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Demonstration of Multi-Analytic Risk Management Tool for the California Pipeline Industry

Project PIR-15-016

DNV GL and UCLA

Utility Partner: SoCal Gas

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Outline

Project PIR-15-016 “Demonstration of Multi-Analytic Risk Management Tool for the California Pipeline Industry”

- Background
- Purpose
- Project Status
- Project Benefits

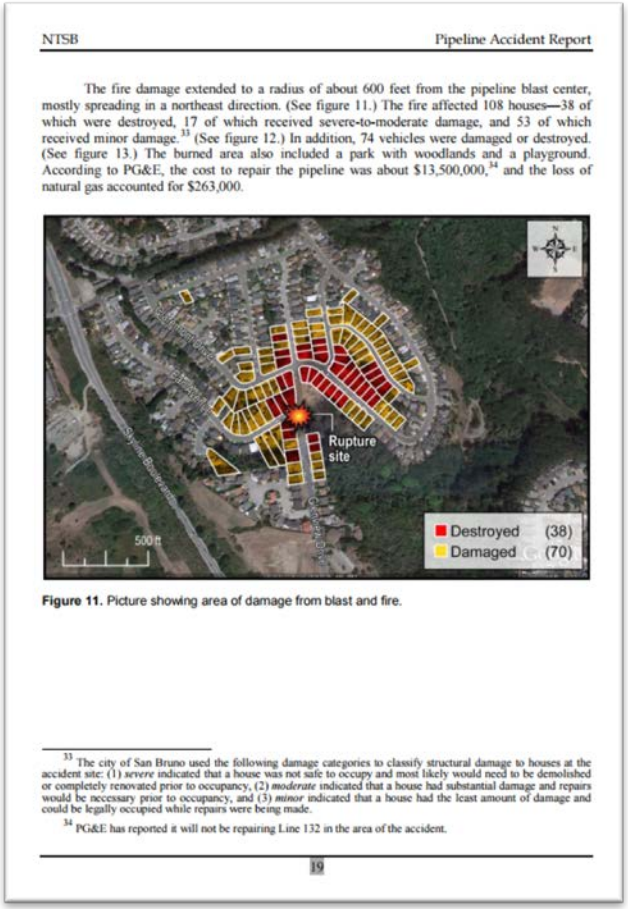
Project PIR-15-016 Background

Project PIR-15-016 Background

Natural gas and liquid pipeline accidents result in loss of life and damage to properties and the environment

The cost of corrosion of natural gas pipelines in California was about $247 million in 2015*

As pipelines age, the cost of corrosion and other damages is expected to rise substantially.



NTSB Pipeline Accident Report

The fire damage extended to a radius of about 600 feet from the pipeline blast center, mostly spreading in a northeast direction. (See figure 11.) The fire affected 108 houses—38 of which were destroyed, 17 of which received severe-to-moderate damage, and 53 of which received minor damage.[33] (See figure 12.) In addition, 74 vehicles were damaged or destroyed. (See figure 13.) The burned area also included a park with woodlands and a playground. According to PG&E, the cost to repair the pipeline was about $13,500,000,[34] and the loss of natural gas accounted for $263,000.

Figure 11. Picture showing area of damage from blast and fire.

[33] The city of San Bruno used the following damage categories to classify structural damage to houses at the accident site: (1) *severe* indicated that a house was not safe to occupy and most likely would need to be demolished or completely renovated prior to occupancy, (2) *moderate* indicated that a house had substantial damage and repairs would be necessary prior to occupancy, and (3) *minor* indicated that a house had the least amount of damage and could be legally occupied while repairs were being made.

[34] PG&E has reported it will not be repairing Line 132 in the area of the accident.

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*NACE, cost of corrosion study
https://www.nace.org/Publications/Cost-of-Corrosion-Study/

Pacific Gas and Electric Company Natural Gas Transmission Pipeline Rupture and Fire San Bruno, California. Source: aga.org/

Project PIR-15-016 Background

Pipeline accidents can be substantially mitigated by combining existing knowledge and data.

There is a need for a comprehensive risk assessment methodology that link different sources of knowledge and data that exist with operators.

