Data Quality – Impact on Pipeline Integrity Management

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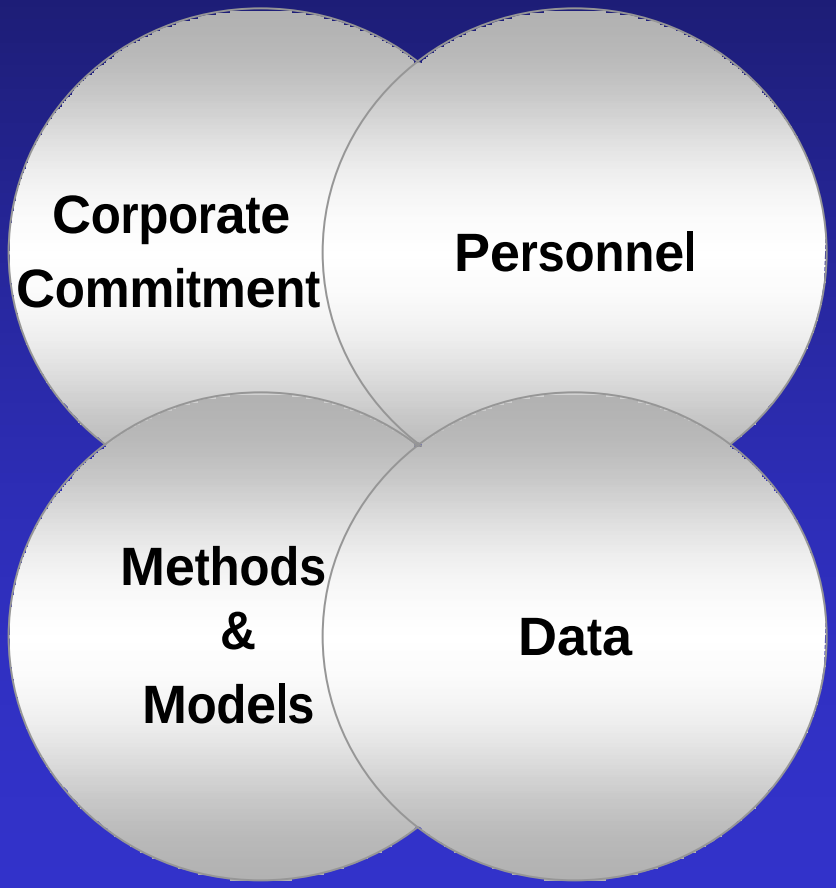
Rationale (and Disclaimer)

- Too many projects go south due to data issues
  - "Silver bullet solutions" won't make data issues go away
- Presentation based on experience – not academic
- Some interaction with Pipeline industry members – not exhaustive
- All points open to criticism

Components of Pipeline Integrity Management



Integrity

Category	Context	Integrity Scale
Corporate	Commitment	
Personnel	Capability	
Methods & Models	Confidence	
Data	Quality	
Pipeline	Operational	

Data Quality

- Quality – “A degree or grade of excellence”
- Directly impacts the “value” of derived information
- Data quality is impacted by:
  - Data Accuracy
  - Data Completeness / Timeliness
  - Data Organization / Usability
  - Data Error

Data Accuracy

- Accuracy refers to data that are the result of measurement
  - Instrument limitations, limitation of recording media, limitation of recording method
- Pipeline data set accuracy will generally be affected by:
  - Spatial (geographic) accuracy
    - GPS Survey, Basemap (USGS, Aerial photography, satellite imagery, etc.)
  - Linear (stationing) accuracy
    - Linear surveys (CIS, DOC, etc.), ILI, Centerline stationing
  - Real Time measurement (SCADA)
- Data accuracy can be measured and controlled
  - Control Points and Instrument Calibration

Data Completeness / Timeliness

- Data set may not exhibit error however
  - If the data set is not complete, it does not accurately represent the entire state of the facility
  - If the data set is not timely, it does not accurately represent the current state of the facility
- Decisions based on less than appropriate completeness & timeliness of data may result in less than judicious action
  - “Appropriate” provides the latitude for phased and periodic data collection

Data Organization / Usability

- **Pipeline integrity management & risk modeling utilizes significant volumes of data**
  - **Number of data set types, Number of pipelines**
  - **Raw data sets, derived data sets, etc.**
- **If data is not systematically organized and managed the result is:**

CHAOS !!

- **Pipeline Integrity Management based on chaotic data structures is not defensible**

Data Error

- Includes primarily “bad” data
  - Error that is unrecoverable but recognizable
  - Error that is undetected (valid – but wrong – values)
- Includes aspects of data accuracy

Types of Data Error

- **Legacy Data Error**
  - **Data from source such as Alignment Sheets that is in error**
- **Transcription Error**
  - **Typing mistakes**
- **Context Error**
  - **“Meta data” for data acquisition or conversion recorded incorrectly or not recorded**
- **Specification Error**
  - **Data specification for acquisition or conversion not followed, or non existent**

