

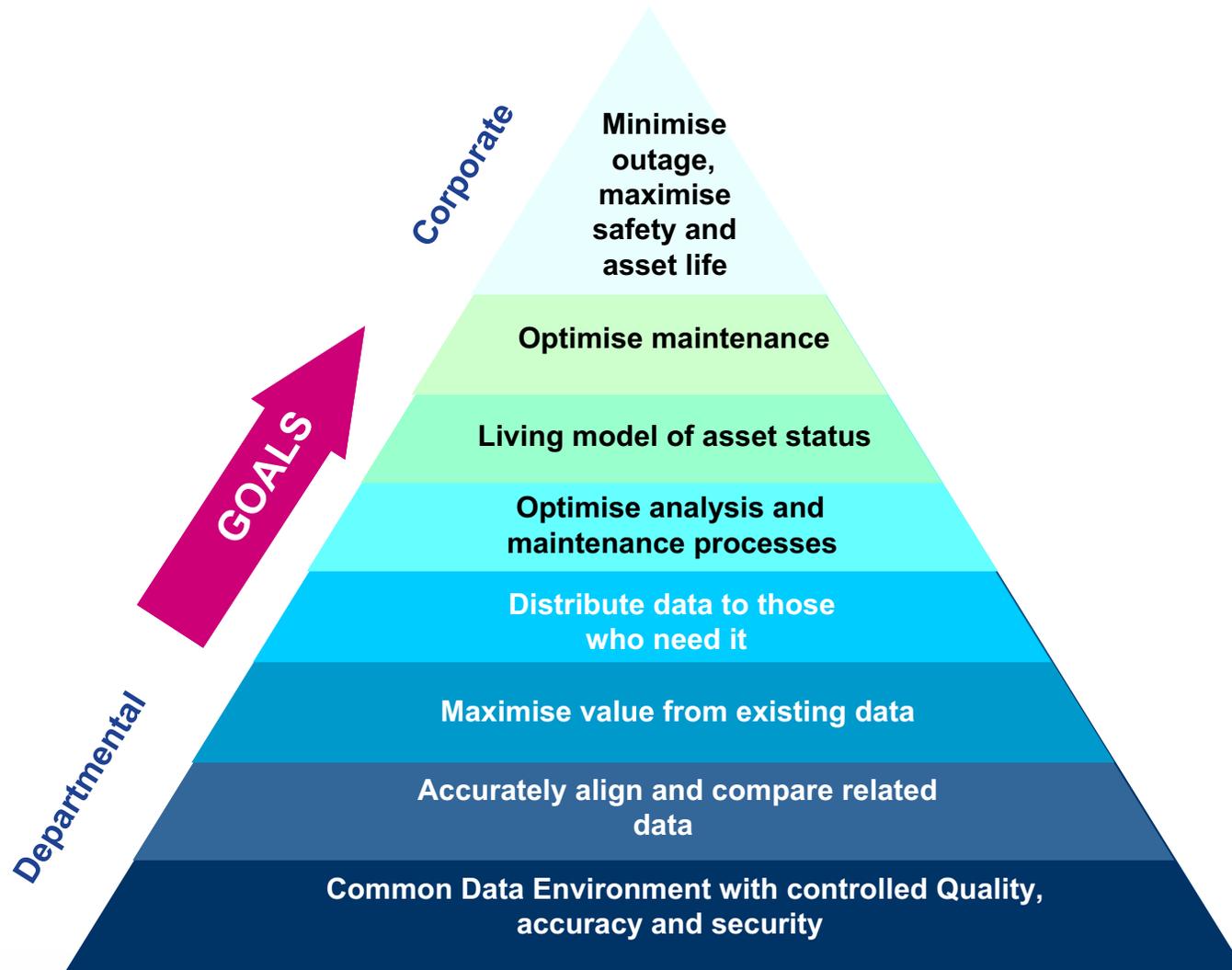
# GE Oil and Gas

## PII Pipeline Solutions

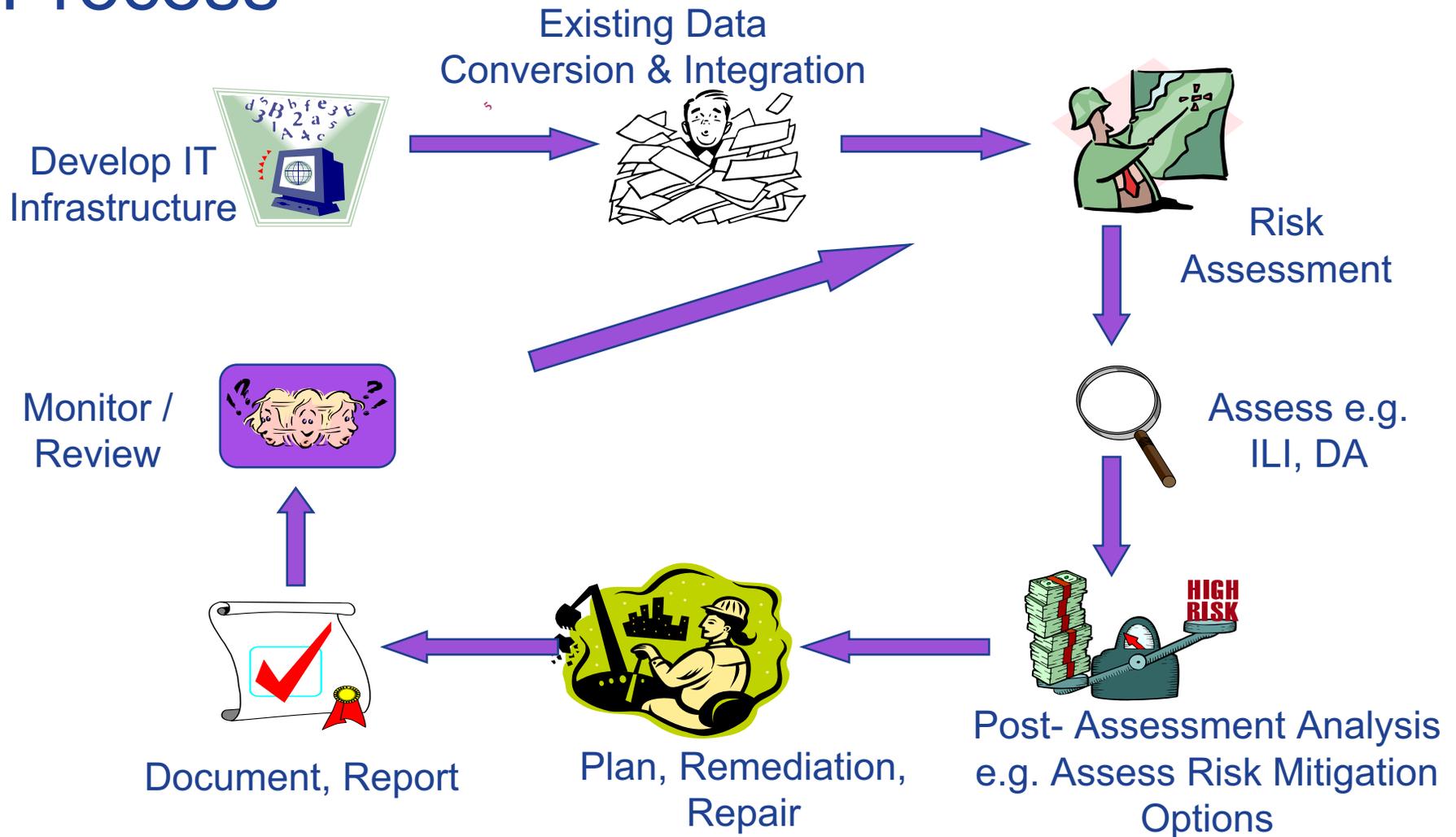
Data Mining and Threat Assessment Track  
Data Visualization and Analysis Tools



