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Migrating CoRe Element Data To The New AASHTO Specification

Designing and Implementing An
Automated Tool

Overview

- Chronology
- Issues
- Considerations
- Solution
- Next Steps

Chronology

- Pontis CoRe Elements Specified for Pontis 2.0
 - Over 10 years ago
- Covered An Expected Standard Set Of Structural Elements
 - Accessible, maintainable, easy to quantify
 - Intended to be interpreted and applied consistently across agencies
- Elements Specifications Were Not Always Followed
- Agencies Defined A Host Of Custom Elements And Flags
 - Physical and operational

Chronology (continued)

- Measurement Units Have Been A Continuing Issue
 - Training, rounding problems and operational obstacles
- ‘Whole’ Elements Have Been Partitioned In Some Inventories
 - Decks
- Minor Adjustments To CoRe Language Has Been Made By T-18 In Past
- Element Actions Often Associated With Agency Maintenance Management Systems

Chronology (continued)

- Pontis Software Has Followed CoRe Specification Throughout
- New Pontis Version (**5.1.2**) Will Support The New AASHTO Specification
 - Display-only access to previous history

Issues

- Consistency Of Data Collection And Reporting
- Disagreement On Condition State Language
- Conflation Of Protective System And Actual Element Condition
- Inability To Track Both Separately
- Single Path Of Deterioration Implied By The State Definitions
- Unnecessary Differentiation Of Condition States Between Classes Of Elements
 - Some with 3, some 4, some 5 – reasons now unclear

Problem Statement

- Implement The New AASHTO Element Specification Nationwide
 - Preserve the substantial inspection data collection investment
 - Implement protective systems separate from elements themselves
 - Implement effective measurement of defect flags and associate with specific elements
 - Enforce a consistent # of 4 condition states
 - Support the ability to report National Bridge Elements reliably (NBE)
 - Support bridge management activities (BME)
 - Provide for customized agency defined elements (ADE)

Problem Statement (continued)

- States Now Manage A Huge Array Of Element Condition Data
 - Probably More Than 20M Rows Of Data
 - Represents Millions Of Inspection Program Hours
- Individual State Agencies Do Not Have The Resources To Migrate These Data
- An Automated Tool Is Required To Support The Conversion And Strengthen Adoption Nationwide

Key Considerations

- Each Agency Has Collected Data To Its Own Standards
- Any Data Migration Must Be Flexible To Accommodate Individual Agency Practice
 - Particularly agency defined elements and variations for CoRe specification
- Migration Logic Should Be Configurable
- Migration Process Must Be Testable And Repeatable
- Migration Results Must Be Understandable And Believable
- Migration Process Should Establish The Initial Relationship Of Elements To Protective Systems And Defect Flags

Key Considerations (continued)

- System Must
 - Be Interactive
 - Permit What-If Development Of Migration Rules
 - Run In Windows (XP and Win7)
 - Have A Minimal Installation Process
 - Be Configurable And Extensible
- System Must NOT
 - Be A Black-Box Closed Application
 - *The Engineer's Judgment Must Be Central*
 - Require Agencies To Hold A Pontis License
 - Even Require A Database

Solution

- Separate User Interface And Migration Engines
- Program Runs In Batch And Interactive Modes
- All Migration Processes Controlled Through Logic Rules
 - Rules are accessible for user adjustment and extension to other elements/situations
- Assumes Configurable Set Of CoRe Element Information Is Used For Input
- Assumes Configurable Set of AASHTO Element Information Will Be Generated

Interfaces

- Command-Line
 - Runs From Command Prompt (DOS Prompt)
 - Classic batch utility approach
- Interactive Windows Program
 - Tabbed Organization
 - Specific activities on each tab
 - Settings accessible from user interface
 - On screen help and diagnostic messages
 - Selective processing of elements and rules for What-If analysis
- ***Both Interfaces Use The Exact Same Migration Engine.***

Command-Line Program

- All Input As Part Of The Command
 - Or
- Program Controlled Through Parameter Files
- Not Interactive
- All Results Available In Xml And Text Files
- Diagnostic Messages Written To Log Files
- Rudimentary Help
- Suitable For Automating Mass Migration