Pipeline risk management today mostly focuses on compliance and is reactive. There is a need for a proactive risk management that anticipates future failures

Project PIR-15-016
Purpose

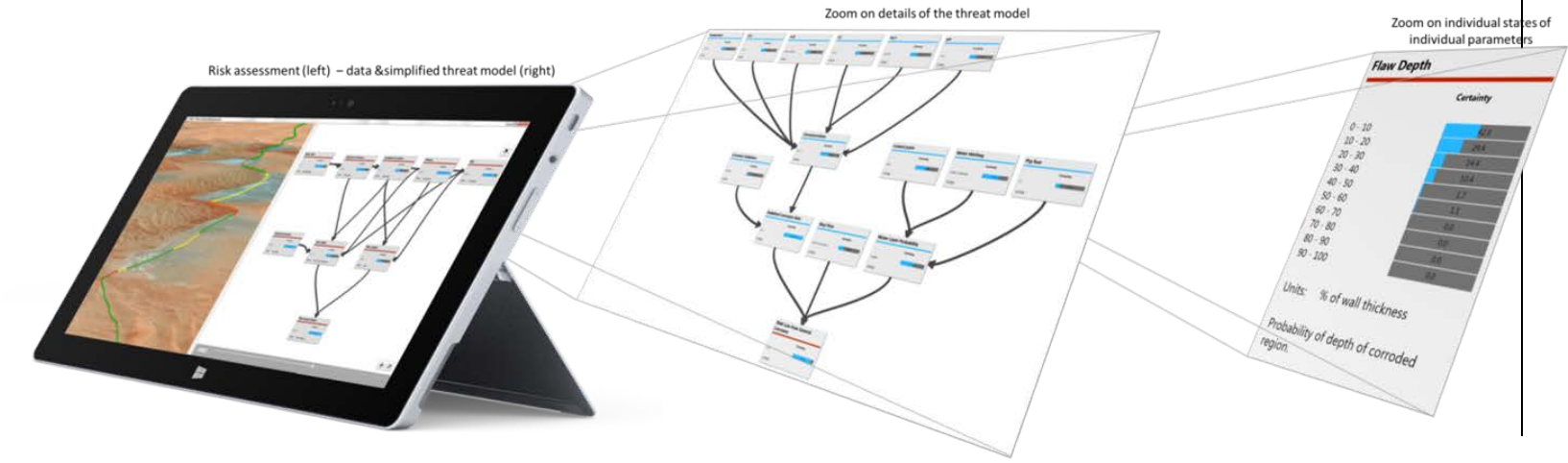
PIR-15-016 Goal

Demonstrate an advanced risk assessment methodology for managing the integrity of pipelines in California.

This risk assessment methodology will enable more effective, systematic, and verifiable decision-making utilizing all the knowledge and data available to the pipeline company. Thus, it allows **more robust pipeline integrity managemen**t and reduces losses due to unanticipated events.

PIR-15-016 Goal

The methodology demonstrated in project PIR-15-016 is called *Multi-Analytic Risk Visualization.* The robustness of the methodology comes from the ability to **aggregate knowledge** from multiple sources using Bayesian Networks.



PIR-15-016 Vision

Map

Data and Threat Mechanism COMBINED

The risk assessment methodology demonstrated in project PIR-15-016 improves pipeline situational information and awareness thus enhancing pipeline safety and integrity management practices.

PIR-15-016 Objectives

- Demonstrate the use of the risk assessment methodology to predict pipeline risks.
- Enable pipeline operators to make decisions under diverse and uncertain conditions.
- Advance the risk assessment methodology to the next technology readiness level.

PIR-15-016 Overall Approach

- Customize Bayesian network models for pipeline external corrosion and mechanical damage
- Validate the models against field data from SoCalGas Company
- From the model, develop leading indicators for pipeline integrity management
- Transfer knowledge and software tools to the pipeline company staff

Project PIR-15-016
Project Status

Project PIR-15-016 Status

Task	% completion
Task 1 General Project Tasks 1.2 Kick-off Meeting 1.3 Critical Project Review 1.10 Technical Advisory Committee	
Task 2 Case Studies Selection	100%
Task 3 Corrosion Threats	99%
Task 4 External Damage Threat	80%
Task 5 Leading Indicators	60%
Task 6 Synthesis	0%
Task 7 Evaluation of Project Benefits	33%
Task 8 Technology/Knowledge Transfer Activities	10%

Project PIR-15-016 Status Overview

DNV GL and UCLA partnered to tailor 2 Bayesian Network threat models to be more specific to the California pipeline Industry.