# Business Goals



# Pipeline Integrity Management Process

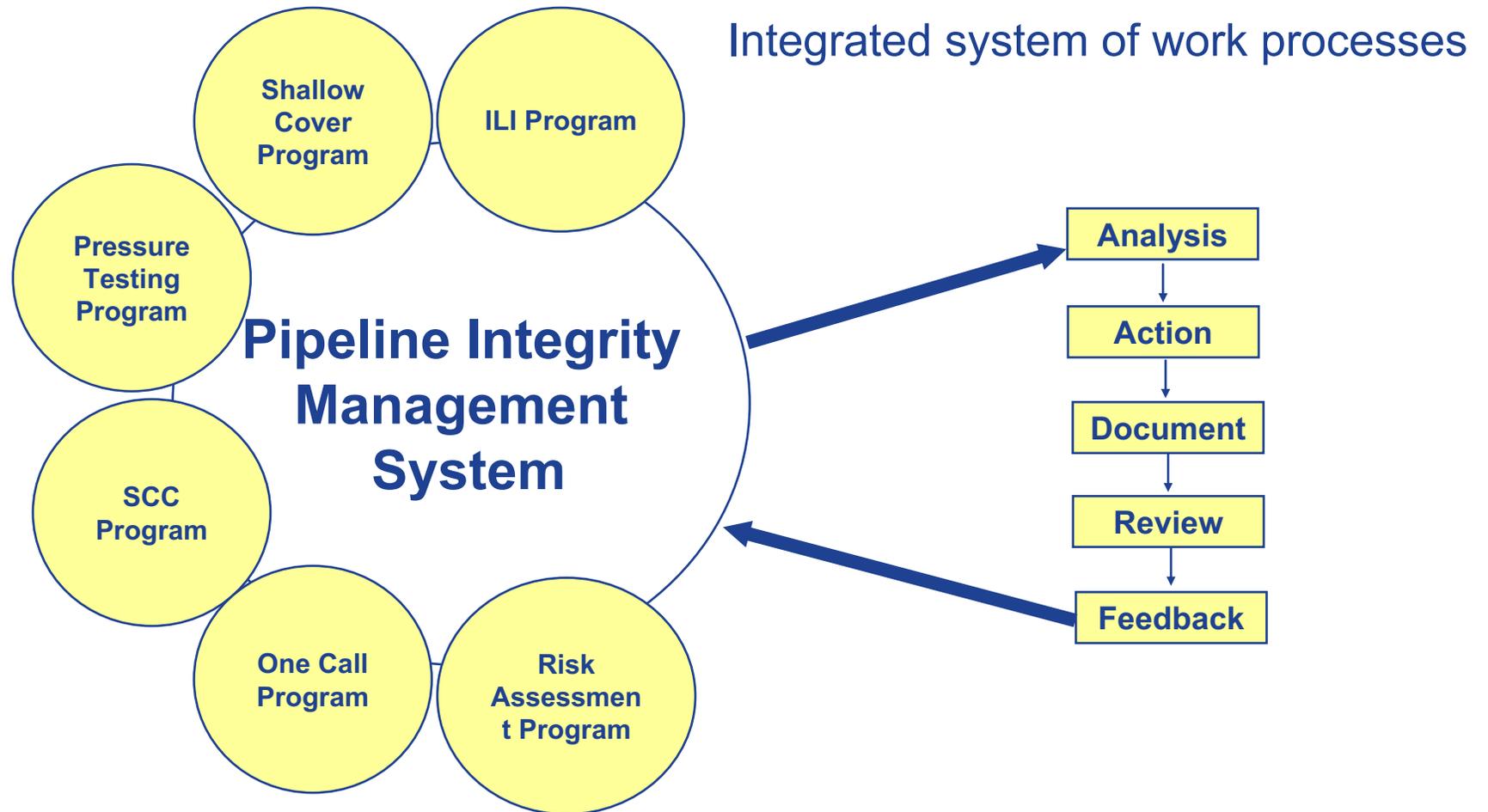


# Traditional Model of Pipeline Management

Distinct areas of work management



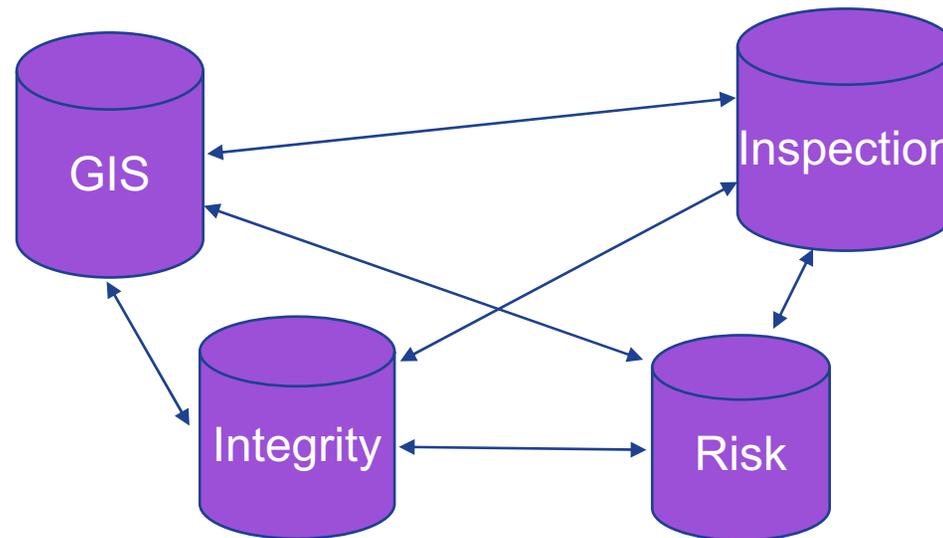
# Data Management as the Foundation



# Data Models

Data Models are used to store the information collected in a series of tables

Tables and different databases can “talk” to each other to get a comprehensive view of what is happening in the ground



Smallworld Core - CornerStoneP

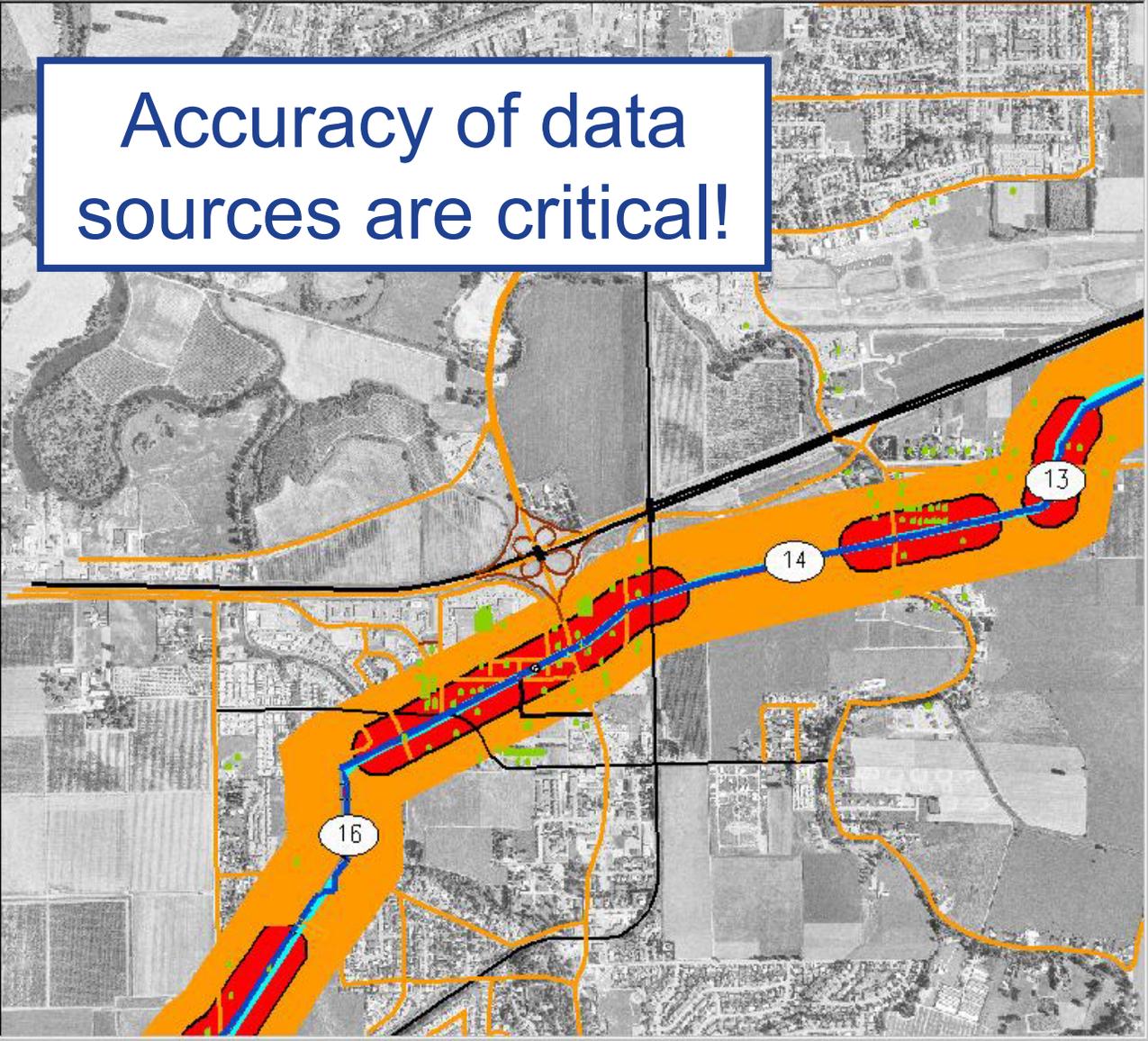
File Edit View Trail Tools Window Application Help

0 1500 3500 ft

1:20428 1:100 Washington North [4601] nad83 (cm) All Value Step 3 - Reposition Pipe Segments

Main View

Accuracy of data sources are critical!



The main view displays an aerial photograph of a rural area with a pipeline route overlaid. The route is highlighted with a thick orange line, and specific segments are marked with red and blue. Station markers 13, 14, and 16 are visible along the route. The map is overlaid with a grid and various data layers.

