



Data Management Practices For Pipeline Integrity

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Pipeline Data Management

“From Data to Wisdom”*

- **Data**
 - Numeric values - pipe attributes, environmental attributes, obtained through inspection , etc
- **Information**
 - Extracted from data through processing. Contained in descriptions (who, what, where, when, how many)
- **Knowledge**
 - Familiarity gained through experience. Makes possible the transformation of information into instructions.
- **Understanding**
 - Knowing the cause and how to correct it
- **Wisdom**
 - The capability to judiciously apply resources

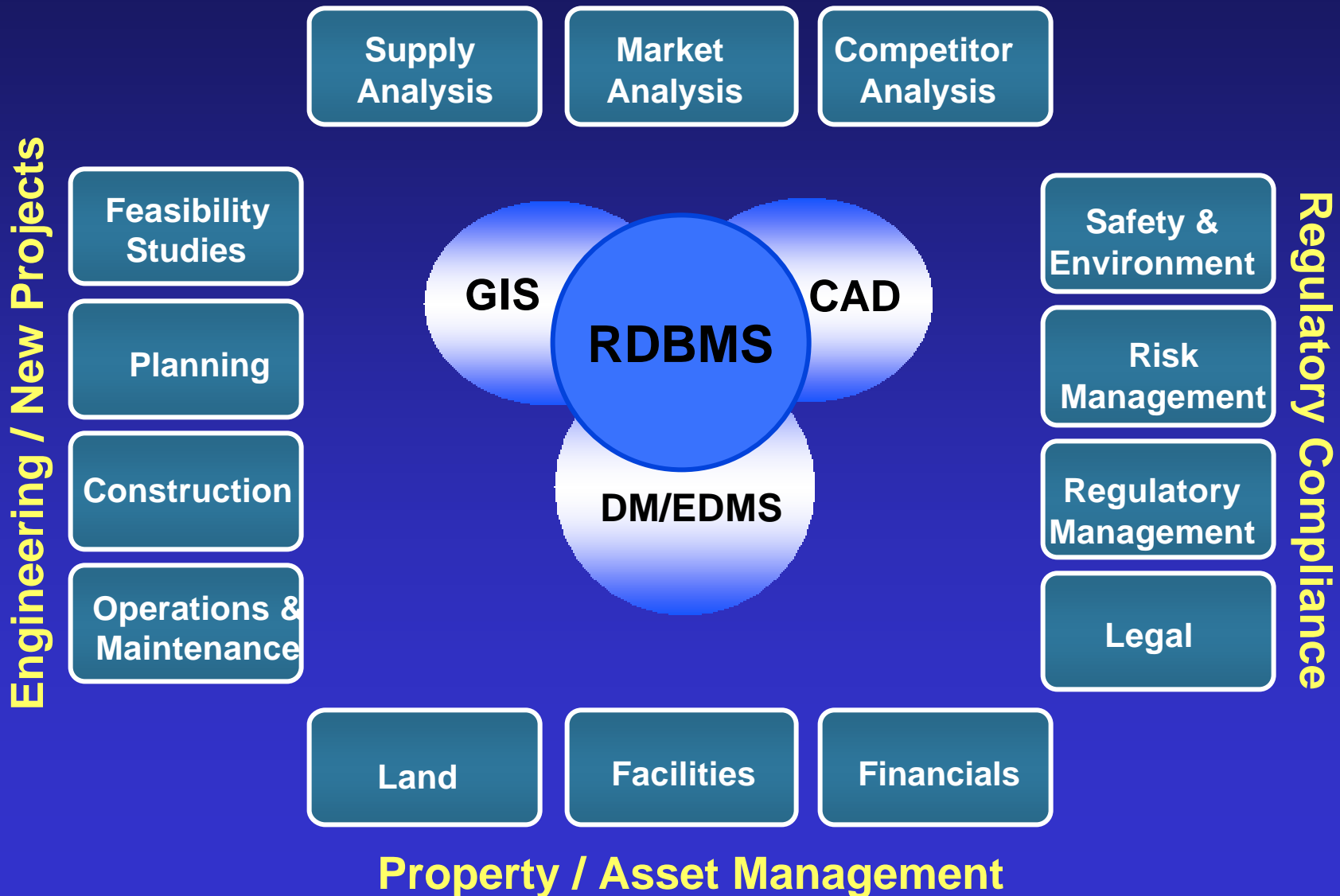
* Russell Ackoff

Pipeline Data Management

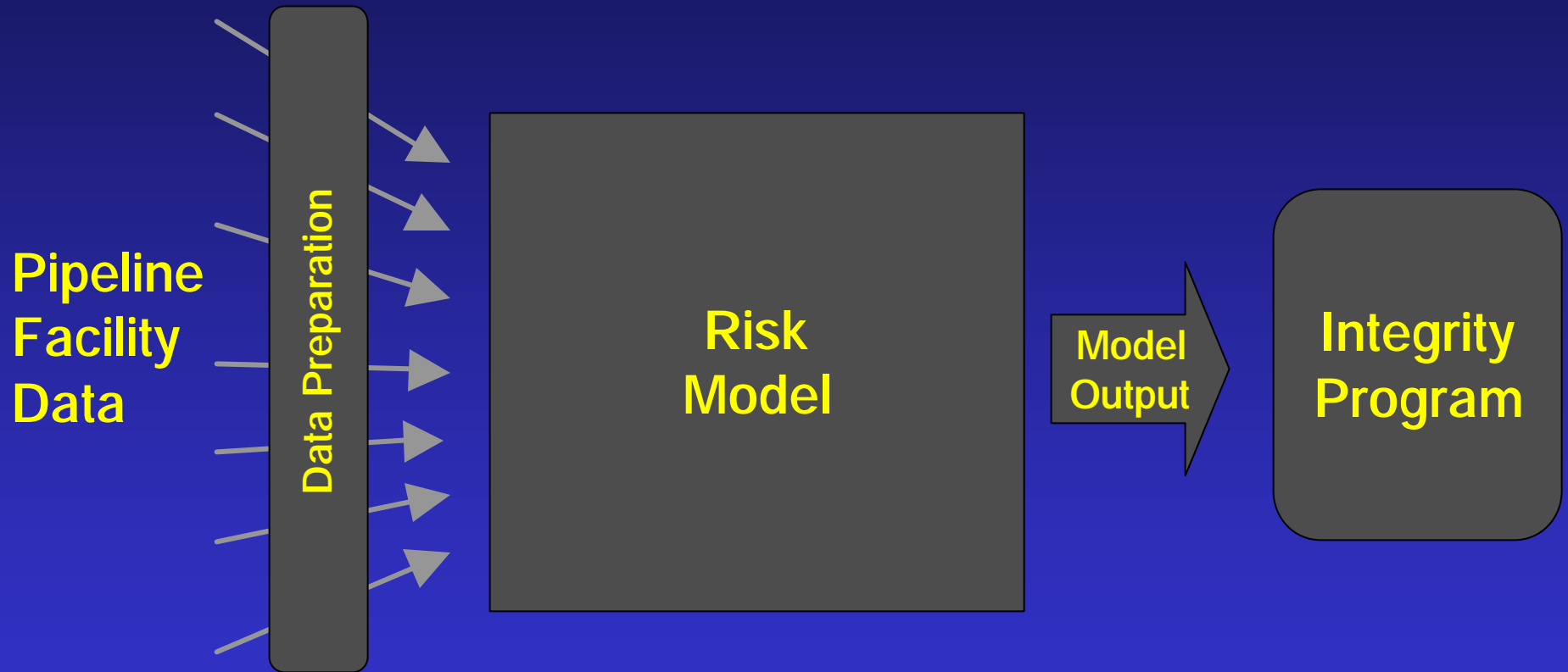
- **Objective**
 - Provide a framework for a coherent, well managed, easily accessible collection of information regarding the facility, operating environment and the operating history
 - **Information Value - Improved with the ability to integrate with other information**