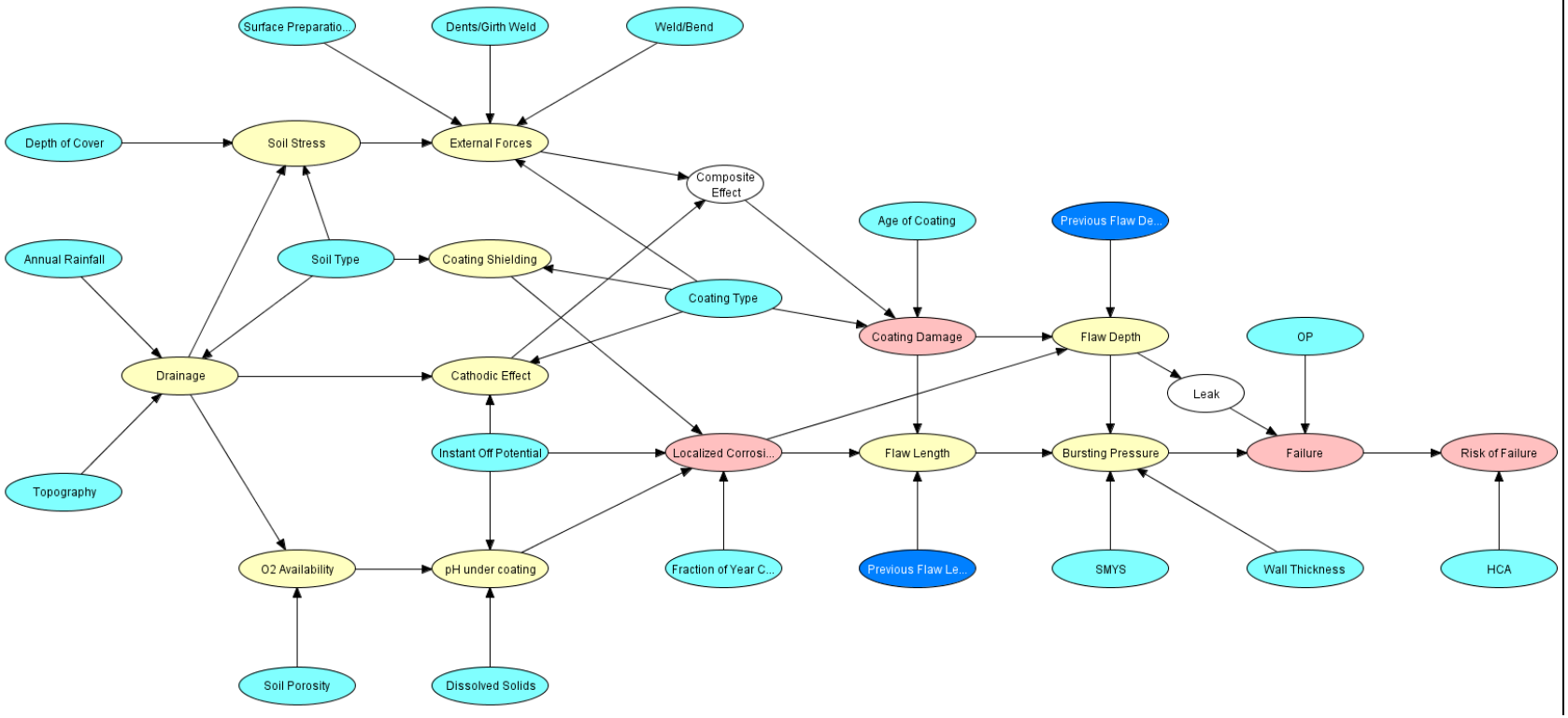
Industry Partner choose the two models to tailored

- **External corrosion threat model** capture expertise about gas pipeline external corrosion from multiple knowledge domain for improved threat assessment.
- **Third party damage threat model** was constructed after analyzing past third party damage failure and create Event Sequence Diagrams (ESD). ESD are then combined to create a mechanistic model of gas pipeline third party damage.

TASK 3 Corrosion Threats

Main Task:

create a Bayesian Network threat model for external corrosion pipeline network of SoCalGas



TASK 3 Corrosion Threats

Results focus on what could happen in the future. Task 6 (leading indicators) will help mitigate unwanted outcomes.