Theme: Default

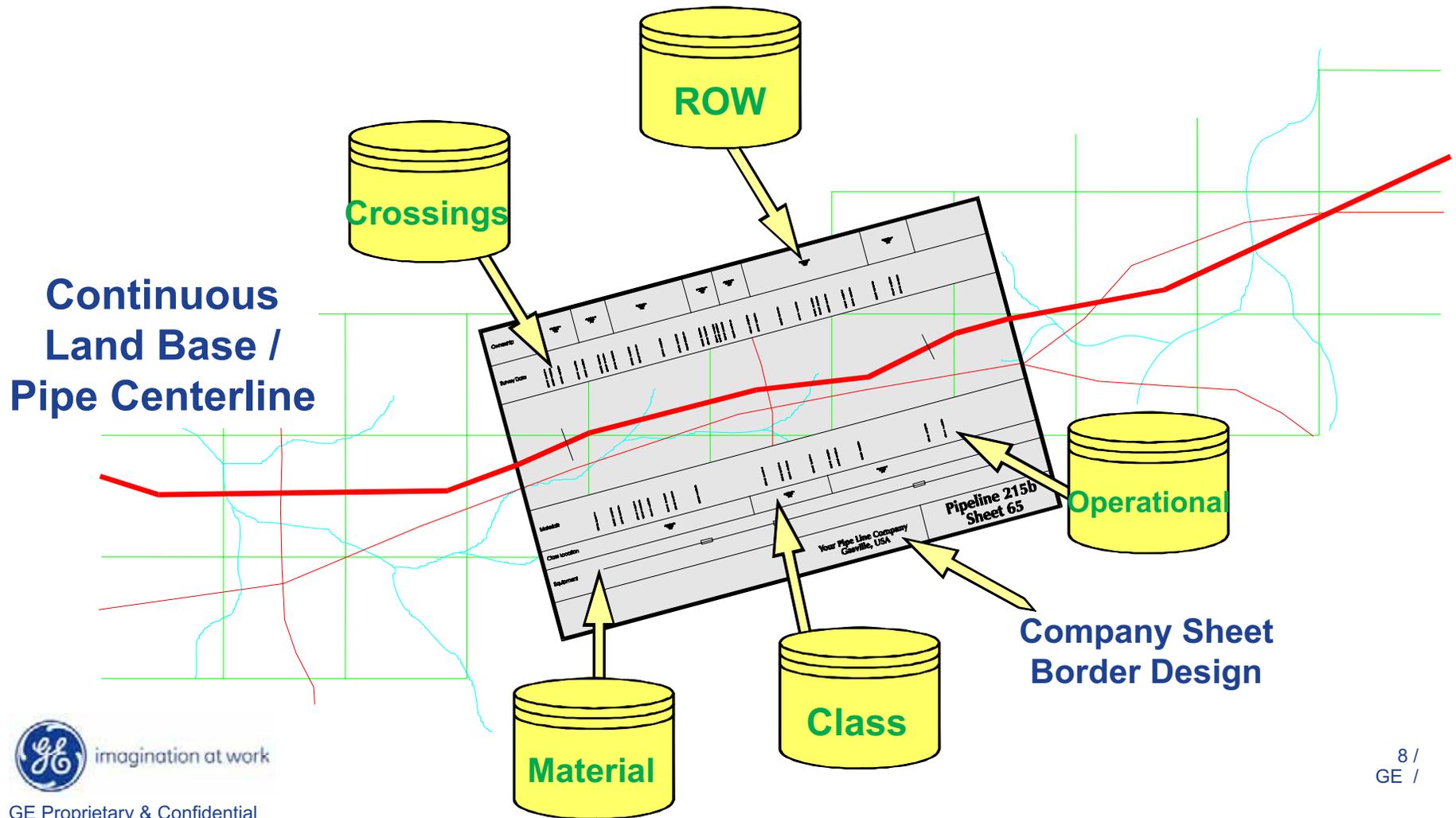
Object Control Object Editor Tab

1:100

Gis (Smallworld Datastore)

- Gas Centerline
- Gas Facilities
- TRIM Land Base
- Cadastral Land Base
- Other
  - Alignment Sheet
  - BCGS Tile
  - Digital Elevation Model
  - Ortho Photo**
  - 5 Plot Inset
  - Representation Map
- Lands System
- Emergency Response
- Pipeline Integrity
- Communications
- Pt St John - Land / Legal
- Pt St John - Pet./Nat. Gas Faciliti...
- Pt St John - Cadastral
- Pt St John - Land Use
- Boundaries
- Representational Graphics
- System
- Miscellaneous
- Work Management
- DXF Translation Objects

# Traditional Hard Copy Alignment Sheets from Digital Data



# Web Based Document Management

The screenshot displays a web-based GIS application interface. The main map area shows a geographic area labeled 'Demoa' with various colored overlays representing pipeline alignments and other data. A 'My Layers' panel on the left lists various data layers such as Buffers, Facility Data, Grids, Imagery, and Landbase. An 'Alignment Sheets Report' window is open, showing a table with the following data:

Pipeline System Name	Line Name	Sheet Name	Beg. Station	End Station
Tertiary	100	PI_SHT_111	55422.22	81546.73
Tertiary	200	PI_SHT_111	55422.22	81546.73
Tertiary	300	PI_SHT_111	55422.22	81546.73
Tertiary	400	PI_SHT_111	55422.22	81546.73

Below the table, it indicates 'Count: 4' and provides options to 'Return to Report Selection', 'Close Report Window', and 'Print Report'. A detailed view of a pipeline section is shown in the bottom right corner, featuring a cross-section diagram with vertical bars, a grayscale aerial photograph of the ground, and a technical drawing of the pipeline structure. The status bar at the bottom of the application window shows '1 'Alignment Sheets' selected', '1:136,215', and '8.42 x 6.36 (in)'.

# Visualization and Analysis Tools

Create the ability to analyze pipeline integrity and evaluate remediation actions.

**Data Alignment** – Load & align new inspection data to a common reference system for subsequent analysis

**Analyze Features** – Engineering critical analysis of in-line inspection data with criteria to determine response

**Assess Risk** – Risk assessment including “what-if” scenario analysis

**Integrity Planning** – Generation of integrity management plans based on risk results and pipeline conditions



# Data Alignment

Data Alignment is critical to load new inspection data and align to a common reference system for subsequent analysis.

- Load integrity-related data such as in-line inspections (ILI), and above-ground surveys
- Account for various file formats
- Manage disparate data in a single reference system for easy comparison and analysis
- Improve integrity decision-making using aligned data as an overall view of cause and effect issues at specific locations Align data for more accurate location for analysis and subsequent field activities
- Relate common features in a graphic or tabular format for alignment
- Proportionately distribute features between aligned features
- Receive immediate visual feedback when adjustments exceed specified tolerances



# Data Alignment

Select any inspection data set as the data to be aligned;  
Select any ILLI run or facility database as target for alignment.