Types of Data Error

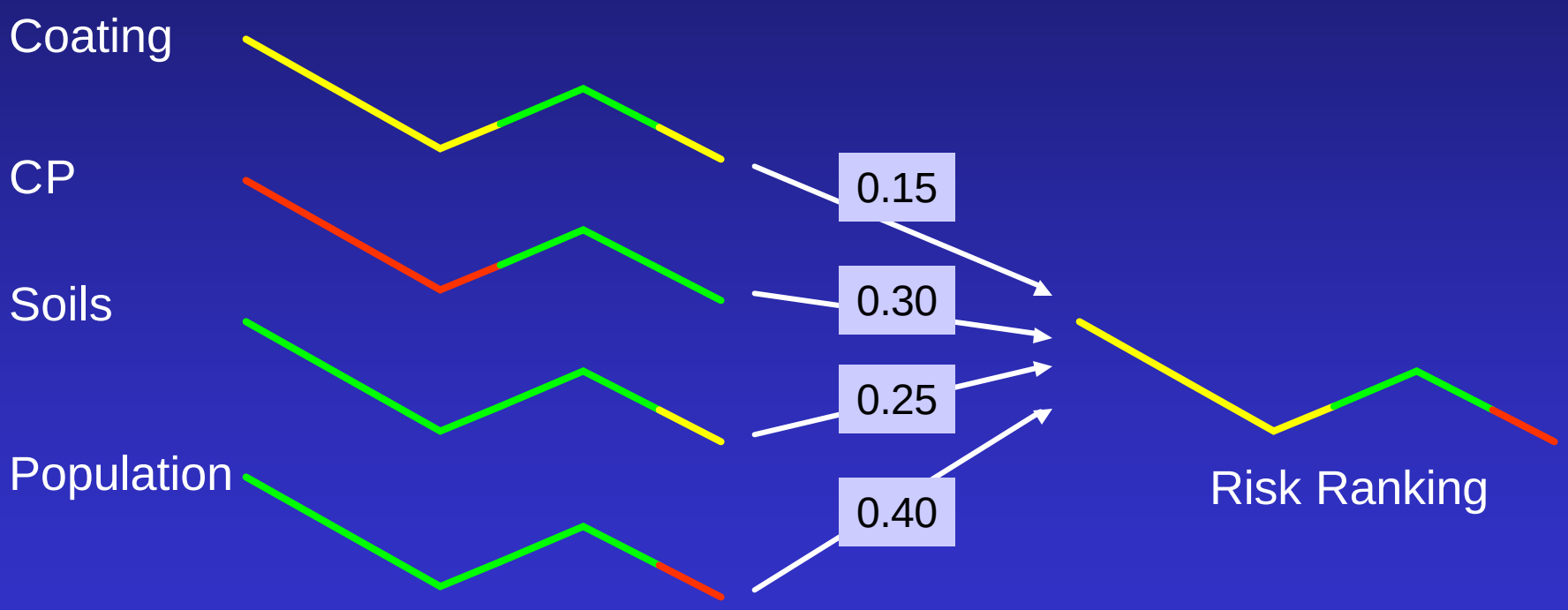
- **Quantified Error**
  - Data source specifies accuracy (USGS Quad - +/- 40 foot, etc.)
- **Unquantified Error**
  - Data source is known to have error, but error is unquantified
- **Centerline Station Control Error**
  - Pipe centerline has widely dispersed or poorly defined station control features (road crossings, section line crossings, etc.)
  - Station control features may have quantified error

Types of Data Error

- Linear “Alignment” Error
  - Data set has widely dispersed or poorly defined linear control features
  - Distance between control features on data set is significantly different from distance on centerline – how should difference be distributed?

- Derived Data Error
  - Data sets that are the result with more than one data set as input
    - HCA Impact Segment is result of intersection of CL with HCA Area (possibly buffered)
    - CL position – Quantified Error; HCA Area – Unquantified error
  - Error of all input data sets must be considered when determining error of derived data sets

Simple Risk Model – Weighted Summation



Handling of Data Error
Weighted Summation

- **Weighted summation is a weighted linear overlay**
  - **Each data set is a set of points or linear segments representing a characteristic over a section of the centerline**
  - **Point & linear characteristics form a weighted “stack”**
  - **Resulting segments from “merging the stack” carry all input characteristics**
  - **Resulting segment length is the “lowest common denominator” of all input segments (including points)**

Handling of Data Error
Weighted Summation

- Error is integrated by “extending” data set elements by the known inaccuracy
  - Example
    - 100 foot segment with linear accuracy of +/- 40 feet
    - 40 feet added to each end of the segment
    - Becomes a 180 foot linear segment
  - Example
    - Point “event” with linear accuracy of +/- 40 feet
    - 40 feet added to each side of point
    - Becomes an 80 foot linear segment

- Linear overlay is performed using “error extended” data elements

Data Classification

- **Thresholding of Data**
  - **“Continuous” data - CP Potential readings, Pit depth, etc. must be set to discreet values (1-10, Good, Medium, Poor) in order to “feed” the Risk Model**
- **Qualitative to Quantitative Transform**
  - **Data such as “coating type” must be transformed from qualitative information (asphalt, FBE, PE) to a numeric value**
- **Matrix Classification**
  - **Two or more variables may be incorporated into the classification process**

Managing Data Quality

- Rule #1 – Your data is likely in worse shape than you thought it was
- Understand integrity management objectives
  - Regulatory satisfaction or “Dig here”
- Understand integrity data requirements thoroughly
  - Fundamental data sets, optional data sets (fine tuning)
- Each data set should be documented
  - Data Source
  - Accuracy / Control
  - Error Issues
  - Processing Methods
  - Data structure requirements
- Remember – computational result reflects the worst error from input data sets