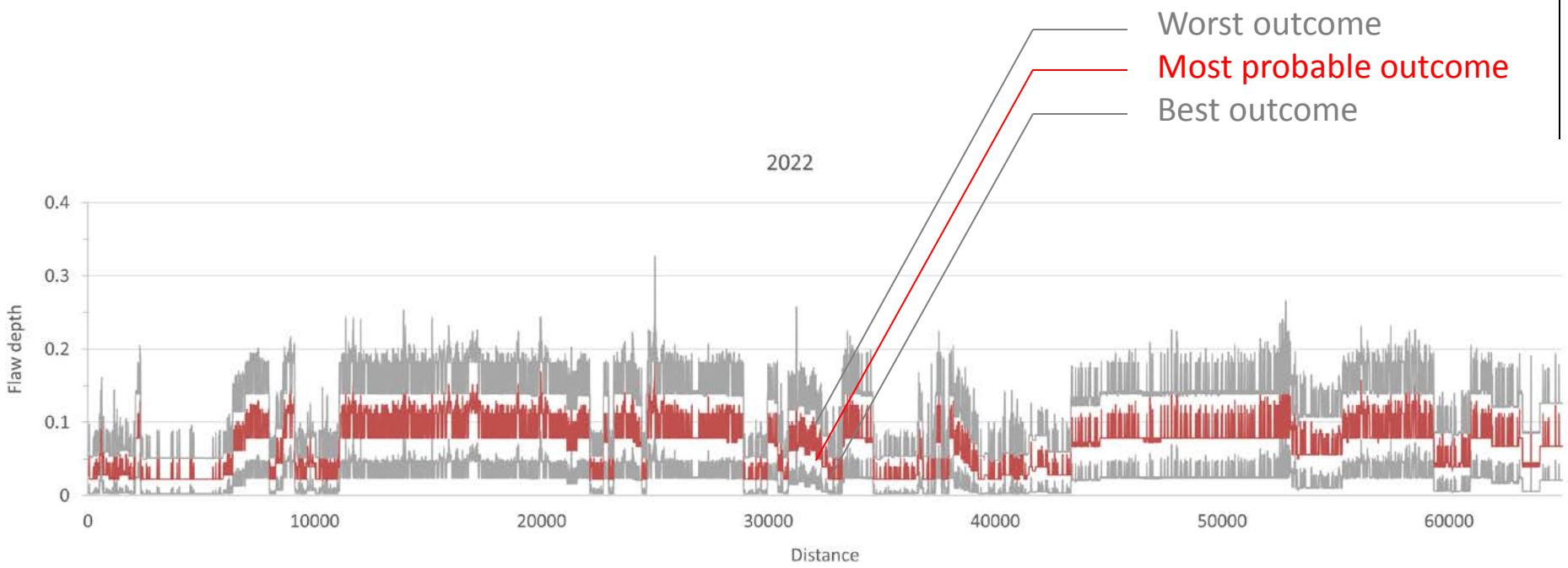


Image is for illustrative purpose only. Distance and flaw depth have been modified for confidentiality reasons