**Data Selection**

 Master Data: Data set used to align data to. Slave Data: Data set to be aligned to the Master data set.

**Select Slave Data**

ContractId	ContractName	OperatingCompany
7	07 EXPRESS ML103	GE
9	07 EXPRESS MAIN LINE T	GE
11	DIG SHEET ML	GE

**Select Master Data**

ContractId	ContractName	OperatingCompany
	Facility Data	
7	07 EXPRESS ML103	GE
9	07 EXPRESS MAIN LINE T	GE
11	DIG SHEET ML	GE

OK Cancel



# Data Alignment

**Slave: ILI**

Matche	Position	MatchID	ID	Feature	Station
<input type="checkbox"/>			1269	Weld	1017.14
<input checked="" type="checkbox"/>		0	1208	Dent	1090.14
<input type="checkbox"/>			1202	Weld	1197.08445026178
<input type="checkbox"/>			1245	Weld	1219.91528795812
<input type="checkbox"/>			1199	Weld	1231.33070680628
<input type="checkbox"/>			1265	Weld	1284.20212041885
<input type="checkbox"/>			1243	Weld	1292.61348167539
<input checked="" type="checkbox"/>		1	1264	Weld	1319.65
<input type="checkbox"/>			1210	Weld	1449.41450381679
<input type="checkbox"/>			1271	Weld	1543.19389312977
<input type="checkbox"/>			1224	Dent	1549.73664122137
<input type="checkbox"/>			1236	Dent	1561.73167938931
<input type="checkbox"/>			1230	Dent	1568.27442748092
<input checked="" type="checkbox"/>		2	1272	Weld	1605.35
<input type="checkbox"/>			1273	Weld	1616.35
<input type="checkbox"/>			1228	Dent	1621.25

**Master: FacilityData**

MatchID	ID	Feature	Station	Difference
	19	Valve	0	
	459	Valve	16.2	
0	441	Tap	1090.14	-106.14
1	442	Tap	1319.65	46.35
2	12966	RoadCrossing	1605.35	22.65
	12970	RoadCrossing	3923.04	
	12969	RoadCrossing	4040.92	
	462	Valve	5774.73	
	470	Tee	8032.19	
	440	Tap	12582.84	
	468	Tee	15124.51	
	464	Valve	16394.03	
	437	Tap	20832.03	
	435	Tap	21734.14	
	466	Tee	24146.52	
	468	Valve	24228.07	

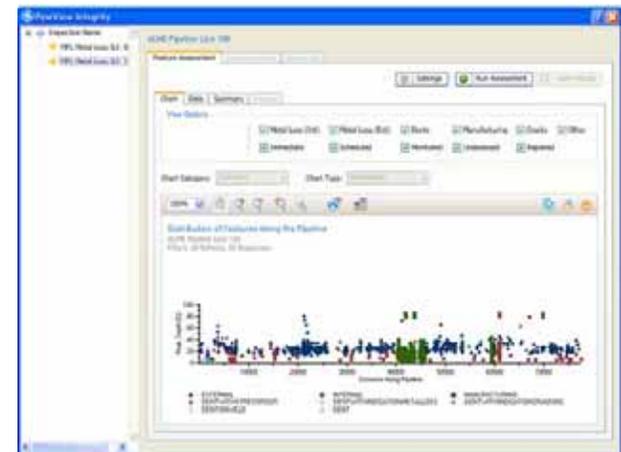
Get immediate feedback about your alignment based on user-defined tolerances.



# Assessing Features on the Pipeline

Feature Assessment allows the performance of engineering critical analysis of in-line inspection data with criteria to determine response types.

- Identify features that pose immediate integrity threats
- Generate dig sheets with field-location data of individual features for validation and repair
- Use industry-standard assessment methodologies: ASME B31.G, Modified ASME B31.G, DNV and Shannon
- Perform corrosion growth analysis using general corrosion growth rate models or growth rate ranges
- Apply response criteria as set by ASME B31.8S or API1160 or utilize safety factors including specifying per class location or HCA
- View results in tables, charts and reports and filter by feature type (internal metal loss, external metal loss, dents, manufacturing, cracks) and response type
- Automatically determine POF classification of each feature
- Use various charts to display features (peak depth, growth location, and distribution on individual pipe segments) and results (RPR, ERF, Sentence Plots)



# Feature Assessment

Perform engineering critical assessment of ILI data including B31.G, Modified B31.G, DNV and POE calculations.

The screenshot displays the 'Feature Assessment' software interface. The main window shows a data plot titled 'Distribution of Features Along the Pipe' with 'Peak Depth [%]' on the y-axis (0 to 100) and 'Distance Along Pipe' on the x-axis (0 to 800). The plot contains data points for 'INTERNAL' (circles) and 'MANUFACTURING' (squares). A tooltip for an internal feature shows: 'INTERNAL Peak Depth (%): 21 Location: 812 Product Status:'. The 'Feature Assessment Settings' dialog box is open, showing the following configuration:

- Assessment Methodology:**
  - Metal Loss: B31G\_Modified
  - Manufacturing: Shannon
  - Cracks: Crack Assessment (7910) Case 1 Axial Through
  - Deterministic Only
  - Probability of Exceedance (depth condition)
  - Exceedance Limit: 0.0001
  - Tool Tolerance:  +/- 10 % for 90 % of the times;  +/- 0 mm for 0 % of the times (USWM)
- Response Criteria:**
  - Maximum Allowed Metal Loss: 80 % of wall thickness
  - Gas:**
    - ASME B31.8S / 49 CFR Part 192
    - RPR Threshold: 0
    - Safety Factor Only
    - Class1: 1.5; Class2: 2; Class3: 2.5; Class4: 3.5
  - Liquid:**
    - API 1160 / 49 CFR Part 195
    - RPR Threshold: 0
    - Safety Factor Only
    - ERF Threshold: 0

Determine response criteria via safety factor approach or using B31.8S and API1160 with configurable criteria.

# Feature Assessment

Manage resulting repairs in a spreadsheet-like interface including capturing proposed and actual remediation activities.

