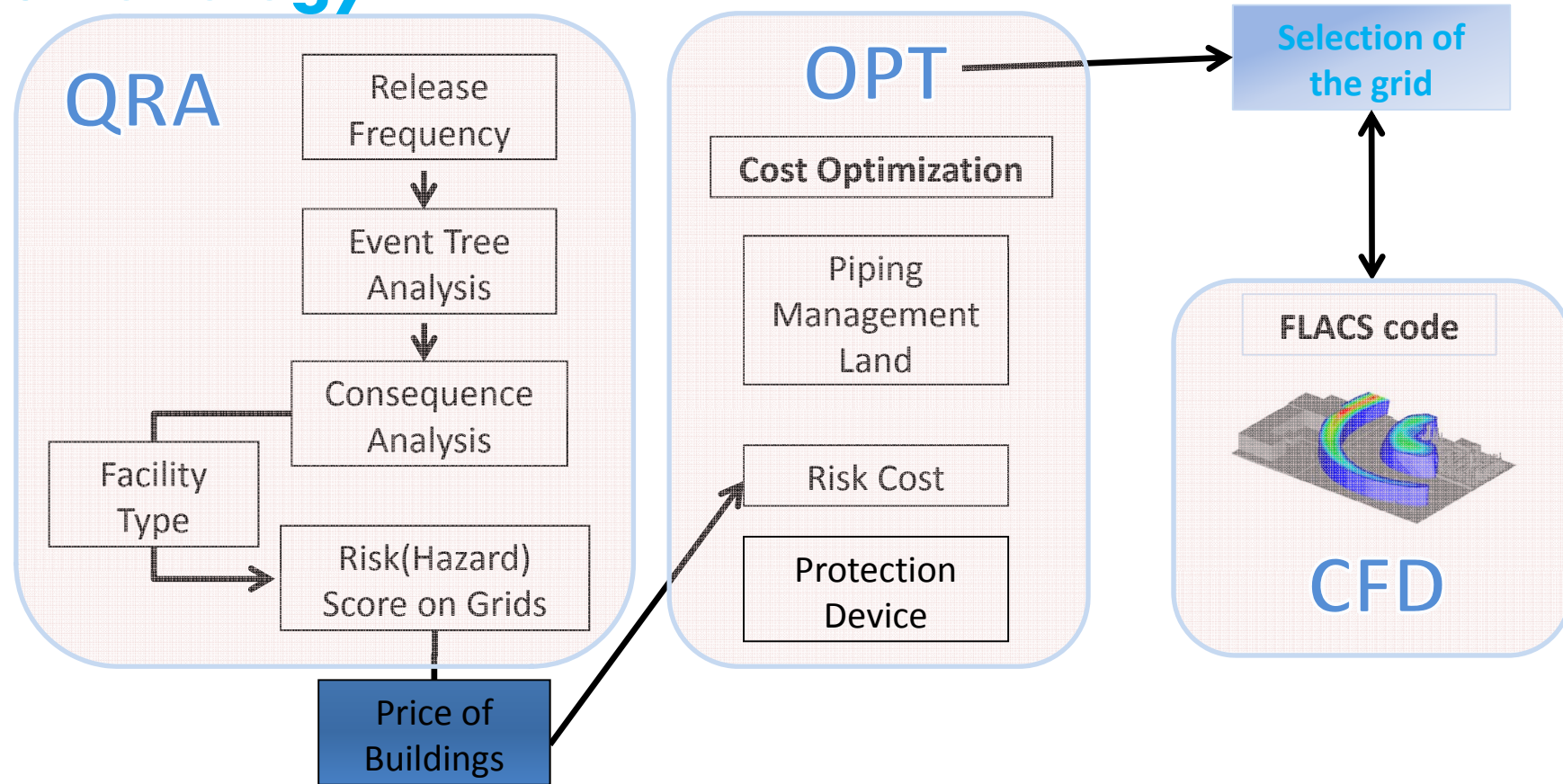


Introduction

- 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.

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

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

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

$$|x_i - x_j| + |y_i - y_j| \geq D_{i,j}$$

$i \in$ occupied buildings, $j \in$ hazardous facilities such as storage tanks

x_i, y_i : x, y coordinate of i-th facility

$D_{i,j}$ is the minimum separation distance between i and j

$$|x_i - x_j| + |y_i - y_j| \leq m_{i,j}$$

$m_{i,j}$ is the limited distance among similar facilities

$i, j \in$ occupied buildings or $i, j \in$ storage tanks

Results and conclusion

G01	G02	G03	G04	G05	G06	G07	G08	G09	Utility
G11	G12	G13	G14	G15	G16	G17	G18	G19	G20
G21	G22	G23	G24	G25	G26	G27	G28	G29	G30
G31	G32	G33	G34	G35	Small storage Tank1	G37	G38	G39	G40
G41	G42	G43	Large storage tank	Process Unit		Small storage tank2	G48	G49	G50
G51	G52	G53	G54			G57	G58	G59	G60
G61	G62	G63	G64	G65	G66	G67	G68	G69	G70
G71	G72	G73	G74	G75	G76	G77	G78	G79	G80
G81	G82	G83	G84	G85	G86	G87	G88	G89	Control Room
G91	G92	G93	G94	G95	G96	G97	G98	Office	Ware House

- 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

Optimal layout