TASK 3 Corrosion Threats

All results are shown in the MARV interface, no input is hidden

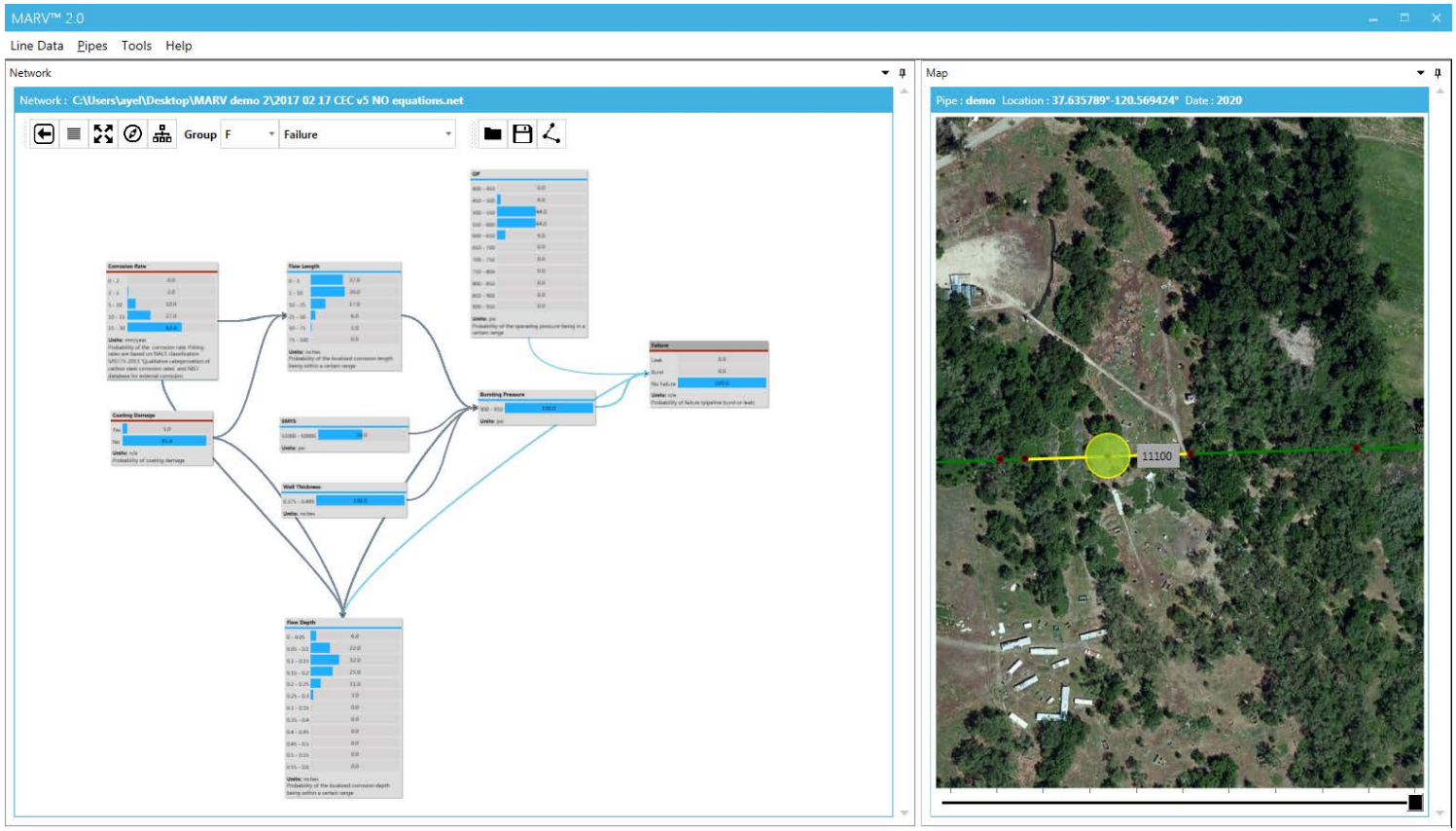
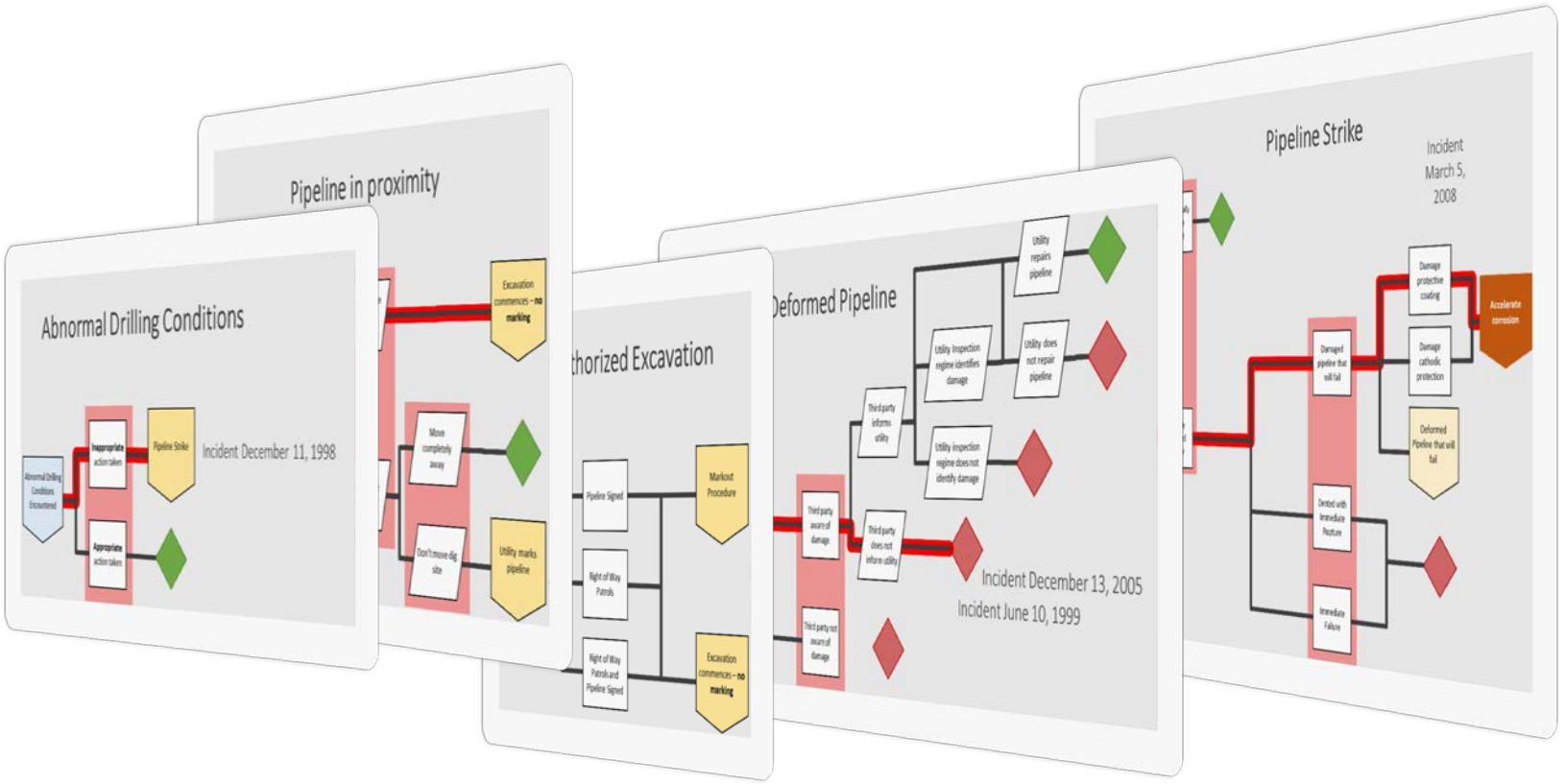


