Supply Chain Risk Analysis Using Dynamic Fault Tree

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Abstract

Disciplines
Industrial Engineering | Industrial Technology | Manufacturing | Operations Research, Systems Engineering and Industrial Engineering

Comments
Supply Chain Risk Analysis Using Dynamic Fault Tree

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Outline:

1. Motivations
2. Main-backup supply chain
3. Mutual-assistance supply chain
4. Conclusions
1. Motivations

External factors

Internal factors

- Interplays within the supply chain

- Dynamic fault tree (DFT)

Opportunities exists in: Supply chain risk analysis using DFT
Main-backup Supply Chain

Main supplier

Backup supplier

Inventory

Information System

Mutual-assistance Supply Chain

Supplier

Information System

Supplier
State-time diagrams of dynamic gates:

**PAND Gate**: \((A = \text{information system’s failure}; \ B = \text{main supplier’s failure.})\)

**SPARE Gate**: \((B = \text{main supplier’s failure}; \ C= \text{backup supplier’s failure.})\)
FDEP Gate: (A = information system’s failure; C= backup supplier’s failure)

MA Gate: (B = one supplier’s failure; C= the other one supplier’s failure)
SEQ Gate: (B = main supplier’s failure; C = backup supplier’s failure; D = inventory’s failure.)

Down time of the SEQ gate

B
\[ \text{TTF}_B \rightarrow \text{TTR}_B \]

C
\[ \text{TTF}_C \rightarrow \text{TTR}_C \]

D
\[ \text{TTF}_D \rightarrow \text{TTR}_D \]

Failure

No common down time

B
\[ \text{TTF}_B \rightarrow \text{TTR}_B \]

C
\[ \text{TTF}_C \rightarrow \text{TTR}_C \]

D
\[ \text{TTF}_D \rightarrow \text{TTR}_D \]

No Failure
2. Main-backup supply chain

A = information system’s failure; B = main supplier’s failure; C = backup supplier’s failure; D = inventory’s failure.
**Simulation Parameters:**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total simulation time</td>
<td>86400 hours (= 10 years)</td>
</tr>
<tr>
<td>Mean time to failure of each component</td>
<td>200 hours</td>
</tr>
<tr>
<td>Mean time to repair of each component</td>
<td>48 hours</td>
</tr>
<tr>
<td>Increasing failure rate of the backup supplier given failure in the main supplier</td>
<td>2</td>
</tr>
<tr>
<td>Standard delivery time</td>
<td>200 hours</td>
</tr>
</tbody>
</table>

- **Failure rate**

- **Overall delivery time**
alpha - increasing failure rate of the backup supplier given failure in the main supplier
k – acceleration rate after supplier recovery
mttf - mean time to failure
mttr - mean time to repair
a - information system
b - main supplier
c - backup supplier
3. Mutual-assistance supply chain

A = information system’s failure; B = one supplier’s failure; C = the other one supplier’s failure.
beta - Increasing failure rate of one supplier given failure in the other supplier
k – acceleration rate after supplier recovery
mttf - mean time to failure
mttr - mean time to repair
a - information system
b, c – two suppliers
4. Conclusions

• Contributions
  • First use of dynamic fault tree to supply chain risk analysis
  • Development of mutual assistance gate
  • Estimate the overall delivery time of supply chain
  • Include low volume and high volume production scenarios

• Limitation
  • Limited kinds of supply chains

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