Interactive User Interface

The screenshot displays the AASHTO Visual Element Migrator 1.0 interface. On the left, a 'Rule Definitions' pane lists various rule names such as 'D.2.1.3d, Unpainted Steel 106 w/ Smart Flags' and 'D.4.1.2 - Approach Slabs'. A callout box labeled 'Rule Selections' points to this list. The main window shows the 'Rules Manager' with 'Selected Rule Details' for rule D.2.1.3d. A callout box labeled 'Individual Rule Syntax' points to the code in this pane. The code includes comments and actions like `ASSIGN_QUANT(107) = QUANTITY (THIS);` and `ASSIGN_PCT(107, 1) = PCT (THIS, 1);`. A callout box labeled 'Rule Actions' points to these specific code lines. The bottom of the window features a toolbar with buttons for 'Load', 'New', 'Copy', 'Remove', 'Compile', 'Validate', 'Import', and 'Save', along with a status bar and a 'Show tooltips' checkbox.

Interactive User Interface

CoRe Element
Data Review

Data Management
Actions

Migration Actions

AASHTO Elements - NBE/BME/ADE Settings

CoRe Element Details

	Total Quantity	State Quantities					BRKEY	INSPDATE	INSPKEY	ELEMKEY	ENV
WQBI' 05-25-2011) Element: 240 SU: 1 Envkey: 2	30.48	0.00:	30.48:	0.00:	0.00:	0.00	0008	05/25/2011	WQBI	240	2
SANV' 05-25-2011) Element: 240 SU: 1 Envkey: 2	33.22	0.00:	0.00:	33.22:	0.00:	0.00	0009	05/25/2011	SANV	240	2
Bridge: ' 0010' Inspection: ('CDKB' 04-28-2011) Element: 218 SU: 1 Envkey: 2	4.88	4.88:	0.00:	0.00:	0.00:	0.00	0010	04/28/2011	CDKB	218	2
Bridge: ' 0012' Inspection: ('IBEU' 04-28-2011) Element: 218 SU: 1 Envkey: 2	17.07	17.07:	0.00:	0.00:	0.00:	0.00	0012	04/28/2011	IBEU	218	2
Bridge: ' 0012' Inspection: ('IBEU' 04-28-2011) Element: 241 SU: 1 Envkey: 2	27.43	26.06:	1.37:	0.00:	0.00:	0.00	0012	04/28/2011	IBEU	241	2
Bridge: ' 0014' Inspection: ('NRIO' 06-24-2011) Element: 218 SU: 1 Envkey: 2	17.07	17.07:	0.00:	0.00:	0.00:	0.00	0014	06/24/2011	NRIO	218	2
Bridge: ' 0014' Inspection: ('NRIO' 06-24-2011) Element: 241 SU: 1 Envkey: 2	21.34	19.20:	2.13:	0.00:	0.00:	0.00	0014	06/24/2011	NRIO	241	2
Bridge: ' 0019' Inspection: ('EIBT' 04-12-2011) Element: 31 SU: 1 Envkey: 2	61.32	0.00:	0.00:	61.32:	0.00:	0.00	0019	04/12/2011	EIBT	31	2
Bridge: ' 0019' Inspection: ('EIBT' 04-12-2011) Element: 107 SU: 1 Envkey: 2	54.86	0.00:	0.00:	16.46:	31.82:	6.58	0019	04/12/2011	EIBT	107	2
Bridge: ' 0019' Inspection: ('EIBT' 04-12-2011) Element: 215 SU: 1 Envkey: 2	5.49	0.00:	4.28:	1.10:	0.00:	0.00	0019	04/12/2011	EIBT	215	2
Bridge: ' 0019' Inspection: ('EIBT' 04-12-2011) Element: 217 SU: 1 Envkey: 2	5.49	0.00:	2.20:	2.74:	0.55:	0.00	0019	04/12/2011	EIBT	217	2
Bridge: ' 0019' Inspection: ('EIBT' 04-12-2011) Element: 334 SU: 1 Envkey: 2	23.77	0.00:	13.08:	7.13:	3.57:	0.00	0019	04/12/2011	EIBT	334	2
Bridge: ' 0019' Inspection: ('EIBT' 04-12-2011) Element: 361 SU: 1 Envkey: 2	1.00	0.00:	1.00:	0.00:	0.00:	0.00	0019	04/12/2011	EIBT	361	2
Bridge: ' 0019' Inspection: ('EIBT' 04-12-2011) Element: 388 SU: 1 Envkey: 2	260.13	0.00:	0.00:	0.00:	260.13:	0.00					
Bridge: ' 0019' Inspection: ('PBRD' 06-16-2010) Element: 31 SU: 1 Envkey: 2	61.32	0.00:	0.00:	61.32:	0.00:	0.00					
Bridge: ' 0019' Inspection: ('PBRD' 06-16-2010) Element: 107 SU: 1 Envkey: 2	54.86	0.00:	0.00:	16.46:	31.82:	6.58					
Bridge: ' 0019' Inspection: ('PBRD' 06-16-2010) Element: 215 SU: 1 Envkey: 2	5.49	0.00:	4.28:	1.10:	0.00:	0.00					
Bridge: ' 0019' Inspection: ('PBRD' 06-16-2010) Element: 217 SU: 1 Envkey: 2	5.49	0.00:	2.20:	2.74:	0.55:	0.00					
Bridge: ' 0019' Inspection: ('PBRD' 06-16-2010) Element: 334 SU: 1 Envkey: 2	23.77	0.00:	13.08:	7.13:	3.57:	0.00	0019	06/16/2010	PBRD	388	2
Bridge: ' 0019' Inspection: ('PBRD' 06-16-2010) Element: 361 SU: 1 Envkey: 2	1.00	0.00:	1.00:	0.00:	0.00:	0.00					
Bridge: ' 0021' Inspection: ('BVDA' 06-10-2011) Element: 243 SU: 1 Envkey: 2	12.19	0.00:	0.00:	12.19:	0.00:	0.00	0021	06/10/2011	BVDA	243	2
Bridge: ' 0021' Inspection: ('BVDA' 06-10-2011) Element: 360 SU: 1 Envkey: 2	1.00	0.00:	0.00:	1.00:	0.00:	0.00	0021	06/10/2011	BVDA	360	2
Bridge: ' 0022' Inspection: ('OWGK' 06-10-2011) Element: 380 SU: 1 Envkey: 2	12.19	12.19:	0.00:	0.00:	0.00:	0.00	0022	06/10/2011	OWGK	380	2
Bridge: ' 0023' Inspection: ('IXFS' 06-10-2011) Element: 380 SU: 1 Envkey: 2	12.19	12.19:	0.00:	0.00:	0.00:	0.00	0023	06/10/2011	IXFS	380	2
Bridge: ' 0024' Inspection: ('HKXP' 06-10-2011) Element: 243 SU: 1 Envkey: 2	12.80	0.00:	6.40:	5.12:	1.28:	0.00	0024	06/10/2011	HKXP	243	2