The screenshot displays the 'Feature Assessment' application window. The main area shows a 'Repair List' table with columns for TYPE, SEVERITY, STATION, RECOMMENDED, and SCHEDULED. The table contains 15 rows of data, with some rows highlighted in red, green, or yellow. Above the table are 'View Options' for filtering repairs by inspection type and defect category. A secondary window, 'Adobe Reader - [tmp109.PDF]', is overlaid on the right, showing a 'Dig Sheet' for 'MAIN LINE 103/13767'. The dig sheet includes a feature description, location, and a schematic diagram of a pipe with markers for feature locations.

TYPE	SEVERITY	STATION	RECOMMENDED	SCHEDULED
Metal Loss	180-day	767	Cut Out	02/22/2007
Material Defect	Scheduled	749	No Decision	
Metal Loss	Immediate	1219	No Decision	
Metal Loss	1 Year Response	728	Re-Apply Coating	
Material Defect	Scheduled	1677	No Decision	
Metal Loss	Immediate	1162	Re-Apply Coating	02/26/2007
Dent	Immediate	692	Cut Out	01/10/2007
Metal Loss	Scheduled	684	No Decision	
Material Defect	Scheduled	667	No Decision	
Metal Loss	Scheduled	644	No Decision	
Dent	Immediate	634	Cut Out	01/09/2007
Dent	Immediate	984	Cut Out	01/19/2007
Dent	Immediate	1651	Cut Out	01/24/2007
Metal Loss	Immediate	1485	Re-Apply Coating	02/20/2007
Material Defect	Scheduled	1663	No Decision	
Metal Loss	Scheduled	619	Re-Apply Coating	

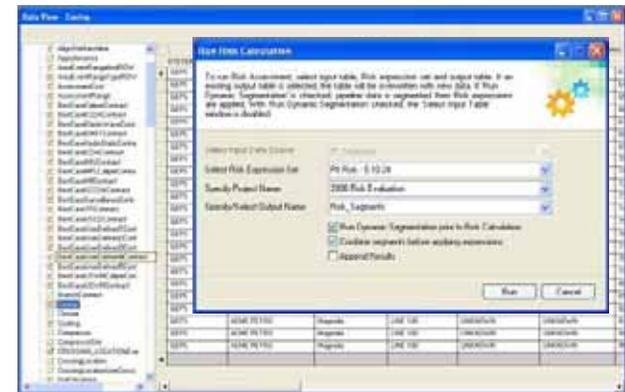


Generate excavation sheets to locate features in the field.

# Risk Assessment

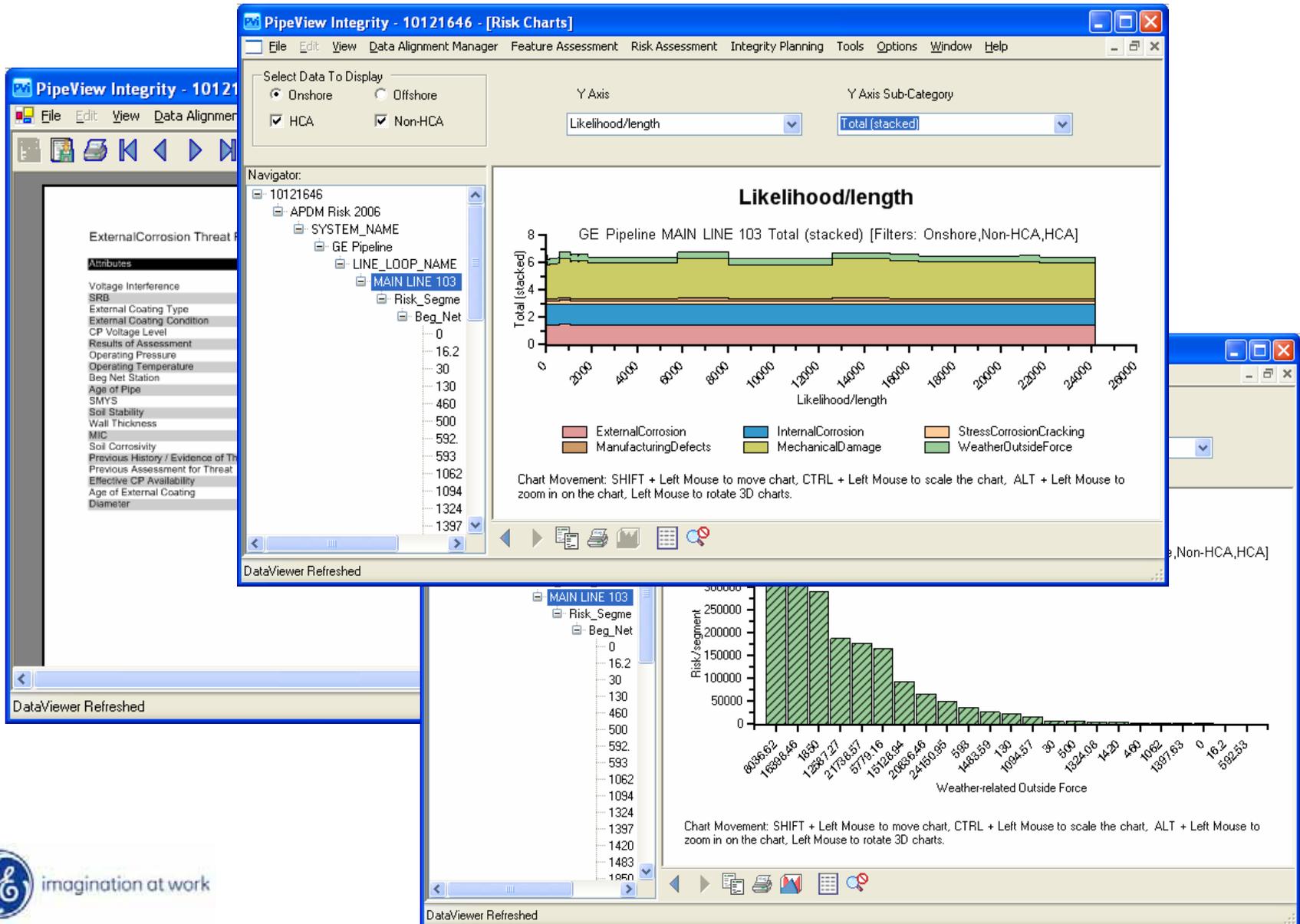
Risk Assessment provides the ability to perform semi-quantitative risk assessment including “what-if” scenario analysis.

