Introduction

• Fire & Explosion scenarios
• Risk score on grids obtained using structural damage Probit function
• Case Study: Locate 7 facilities around Hexane distillation unit
• Goal: Minimization of costs associated with layout

Methodology

Risk Score = Incident frequency x Plant Lifetime x % of structural damage (k) x Weighting factor
Objective function, constraints for optimization

\[
\text{Min} \quad \sum_{i=1}^{n} \sum_{k=1}^{K} [RS_k \times FC^i + RD_k \times UP^i] \times B_{ik}
\]

\(RS_k\) = Risk score of \(k\) grid caused from the center facility (process unit)

\(RD_k\) = Rectilinear distance of \(k\) grid calculated from the center facility (process unit)

\(FC^i\) = Facility building cost of \(i\)-th facility

\(UP^i\) = Unit piping cost between \(i\)-th facility and the center facility (process unit)

s.t.

\[
\sum_{k=1}^{K} B_{ik} = 1, \forall i \in \text{Facilities}, \forall k \in \text{all grids on the plane}
\]

\[
\sum_{i=1}^{n} B_{ik} \leq 1
\]

\(B_{ik} = \begin{cases} 
1 & \text{if unit } i \text{ is allocated to site area} \\
0 & \text{otherwise}
\end{cases}
\]

\[
|x_i - x_j| + |y_i - y_j| \geq D_{ij}
\]

\(i \in \text{occupied buildings}, j \in \text{hazardous facilities such as storage tanks}\)

\(x_i, y_i\) = \(x, y\) coordinate of \(i\)-th facility

\(D_{ij}\) is the minimum separation distance between \(i\) and \(j\)

\[
|x_i - x_j| + |y_i - y_j| \leq m_{ij}
\]

\(m_{ij}\) is the limited distance among similar facilities

\(i, j \in \text{occupied buildings or } i, j \in \text{storage tanks}\)
Results and conclusion

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<td>Large storage tank</td>
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- Case study for hexane-heptane separation plant was demonstrated to obtain the optimal layout of 7 facilities around the hazardous process unit.
- Adaptable for numerous facilities with swift calculation using MILP.