Enterprise Perspective

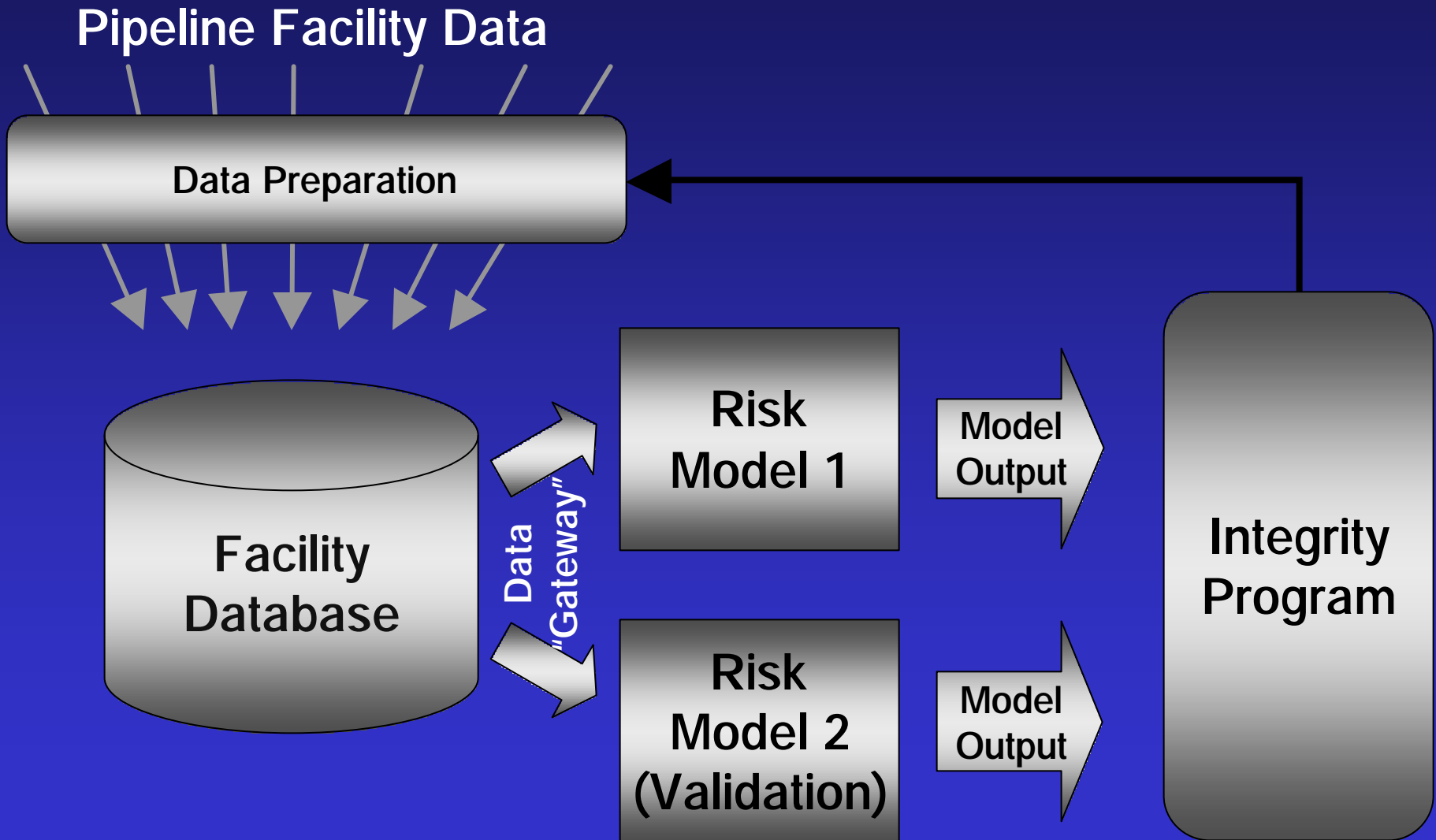
Improved Revenue / Competitive Position



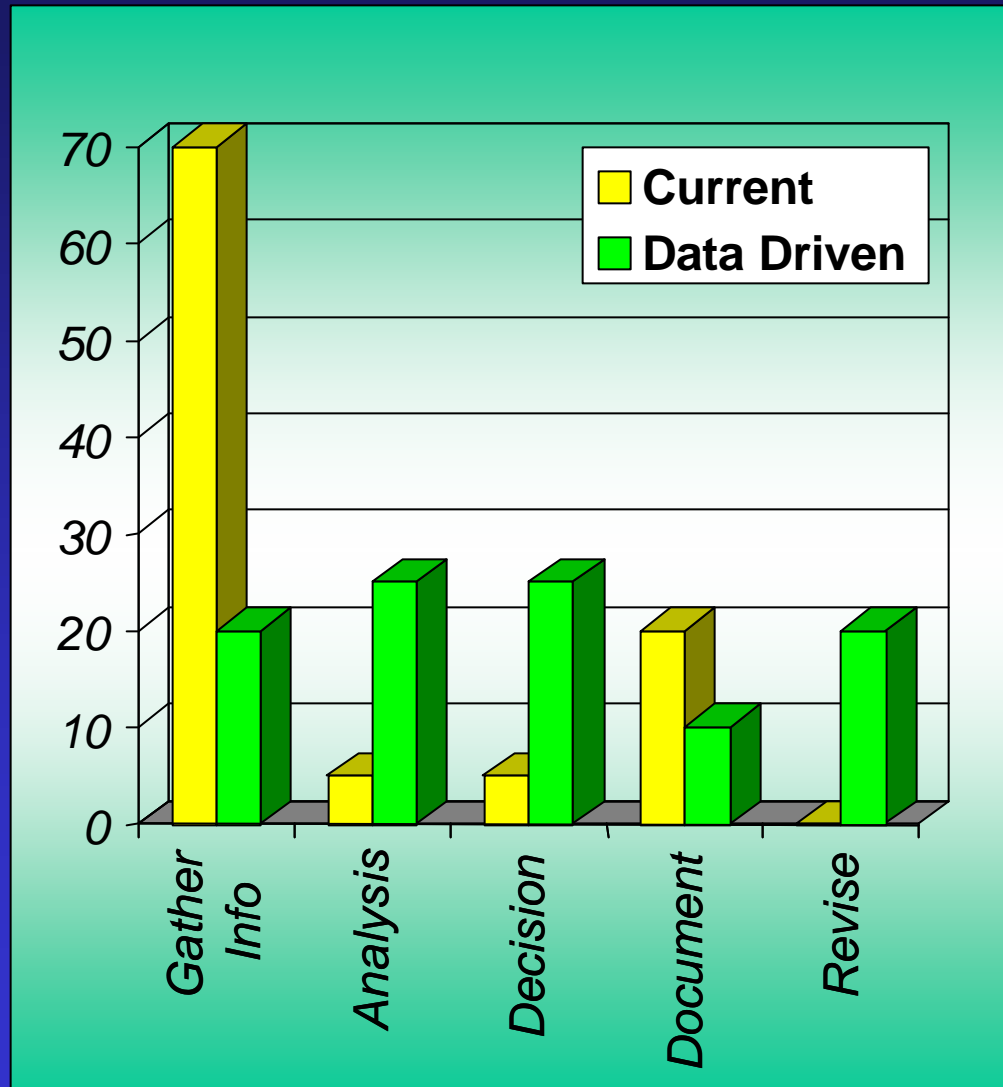
“Model Centric” Risk Assessment



“Data Centric” Risk Assessment



Re-engineering the Risk Assessment Process



Objectives

- ✍ Stepwise reduction in effort to gather and format information
- ✍ Improve analytical environment
- ✍ Facilitate decision modeling and scenario building
- ✍ Improved documentation of decision rationale
- ✍ Flexibility of process to incorporate revision

