



Emergency Preparedness Modeling

PG&E EPIC Project 2.10 Overview

Greg Molnar, Manager, PG&E
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Project Objective

Create an integrated solution that uses damage model outputs and real-time restoration constraints to recommend restoration strategies and build resource work plans.

Concern, Problem, or Gap Addressed

1. Resource planning for emergency response is a process that requires excel-based/heavy manual input, largely perceived as an art instead of a science.
2. Damage models are not effectively used for emergency response, and multiple constraints that are available to planners are not incorporated into the emergency plans. At times, the plans are disconnected from the field.

Key Deliverables

Develop a software proof of concept that integrates incident management principles, decisions and actions into the entire enterprise ecosystem and develop/document algorithm findings

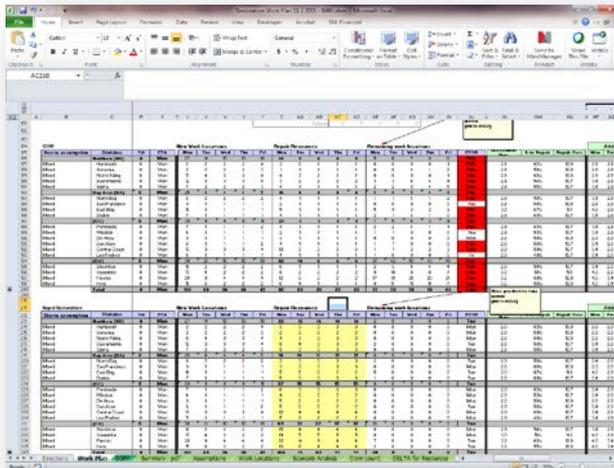
- **Enhance Decision Making**

- System will allow planning and decisions to be made in less time, allowing for a quicker turnaround to provide direction to field employees and emergency responders.
- Decisions will incorporate data from field reports, damage models, and enterprise systems so that the plans will be accurate and actionable.
- Current process for resource planning does not allow for efficiencies to be realized; this system will rapidly identify opportunities for financial or operational improvements.

- **Improve Safety, Reliability, Affordability**

- **Safety:** Improve public safety by identifying the right amount of incident management teams and restoration crews before or immediately after an event.
- **Reliability & Customer Service:** Tradeoffs and visibility into the response will allow incident commanders and operations crews to make optimal decisions to improve customer service and reliability.
 - Simple planning decisions in the initial planning phase of a response can make a dramatic impact.
- **Affordability:** PG&E leaders have visibility to quickly understand financial sensibility to pre-stage a resource, weighing opportunity cost versus the benefit of an additional resource.
 - Currently, this information is difficult to extract due to the currently manual approach to estimate required resources during an emergency.

