Empowering Supply chains Resilience: LLMs-Powered BN for Proactive Supply Chain Risk Identification

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Table of Contents

- Introduction
- Methodology
- Event Detector Module
- Probability Assigner Module
- Evaluation
Introduction

• **Proactive Risk Management with CERIA**
  
  • Contributing Event-based Risk Identification and Assessment
  
  • AI, specifically NLP and LLMs, to predict and manage supply chain risks
  
  • systematically identifies causative events through daily news scanning,
  
  • employing Bayesian Networks to model causal connections and assess risk probabilities

• **Application and Impact**
  
  • quantifying the likelihood of risk events, offering a dynamic early warning system.
  
  • not only aids in navigating complex supply chains but also enhances resilience against potential disruptions.

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Methodology (CERIA Framework Overview)

• Module Descriptions:
  1. Causal Relationship Extractor Module:
     Identifies causal connections between contributing events (CEs) and risk events using historical news data, represented in a Bayesian Network.
  2. Seed Collector Module:
     Collects and aggregates relevant keywords for each risk event/CE, termed as seed-phrases.
  3. News Crawler Module:
     Uses seed-phrases to search for and collect news articles related to each CE.
  4. Event Detector Module:
     Employs AI and LLMs to determine the relevance of news articles to specific CEs.
  5. Probability Assigner Module:
     Analyzes data to assign probabilities to events, enhancing predictive capabilities.
  6. Output Generator Module:
     Forecasts the probability of main risk events and notifies risk managers of potential risks.
Methodology (Event Detector Module)

1. Outputs:
   - CE{s} that have been detected as happening.
   - List of the news confirming that.
   - Their score (between 0.5 and 0.7)

Example:
- Staff shortage is happening.
  - News 1: 0.58
  - News 2: 0.6
  - News 3: 0.52
Methodology

1- Is the detected event impacting the SC?

Important features of event for our use case:

- Location
- Time and Duration

Prompt engineering approach (GPT-3.5-Turbo)

“within the text which is in triple backticks, answer these questions about CEx:

1- where is the location of the CEx?
2- What is the date of the CEx.
3- For how long will the CEx happen?

“ news_body“ “
2- Understanding Event Probability Through News Relevance Scoring

○ **Score Range Breakdown**
  - The range from 0.5 to 0.7 is divided into three equal parts to reflect the likelihood of event occurrence:
    - Range 1 (0.5 to 0.57): Low chance
    - Range 2 (0.57 to 0.64): Medium chance
    - Range 3 (0.64 to 0.7): High chance

○ **Empirical Estimation Method**
  - The proportion of news articles within each score range relative to total articles scored between 0.5 and 0.7 serves as an empirical estimate of event likelihood
Methodology (Probability Assigner Module)

Probability Calculation Formula

\[
P(CE \text{ in range } x) = \frac{N_x}{N_{total}}
\]

\(P(CE \text{ in range } x)\) is the probability of the event happening within the specified range \(x\).

\(N_x\) is the number of articles with scores in range \(x\).

\(N_{total}\) is the total number of articles scored between 0.5 and 0.7.
Evaluating CERIA Framework Performance Using Historical News Data

- Analyzing the past news related to the risk event of interest in transportation sector in Australia

- The system found the following CEs as contributors to delay in delivery (output of Module 1 of CERIA):
  1- There is an increase in Covid cases
  2- Government mandates on vaccinations for construction workers
  3- Construction workers hold strike
  4- Blockade of the West Gate Bridge
  5- Risk event: Delay in delivery of products
Evaluation

For each CE:
1- Module 2: Extracted seed phrases
2- Module 3: Search the seed phrases in Google News
3- Module 4: Scored the relevance of News to CEs
4- Module 5: Extracted the features of the event, along with it’s probability
Increase in Covid cases

Government mandates on vaccination

Construction workers' strike

Blockade of West Gate Bridge

Delay in Delivery

Important COVID-19 update: Mandatory vaccination for construction workers

Friday, 17 September 2021

The Victorian Government has announced that construction workers across Victoria will need to show evidence to their employer that they have had at least one dose of a COVID-19 vaccine by 11:59pm on Thursday, 23 September. Public health officials have become increasingly concerned about COVID-19 transmission and exposure in construction settings. Construction workers are often highly mobile and the risk of spreading coronavirus in these settings is concerning. Therefore, the Victorian Government has announced that construction workers across Victoria will need to show evidence to their employer that they have had at least one dose of a COVID-19 vaccine by 11:59pm on Thursday, 23 September.

Limited medical exemptions and proof-of-focussing exceptions will apply, in line with previous requirements for residential aged care workers.

Employers will be required to keep a record of their employees' COVID-19 vaccinations.

In further tightening of COVID-19 settings for the industry to slow the spread of coronavirus, construction workers will not be able to cross the metropolitan regional boundary for work effective immediately, in light of COVID-19 cases spreading from Melbourne into regional Victoria. We understand this may be difficult to manage but we have to do our part to keep the industry and its workers safe.

From 11:59pm Friday 17 September, sea rooms will also close and food or drink cannot be consumed indoors at work.
<table>
<thead>
<tr>
<th>Event</th>
<th>Location</th>
<th>Time</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Victoria, Australia</td>
<td>September 13, 2021</td>
<td>Not specified</td>
</tr>
<tr>
<td>2</td>
<td>Victoria, Australia</td>
<td>September 17 to September 23, 2021</td>
<td>Indefinitely, starting from the specified date</td>
</tr>
<tr>
<td>3</td>
<td>Melbourne, Australia</td>
<td>September 21, 2021</td>
<td>Not specified</td>
</tr>
<tr>
<td>4</td>
<td>Melbourne, Australia</td>
<td>September 21, 2021</td>
<td>Not specified</td>
</tr>
<tr>
<td>CE</td>
<td>Low chance</td>
<td>Medium chance</td>
<td>High chance</td>
</tr>
<tr>
<td>-------------------------------------------------------------------</td>
<td>------------</td>
<td>---------------</td>
<td>-------------</td>
</tr>
<tr>
<td>There is an increase in Covid cases</td>
<td>3.13%</td>
<td>10.94%</td>
<td>85.94%</td>
</tr>
<tr>
<td>Government mandates on vaccinations for construction workers</td>
<td>13.33%</td>
<td>28.89%</td>
<td>57.78%</td>
</tr>
<tr>
<td>Construction workers hold strike</td>
<td>12.33%</td>
<td>35.71%</td>
<td>51.94%</td>
</tr>
<tr>
<td>Blockade of the West Gate Bridge</td>
<td>10%</td>
<td>33.25%</td>
<td>56.75%</td>
</tr>
</tbody>
</table>
Thank you for your attention

Any questions?