Acceptance and Confidence

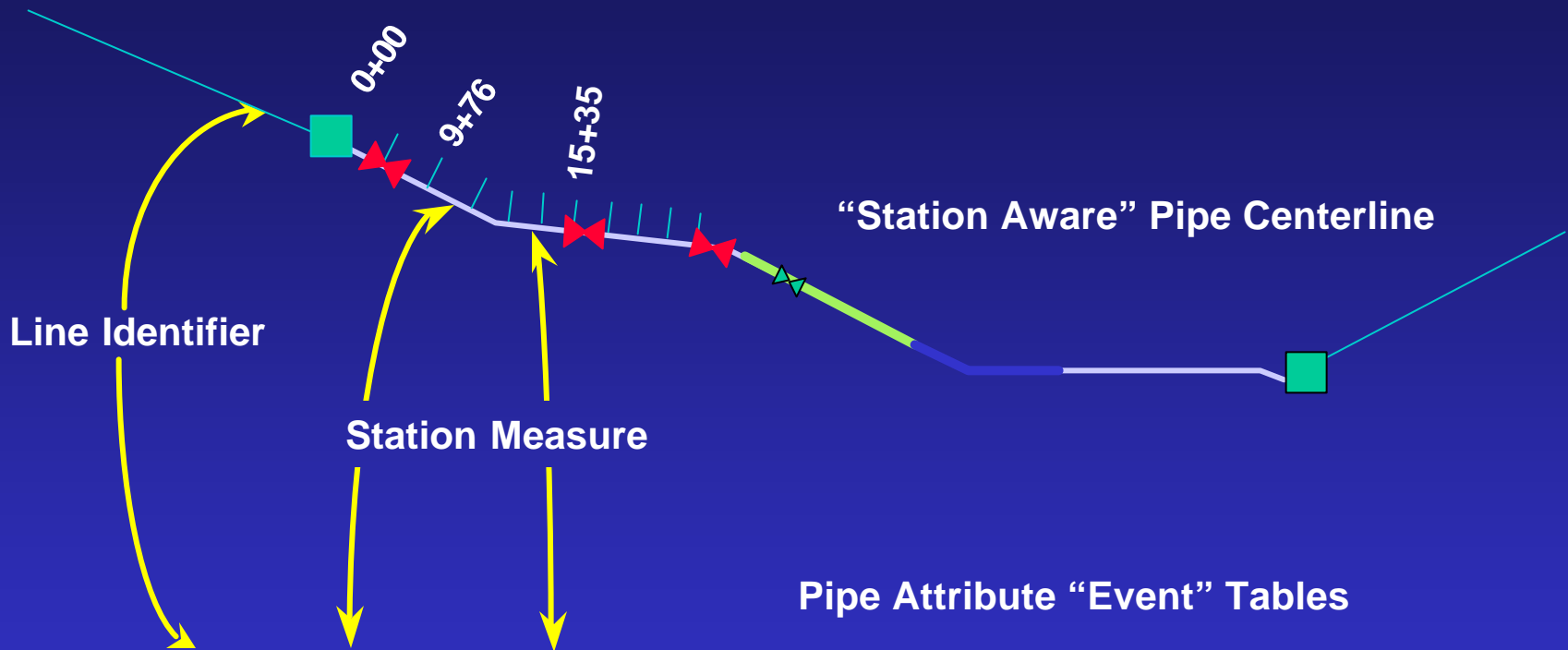
Formulating Decisions from Risk Assessment

- **Characteristics of a Risk Assessment Process which lead to acceptance and confidence**
 - Feasible
 - Systematic
 - Defensible
- **To establish confidence, risk results must be *validated***
 - models must be “robust” and based on accepted research
 - alternate models should deliver similar results
 - Quality of data must be maintained (garbage in / garbage out)
 - Raw data must be available for diagnostics

Pipeline Data Model

- **Basemap**
 - Vector: Transportation, Hydrography, HCA polygons, etc.
 - Raster: DRG, DOQ, Photography, etc.
- **Pipe Centerline**
 - Station aware
- **Attribute (event) Tables**
 - Relational tables linked to centerline by line identifier and stationing
 - Point (valves, meters, pig anomalies, etc.)
 - Linear (casings, coating, pipe spec, hydrotest, etc.)
- **“String” or “Series” data**
 - Efficient management of survey data (CIS, PIG, DOC, etc.)