- Rank all pipeline segments with semi-quantitative risk model considering probability and consequence of failure
- Customize risk equations and weighting factors
- Automatic dynamic segmentation of pipeline data based on attributes that contribute to risk equations
- Roll-up resulting risk segments for effective reporting and remediation planning
- View results in reports and graphs with ability to drill down to view specific attribute data that drove risk on individual segments
- Evaluate results in a risk matrix with user defined threshold limits
- Define “what-if” scenarios can be performed to evaluate the effectiveness of various remediation strategies



*PipeView Integrity Risk Assessment*

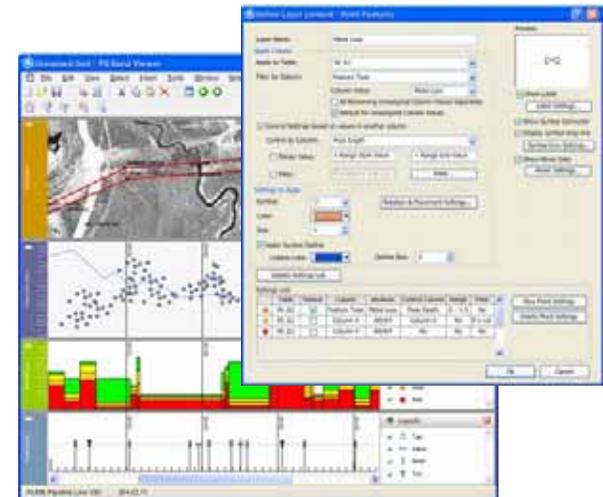
# Risk Assessment



# Moving from Static Alignment Sheets to Dynamic Views

Providing effective access to data in band views, data views and reports.

- Assess pipeline data by viewing as bands along the length of the pipeline with the ability to zoom and navigate
- Configure various bands to establish effective visualization including control of symbols, labels, tool-tips, line types
- Dynamically add and remove defined bands and optionally save as named band layouts
- Include map band with landbase data for location purposes
- View data with y-axis control for scatter plots, line graphs and histograms
- Control color and symbology based on specified data ranges to more effectively locate and present areas of concern
- View data spreadsheet-like Data Views including ability to control column visibility and order, sort based on data in specified column
- Customized reports based on corporate requirements



**SchematicViewer** Pipeline MapView

Available Lines

- Lines
  - MAIN LINE 068
  - MAIN LINE 103

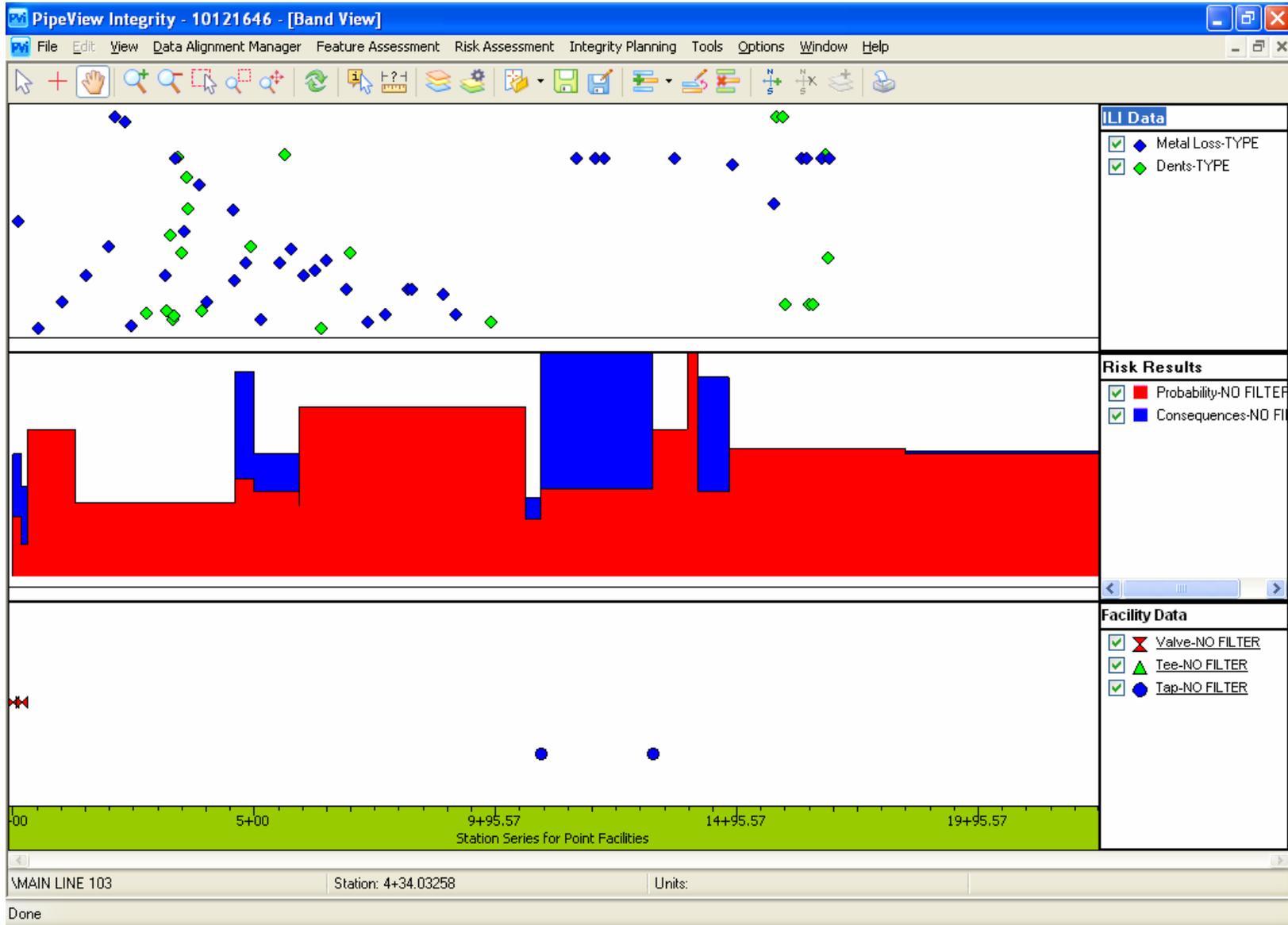
Available Sessions

Session Name	Last Modified Date
10121646	Monday, January 22, 2007...