Download Elements Generate Specs Migrate List Load Save

View Show tooltips Exit

Interactive User Interface

AASHTO Visual Element Migrator 1.0

Edit Migrator Rules CoRe Elements AASHTO Elements - NBE/BME/ADE Settings

Migrated AASHTO Element Details

Summary	Total Quantity	State Quantities				BRKEY	INSPDATE	INSPKEY	ELEMKEY	ENV	STR_UNIT
<input checked="" type="checkbox"/> Bridge: ' 0008' Inspection: ('WQBI' 05-25-2011) Element: 240 SU: 1 Envkey: 2	30.48	0.00	30.48	0.00	0.00	0008	05/25/2011	WQBI	240	2	1
<input type="checkbox"/> Bridge: ' 0009' Inspection: ('SANV' 05-25-2011) Element: 240 SU: 1 Envkey: 2	33.22	0.00	33.22	0.00	0.00	0009	05/25/2011	SANV	240	2	1
<input type="checkbox"/> Bridge: ' 0010' Inspection: ('CDKB' 04-28-2011) Element: 241 SU: 1 Envkey: 2	9.75	9.75	0.00	0.00	0.00	0010	04/28/2011	CDKB	241	2	1
<input type="checkbox"/> Bridge: ' 0012' Inspection: ('IBEU' 04-28-2011) Element: 241 SU: 1 Envkey: 2	27.43	26.06	1.37	0.00	0.00	0012	04/28/2011	IBEU	241	2	1
<input type="checkbox"/> Bridge: ' 0014' Inspection: ('NRIO' 06-24-2011) Element: 241 SU: 1 Envkey: 2	21.34	19.21	2.13	0.00	0.00	0014	06/24/2011	NRIO	241	2	1
<input type="checkbox"/> Bridge: ' 0019' Inspection: ('EIBT' 04-12-2011) Element: 31 SU: 1 Envkey: 2	61.32	0.00	0.00	61.32	0.00	0019	04/12/2011	EIBT	31	2	1
<input type="checkbox"/> Bridge: ' 0019' Inspection: ('EIBT' 04-12-2011) Element: 107 SU: 1 Envkey: 2	54.86	0.00	16.46	31.82	6.58	0019	04/12/2011	EIBT	107	2	1
<input type="checkbox"/> Bridge: ' 0019' Inspection: ('EIBT' 04-12-2011) Element: 241 SU: 1 Envkey: 2	5.49	0.00	4.37	1.12	0.00	0019	04/12/2011	EIBT	241	2	1
<input type="checkbox"/> Bridge: ' 0019' Inspection: ('EIBT' 04-12-2011) Element: 217 SU: 1 Envkey: 2	5.49	0.00	4.94	0.55	0.00	0019	04/12/2011	EIBT	217	2	1
<input type="checkbox"/> Bridge: ' 0019' Inspection: ('EIBT' 04-12-2011) Element: 334 SU: 1 Envkey: 2	23.77	0.00	20.20	3.57	0.00	0019	04/12/2011	EIBT	334	2	1
<input type="checkbox"/> Bridge: ' 0019' Inspection: ('EIBT' 04-12-2011) Element: 515 SU: 1 Envkey: 2	23.77	0.00	13.07	0.00	10.70	0019	04/12/2011	EIBT	515	2	1
<input type="checkbox"/> Bridge: ' 0019' Inspection: ('PBRD' 06-16-2010) Element: 31 SU: 1 Envkey: 2	61.32	0.00	0.00	61.32	0.00	0019	06/16/2010	PBRD	31	2	1