Linear Referencing (Dynamic Segmentation)



LINE_ID	BEG_STATION	END_STATION	PIPE_OD	DESCRIPTION	WALL_THICK	WELD_TYPE	IN_SERVICE	GRADE
1	196	693	10.75	REPAIRED	0.250	E.W.	4/1/58	X-42
1	693	1210	10.75	REPLACED	0.219	E.R.W.	9/1/75	N/A
1	1210	1706	10.75	REPLACED	0.219	E.R.W.	12/1/63	X-46
1	1706	2200	10.75	REPAIRED	0.250	E.W.	5/1/58	X-42
1	2200	2500	10.75	REPAIRED	0.250	E.W.	7/1/56	X-42
1	2500	2691	10.75	REPAIRED	0.250	E.W.	7/1/56	X-42
1	3181	3671	10.75	REPAIRED	0.250	E.W.	2/1/60	X-42
1	3671	4000	10.75	REPAIRED	0.250	E.W.	12/1/55	X-42
1	4161	5200	10.75	REPLACED	0.219	E.R.W.	11/1/75	N/A
1	5200	5577	10.75	REPLACED	0.219	E.R.W.	11/1/75	N/A
1	5577	5674	10.75	INSTALLED	0.250	E.R.W.	6/1/73	X-52

Risk Modeling

Data Related Issues

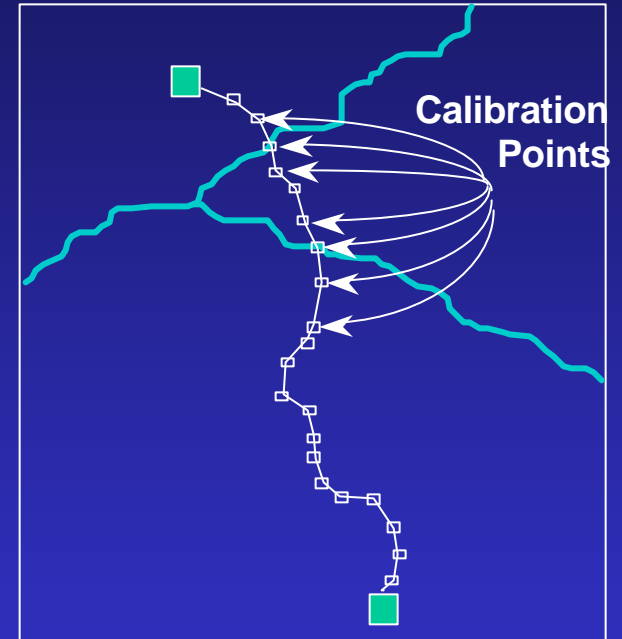
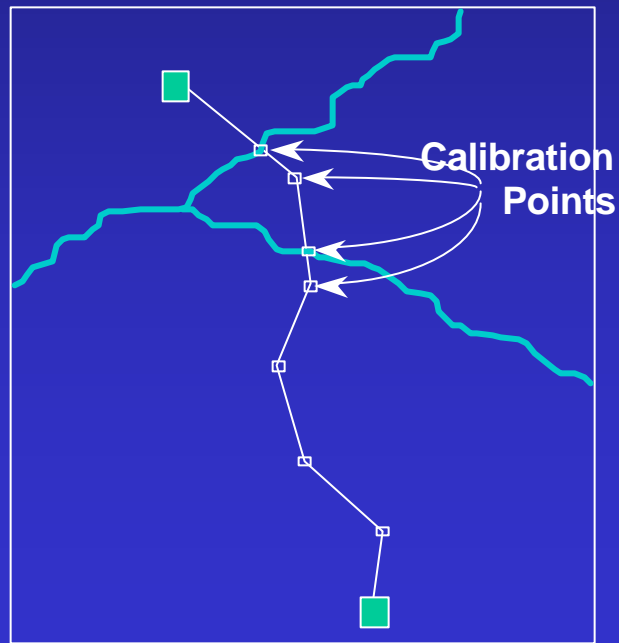
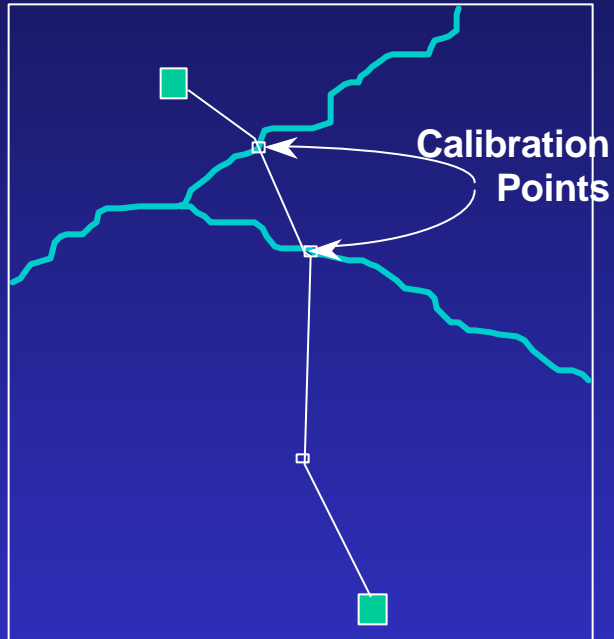
- **Pipe Centerline Definition**
 - **Establishing a geographic pipe centerline allows**
 - Full confidence in determination of impact on HCA
 - Determination of interaction between pipeline and off line features (residential development, roads, rail, etc.)
 - Submission to NPMS
 - **Establishing a “stationed” geographic centerline allows**
 - Integration of data sets utilizing station as a common location
 - Integration of “stationed” data sets with geographic data sets