Image is for illustrative purpose only. Results have been modified for confidentiality reasons. Pipeline location has been changed.

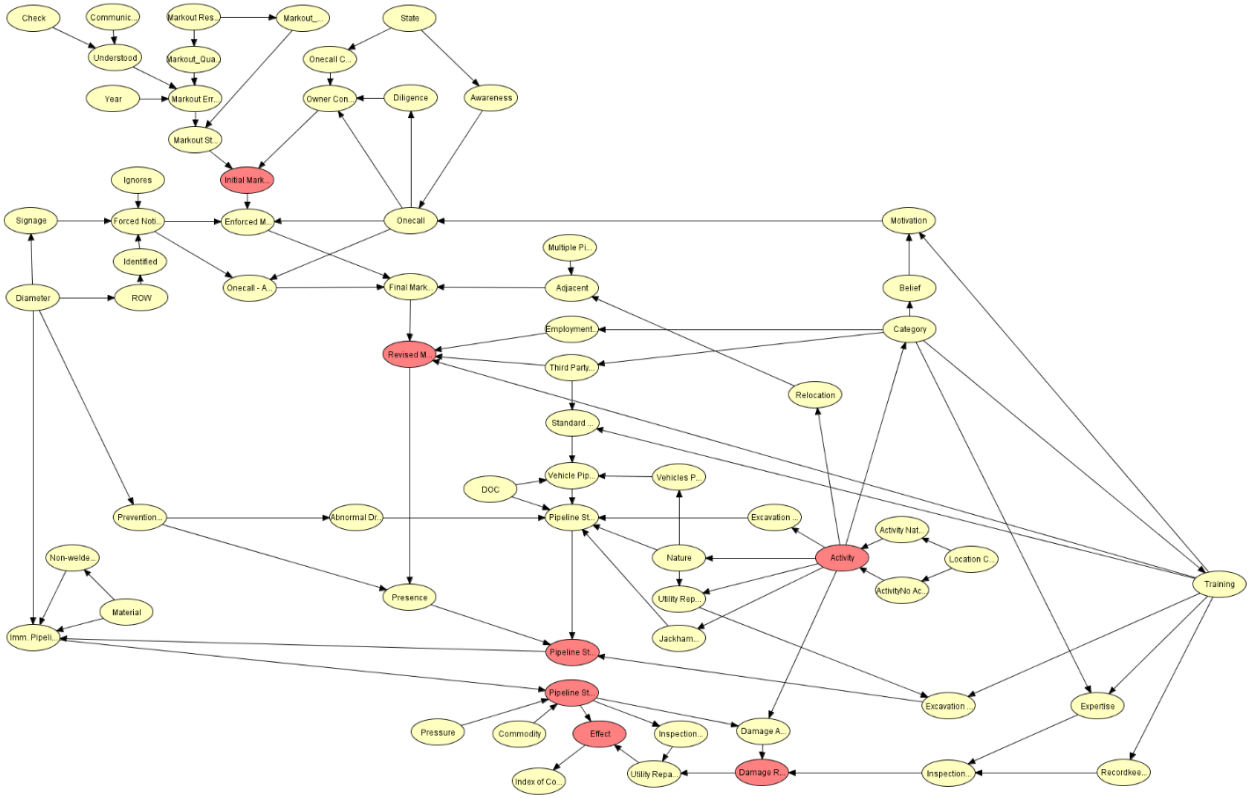
TASK 4 External Threats

Research literature and failure reports for past third party failures and create event sequence diagrams.



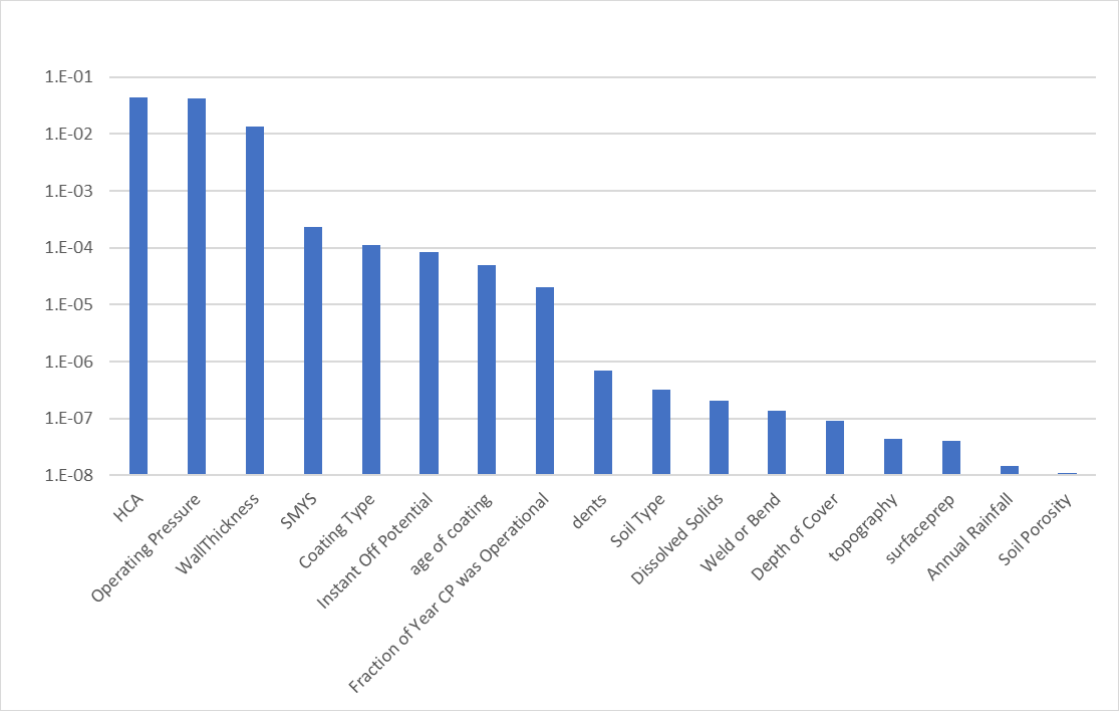
TASK 4 External Threats

Event sequence diagrams become part of a large Bayesian network threat model



TASK 5 Leading indicators

The goal of this task is to demonstrate how the sensitivity analysis of on the threat models can be used to identify prioritization of data collection in order to reduce risk.



Project PIR-15-016
Project Benefits

Project PIR-15-016 Benefits to the state of California

- Increase safety through knowledge integration
- Greater reliability by analyzing what could happen in the future
- Reduced failures and decrease down time
- Environmental benefits
- Public health
- Consumer appeal and trust

PIR-15-016

DEMONSTRATION OF MULTI-ANALYTIC RISK MANAGEMENT TOOL FOR THE CALIFORNIA PIPELINE INDUSTRY