources

- AASHTO TAM Portal - Access to variety of resources
- NCHRP Report 666 - Target Setting and Data Management
- NCHRP Report 754 – Management of Transportation Information
- NCHRP Report 813 – Guide to Agency-Wide KM
- NCHRP Report 800 – Successful Practices for GIS and TAM
- NCHRP Report 814 – Data Self-Assessment Guide
- NCHRP Report 829 – Executive Guide to Strategic Information Management
- NCHRP Project 08-90 Asset Management Gap Analysis Tool
Knowledge Management Drivers

State DOT Knowledge Management

- Improve Organizational Efficiency and Effectiveness
- Strengthen Organizational Resilience
- Strengthen Workforce Capabilities
- Leverage External Expertise
- Reduce Vulnerability to Employee Transitions
- Foster Learning and Innovation
• Do we have the right data to make good decisions and meet reporting requirements?
  – What data do we need and why?

• Is our current data good enough?
  – What level of accuracy, timeliness, completeness, etc. is needed?

• Are we making best use of our data collection and management resources?
  – Are we being efficient about how we collect and manage the data?

• Are we getting full value from the data that we have?
  – Are users able to access, integrate and analyze it?
Implementing a Transportation Agency Data Self-Assessment

**Prepare**

- **ASSEMBLE TEAM**
  Assemble a broad-based team to guide the effort.

- **ESTABLISH ASSESSMENT GOALS**
  Set a clear direction for what is to be accomplished.

- **SET SCOPE AND TIMELINE**
  Select data programs and assessment elements to include and establish a scope and schedule for the effort.

**Assess**

- **ASSESS DATA VALUE**
  Assess current data availability, quality, and usability.

- **ASSESS DATA MANAGEMENT**
  Assess maturity level for current data management processes.

- **DETERMINE GAPS**
  Identify gaps between current state and desired state and identify candidate actions to close gaps.

**Improve**

- **PRIORITIZE IMPROVEMENTS**
  Analyze the results and prioritize actions for improvement.

- **DEVELOP ACTION PLAN**
  Develop a plan of specific actions to address the priority gaps.

- **IMPLEMENT PLAN**
  Assign responsibilities, allocate resources and track implementation.

**ASSESSMENT**

- **DATA VALUE**
  Availability, Quality, Usability

- **DATA MANAGEMENT**
  Data Strategy and Governance, Data Architecture and Integration, Life Cycle Data Management, Data Collaboration, Data Quality Management

**Actions**

- Data Consolidation and Standardization
- Data Collection, Processing, and Quality Improvements
- Data Management Staffing and Responsibilities
- Data Policies, Procedures, and Standards
- Data Mapping and Documentation
- Data Presentation and Analysis Improvements
- Information System Improvements

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**Questions**

- **Agency Leaders**
  Do we have the right data to make good decisions and meet reporting requirements?

- **Data Users**
  How can our agency make it quicker and easier to access and analyze data so that we can do our jobs more efficiently and effectively?

- **Data Stewards**
  Is our data good enough? Do we need to improve its level of accuracy, precision or timeliness?

- **Data Managers**
  Are we managing our data to maximize its value and ensure its integrity?
Guidebook for state DOT executives and managers on how to **effectively allocate resources** to develop and maintain the agency’s capability to **provide mission-critical information** when and where it is needed.