Risk Modeling

Data Related Issues

- **Pipeline Attributes – Stationing vs GPS Location**
 - Maintaining station provides a location wrt pipe centerline
 - GPS location provides an absolute location (wrt Earth)
 - GPS located points will only fall on pipe centerline if both GPS location and pipe centerline have high accuracy
 - Maintaining stationing allows “enhancement” of centerline position
 - stationed points will always fall on centerline.
 - Integration of data sets can be performed without a “perfect” pipe centerline.

Evolutionary Centerline Development



Risk Modeling

Data Related Issues

- **Model / Data Dependencies**
 - User should understand impact of a data set on model
 - Not a “black box”
 - Model must be defensible
 - 20% of factors have 80% of influence on model output
 - Model should operate with any number of data inputs
 - Allows “iterative modeling” & model refinement on as needed basis

Risk Modeling

Data Related Issues

- **Data Preparation**
 - A suite of processing data processing functions that “prepare” data for loading to Pipeline Database
 - **Attribute Validation**
 - Checking of attribute values to ensure validity
 - Valid range of values
 - Valid station values

Risk Modeling

Data Related Issues

- **Data Preparation**
 - **Data “Alignment”**
 - Sometimes referred to as “Data Integration”
 - Refers to the process of insuring that data from different sources are “aligned” such that features (valves, vents, welds, etc.) from each data set have the same “station” value.
 - Facilities database, CIS, PIG, Hydraulic models, etc.

Risk Modeling

Data Related Issues

- **Data Preparation**
 - A sequence of data preparation functions may be required
 - **Data “Derivation”**
 - Extracting data from externally maintained sources
 - CPDM, HCA, corporate databases
 - **Data Alignment** may need to be performed on derived data sets

Risk Modeling

Data Related Issues

- **Data Error**
 - Positional accuracy error (GPS, Data Source)
 - Human (Interpretive) error
 - Missing data

 - Rarely given adequate consideration
 - Error has a significant impact when integrating data sets from multiple sources

Data Management for Pipeline Integrity Implementation

- Identify the process & stakeholders
- Build the Team
- Set & Understand Objectives
- Develop Feasible Scope
- Set Milestones & Define Deliverables
- Manage Expectation & Scope
- Project Management
 - ✍
 - ✍
- Work Hard & Manage Issues
 - ✍
 - ✍
- Plan Early
 - Identify follow-on activities – how is the process kept evergreen