Map Satellite Hybrid

Data Alignment Feature Assessment Risk Assessment Integrity Planning View All Data

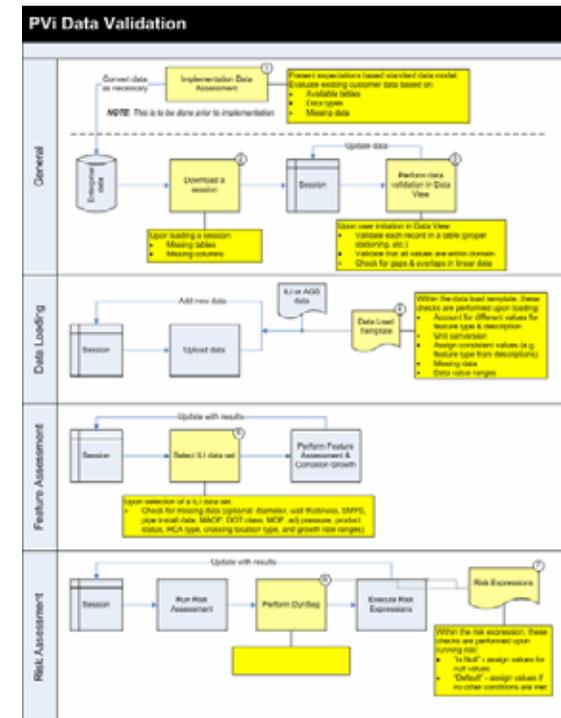
# Band View



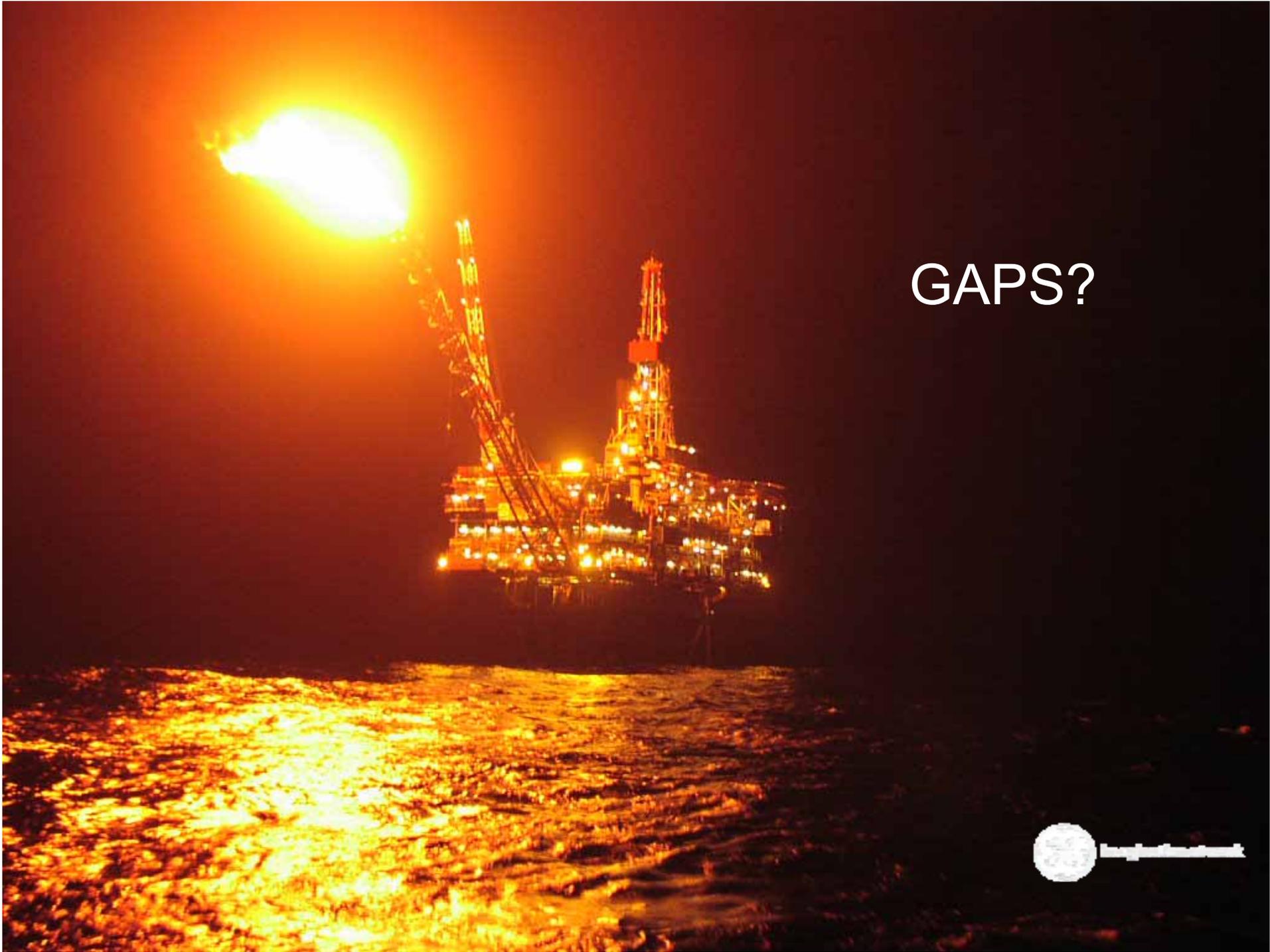
# Summary

Proper data configuration and management provides the ability to access/visualize enterprise data and to perform analysis.

- Ability to leverage data stored in enterprise data systems
- Perform data validation (missing data, data ranges) as part of loading new inspection data
- Check for missing data needed for analysis when selecting ILI data set for assessment
- Validate each table for proper stationing and check for gaps & overlaps in linear data
- Ability to assign default values for missing or out of domain range data as part of risk assessment



PipeView Integrity Data Validation



GAPS?