Excel-Based Tools with Historic Data Assumptions



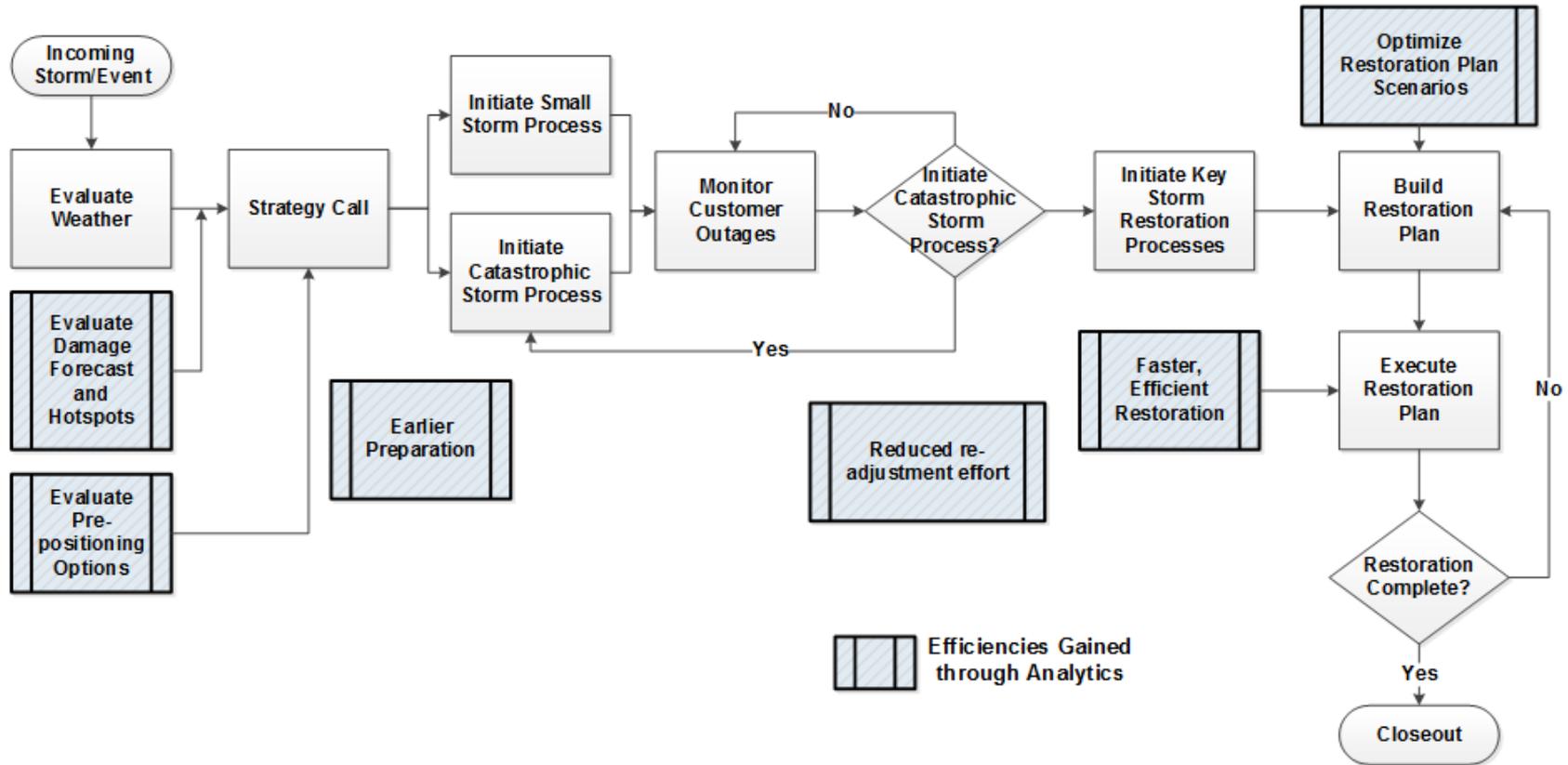
This screenshot shows a full Excel spreadsheet interface. The data table is dense with columns and rows. A prominent red vertical bar highlights a specific column, likely representing a critical data point or a variable being tracked. The spreadsheet appears to be a detailed operational or financial model.




This screenshot shows a simplified version of the data table. The table is more compact and organized, with several cells highlighted in yellow. This suggests a more streamlined or updated version of the data, possibly representing a more efficient or accurate analytical tool.

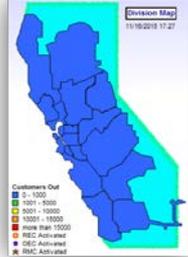
- Work rates and equations are simple assumptions with no ability to automatically update according to historic or real-time input.
- Most effort is wasted on manually changing numbers according to an ad-hoc staffing methodology.
- Travel times, model uncertainty, and crew locations are not included in this tool.

Vision for Informing the Emergency Operations Center (EOC) Planning Process

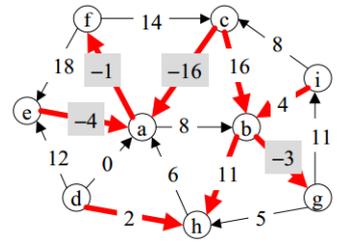


- Before the storm or natural hazard affects utility assets, analytics and forecasts can be used to make decisions about where to focus efforts and how many resources are required.
- Additional metrics and historic information can be used to create updated restoration plans and scenarios within minutes that can optimize for cost and system reliability.