<input type="checkbox"/> Bridge: ' 0019' Inspection: ('PBRD' 06-16-2010) Element: 107 SU: 1 Envkey: 2	54.86	0.00	16.46	31.82	6.58	0019	06/16/2010	PBRD	107	2	1
<input type="checkbox"/> Bridge: ' 0019' Inspection: ('PBRD' 06-16-2010) Element: 241 SU: 1 Envkey: 2	5.49	0.00	4.37	1.12	0.00	0019	06/16/2010	PBRD	241	2	1
<input type="checkbox"/> Bridge: ' 0019' Inspection: ('PBRD' 06-16-2010) Element: 217 SU: 1 Envkey: 2	5.49	0.00	4.94	0.55	0.00	0019	06/16/2010	PBRD	217	2	1
<input type="checkbox"/> Bridge: ' 0019' Inspection: ('PBRD' 06-16-2010) Element: 334 SU: 1 Envkey: 2	23.77	0.00	20.20	3.57	0.00	0019	06/16/2010	PBRD	334	2	1
<input type="checkbox"/> Bridge: ' 0019' Inspection: ('PBRD' 06-16-2010) Element: 515 SU: 1 Envkey: 2	23.77	0.00	13.07	0.00	10.70	0019	06/16/2010	PBRD	515	2	1
<input type="checkbox"/> Bridge: ' 0021' Inspection: ('BVDA' 06-10-2011) Element: 217 SU: 1 Envkey: 2	12.19	0.00	12.19	0.00	0.00	0021	06/10/2011	BVDA	217	2	1
<input type="checkbox"/> Bridge: ' 0024' Inspection: ('HKXP' 06-10-2011) Element: 217 SU: 1 Envkey: 2	12.80	0.00	11.52	1.28	0.00	0024	06/10/2011	HKXP	217	2	1
<input type="checkbox"/> Bridge: ' 0027' Inspection: ('ZMUR' 06-24-2011) Element: 240 SU: 1 Envkey: 2	28.96	0.00	28.96	0.00	0.00	0027	06/24/2011	ZMUR	240	2	1
<input type="checkbox"/> Bridge: ' 0028' Inspection: ('JIUJ' 06-29-2011) Element: 241 SU: 1 Envkey: 2	12.19	0.00	0.00	6.09	6.10	0028	06/29/2011	JIUJ	241	2	1
<input type="checkbox"/> Bridge: ' 0028' Inspection: ('JIUJ' 06-29-2011) Element: 334 SU: 1 Envkey: 2	6.10	0.00	0.00	3.66	2.44	0028	06/29/2011	JIUJ	334	2	1
<input type="checkbox"/> Bridge: ' 0028' Inspection: ('JIUJ' 06-29-2011) Element: 515 SU: 1 Envkey: 2	6.10	0.00	0.00	0.00	6.10	0028	06/29/2011	JIUJ	515	2	1
<input type="checkbox"/> Bridge: ' 0032' Inspection: ('OQEQ' 06-29-2011) Element: 217 SU: 1 Envkey: 2	9.45	0.00	8.98	0.47	0.00	0032	06/29/2011	OQEQ	217	2	1
<input type="checkbox"/> Bridge: ' 0032' Inspection: ('OQEQ' 06-29-2011) Element: 334 SU: 1 Envkey: 2	15.24	10.67	4.57	0.00	0.00	0032	06/29/2011	OQEQ	334	2	1
<input type="checkbox"/> Bridge: ' 0032' Inspection: ('OQEQ' 06-29-2011) Element: 515 SU: 1 Envkey: 2	15.24	10.67	4.57	0.00	0.00	0032	06/29/2011	OQEQ	515	2	1
<input type="checkbox"/> Bridge: ' 0046' Inspection: ('KSXH' 08-09-2011) Element: 217 SU: 1 Envkey: 2	19.51	0.00	19.51	0.00	0.00	0046	08/09/2011	KSXH	217	2	1

