# Available Data:

* F543 Case Study Data
* Broader FDOT Dataset
* Interview potential

# Ideas:

Ideas 1: “**The Hidden Cost of Specialty Trade Oligopolies: How Subcontractor Market Concentration Creates Systemic Delays in Public Infrastructure**”

* Existing research assumes: Competitive subcontractor market with multiple options
* Reality in specialty trades: Oligopoly with 2-3 players controlling entire regional market
* Nobody has studied: Impact of subcontractor market concentration on project delivery

Idea 2: **“Early Detection of Subcontractor Performance Deterioration Using Natural Language Processing of Daily Construction Reports”**

* What OHLA Needs: "How do we spot a failing subcontractor BEFORE they cause major damage?"
* What Literature Needs: Novel methods to extract early warning signals from project documents
* What We Have: Massive text corpus (daily reports, emails, notices) that documents the deterioration process
* Literature Gaps:
  + Most research on subcontractor performance is:
    - Survey-based (asking opinions)
    - Post-hoc analysis (after project ends)
    - Focuses on selection/qualification (before problems occur)
  + What's MISSING:
    - Real-time warning signs from daily documentation
    - Pattern detection in project communications
    - Predictive indicators from ongoing project data
    - Text mining of daily reports to identify deteriorating performance

Idea 3: **"What is the cascading financial and reputational impact of subcontractor performance failures on prime contractors in public transportation projects?"**

AIS Fails

↓

OHLA gets Notice of Default

↓

OHLA back-charged for AIS work

↓

OHLA pays liquidated damages

↓

OHLA's CPPR score drops

↓

OHLA loses competitive advantage on future bids

↓

Surety involved (but bond insufficient?)

↓

TOTAL COST >> Original delay cost

* Lit Review has: "Subcontractor delays cause liquidated damages" ← Obvious, already well-studied
* But this: "When a subcontractor fails, what's the TOTAL damage to the prime contractor?"

# Understand Problem of F543 Project

* Project: FDOT T1843 Colonial Boulevard & Fowler Street Intersection ([Google Map](https://maps.app.goo.gl/N55rUzpQErHaUU8C9))
* Traffic signal and roadway improvement project
* SR-884 = Colonial Boulevard
* Scope of Work
  + Installing new traffic signals and mast arms
  + Installing lighting systems
  + Roadway widening and turn lane improvements
  + Drainage improvements
  + CCTV camera installation
  + Fiber optic cable installation
  + Pavement work and striping
* Key Parties:
  + Owner: FDOT
  + Prime Contractor: OHLA
  + Subcontractor: AIS
  + Surety: Swiss Re Corporate Solutions America Insurance Corporation
* Problem:
  + AIS failed to complete electrical and signalization work
    - Timeline (Delay):
      * Contract due: 8/26/24
      * Currently: 1/25 (incomplete)
    - Problem:
      * Signal poles placed in wrong locations, conflicting with turn lane widening
      * CCTV pole conflicts with roadway design
      * Directional boring crew abandoned the site (March 21, 2024) due to material shortages and never returned
      * Incomplete lighting installations - 8 light poles and electrical work unfinished
      * Incomplete signalization - mast arms, signal heads, controllers not fully installed
      * Defective work - damaged sidewalks, curbs, and sod from boring operations and heavy equipment
      * Quality issues - pull boxes with incorrect labeling, luminaires needing repair
* Financial Damages to OHLA
* OHLA is claiming $395,006 in damages from AIS, including:

|  |  |
| --- | --- |
| Damage Category | Amount |
| FDOT Liquidated Damages (80 days) | $207,360 |
| Extended Overhead Costs (project team) | $65,888 |
| Rework/Repairs (damaged concrete, sod) | $11,313 |
| Extended MOT Equipment Rentals | $48,020 |
| Police Details for Rework Operations | $10,525 |
| Additional Survey/Restaking Fees | $33,640 |
| Mobilization/Paving Equipment Delays | $30,000 |
| TOTAL | ~$395,006 |

# Potential Ideas After Reviewing the Project

* Topic: "AI-Based Early Detection of Subcontractor Performance Deterioration: Preventing Cascade Failures in Infrastructure Projects"
* Research Questions: "Can AI detect early warning signs of subcontractor performance deterioration in daily construction reports, and what is the cascade impact when detection fails?"
* Motivation:
  + "Early detection could have prevented $395,006 in damages - here's the AI that can do it"

# Data Analysis Plan

* Phase 1 – Qualitative Analysis with NLP for the F543 project
  + Convert all files to PDF.
  + Use OpenAI API loop through each daily report + Emails, other files
    - Make sure openAI API loop through file, not ready all file at one since it will not have enough token to good analysis
    - Write Prompt to ask it to do find the following information:
      * Date, Time (Make sure you find a consistent format for it)
      * What types of documents (email, daily report, announcements, schedules)
      * Who created the file?
      * Who are mentioned in the files.
      * Which subcontractor is mentioned in the document? Get the name of it
      * Describe briefly the problem discussed on that document. Make it concise. The length can be around like 5 sentences max (need to think a little bit about this more)
      * Type of problem (Resource shortage / Quality issue / Schedule delay / Communication gap / Abandonment, etc.)
      * Who created the problem and why? Make it concise
      * Any solution involve?
      * Any delay mentioned? How much
      * Any cost overrun mentioned? How much
      * Severity levels???
      * Anything else?
    - For the preliminary analysis, consider using OpenAI API GPT-4o-mini for exploration
    - Make sure the loop run in a way if some interruption happen, it still save in temporary files.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Date | Document | Created by | Problem | Solution | Delay | Overrun? |  |
| 8/1/2024 | Email | John Doe | Sub did not show up…… | No solution discussed | Probably 3 days? |  |  |
| 8/2/2024 | Daily Report | Caden | Material shortage | Find another suppliers | None |  |  |
|  |  |  |  |  |  |  |  |

* Phase 2 – Qualitative Analysis with NLP for the FDOT projects
  + Similar style like phase 1 but with different data
  + Need to refine the method a bit
* Phase 3 – Analyze the results of phase 1 and phase 2
* Phase 4 – Interview

# Example Figures:

* Figure 1: Sentiment time series
* Figure 2: Warning phrase frequency
* Figure 3: ROC curves
* Figure 4: Cascade flow diagram
* Figure 5: Intervention timing vs savings

# Potential of Results and Contributions

* Results:
  + AI can predict sub failure 60+ days early
  + Cascade costs >> direct costs
  + Current risk transfer insufficient
* Contribution:
  + Methodological innovation
  + Empirical insights
  + Practical tool (Extra)

# Journal Submit?

* ASCE JCEM
* Automation in Construction