Initial Proposal and Expected Outcomes



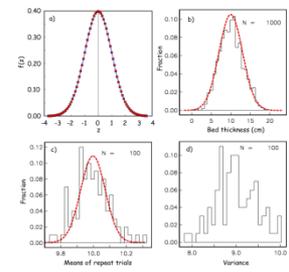
Crew Locations



Network Optimization

Optimal Crew Movements

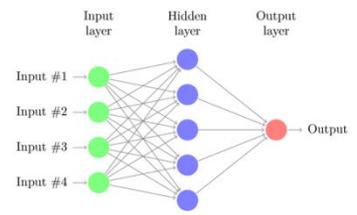
PG&E Models



Statistical Methods

Informed Decision Making

Prior Event Data

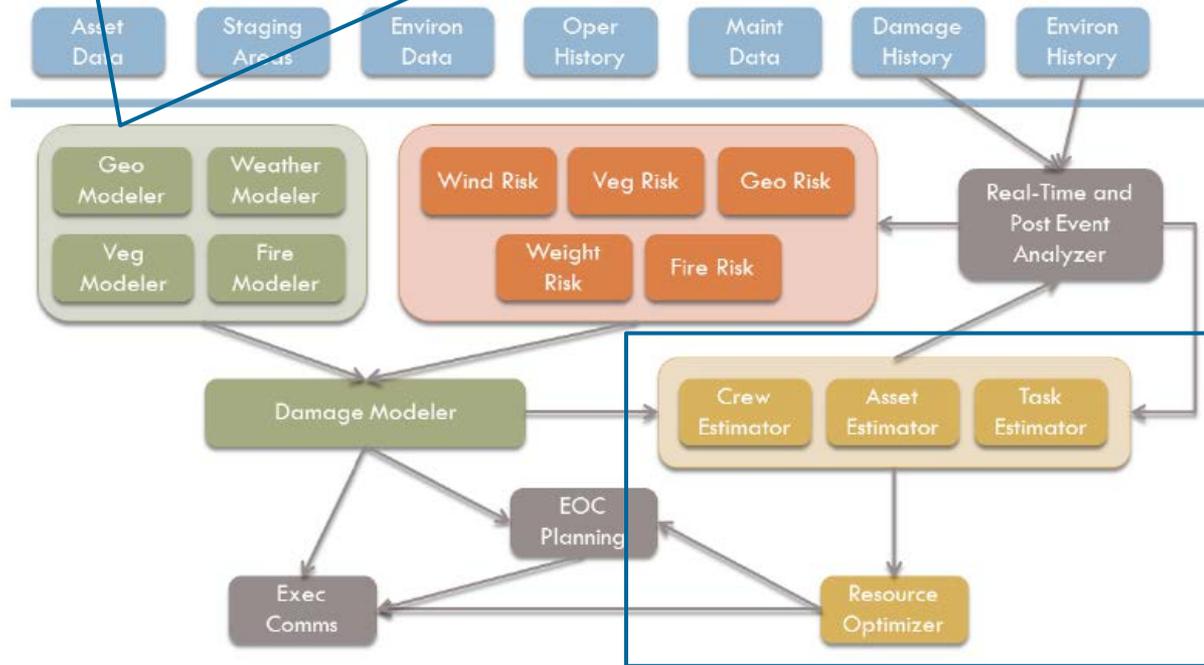


Learning Algorithms

Automatic Strategy Generation

Proposed Solution Context Diagram

PG&E Damage Models will be leveraged for this system



The primary focus of this project is to complete the resource optimization.

Philosophy: Integrate incident management principles, decisions and actions into the entire enterprise ecosystem. System is not just for major events, but in day to day incidents, as well, which provides contestant insight into PG&E operations.



System Module (Leveraging DTE Solution Prototype)	Description	System Module Enhancement Scale
Outage / damage prediction interfaces	Input from existing PG&E damage models, (e.g. SOPP, DASH, Fire, Others.)	Minor Customization
Crew pre-positioner	Module that utilizes multi-objective optimization to determine ideal crew placements that support the response strategy	Customization
Crew performance estimation	A machine learning module that estimates crew performance (e.g. ETOR for various tasks) as a function of factors such as task type, location, weather conditions, etc.	Module Creation
In-storm crew planner	Computes the optimal prioritization of circuits and allocation of crew to the circuits, given actual or predicted outages.	Customization
Job schedule optimizer	Generates optimal work plans for each reporting crew, using the output of the other modules and situational factors such as crew availability and transportation conditions.	Module Creation

Anticipated Outcomes & Key Takeaways for Industry

Damage Models

- Storm Outage Prediction Project (SOPP)
- Dynamic Automated Seismic Hazard (DASH)
- System Earthquake Risk Assessment (SERA)

Real Time Information

- Distribution Management System (DMS)
- SmartMeter™
- Automated Roster Callout System (ARCOS)
- Grid Operations Situational Intelligence (GOSI)

EPIC 2.10 Restoration Workplan

Expected Outcomes

- Incident commanders and first responders can incorporate predictive uncertainty in planning
- Plans are made in minutes or seconds instead of hours
- Aligning system-level and division-level emergency operations center resource planning is aligned
- Metrics are quickly incorporated into response plans; predicted outcomes are immediately communicated

Key Takeaways for Industry: EPIC 2.10 will lead to a unique planning solution that enhances the way organizations respond to catastrophic events.

Project Value: Optimize decision making, improve public safety by identifying the right amount of incident management teams and create cost savings by identifying the right level of required resources for emergency response.



Questions?