Migrate A File Load Results Save Results

Page 1 of 41

View Show tooltips Exit

Migration Actions

Rules

```
TRANSFORM("D.1.3.1", "D.1.3.1, Timber, Example Deck 6 - Grid Deck Elements  
Only");  
SCOPE (ELEM_LIST, 31, 54);  
EXCEPTION(101,"Runtime exception when trying to apply rule D.1.3.1");  
//RAE - 7/21/11 - checked  
CASE WHEN (THIS=31)  
  THEN  
    ASSIGN_QUANT(31) = QUANTITY(THIS);  
    ASSIGN_PCT(31, 1) = PCT(THIS, 1);  
    ASSIGN_PCT(31, 2) = PCT(THIS, 2);  
    ASSIGN_PCT(31, 3) = PCT(THIS, 3);  
    ASSIGN_PCT(31, 4) = PCT(THIS, 4);  
  ELSE  
    ASSIGN_QUANT(54) = QUANTITY(THIS);  
    ASSIGN_PCT(54, 1) = PCT(THIS, 1);  
    ASSIGN_PCT(54, 2) = PCT(THIS, 2);  
    ASSIGN_PCT(54, 3) = PCT(THIS, 3);  
    ASSIGN_PCT(54, 4) = PCT(THIS, 4);  
END;
```

Next Steps

- Integrate NBE Rollup Logic
- Integrate Automated Defect Flag And Protective System Element Generation
- Finalize Rules
 - Consensus Decision
- Distribute To Community

Thank You!

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