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Operational risk evaluation and control plan design

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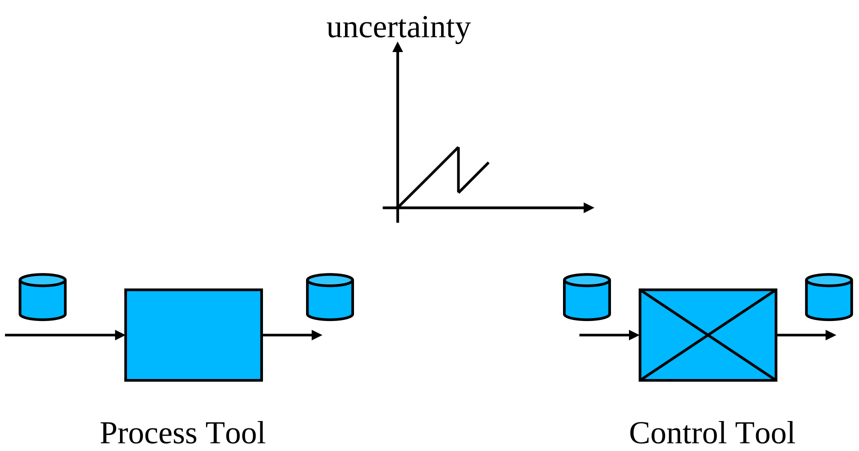
Agenda

- Problem statement
- Operational risk evaluation
- Control plan added value
- Example
- Conclusion

Problem statement (1/2)

- Quality control and production control policies are usually designed separately
- Tools and processes may remain uncontrolled over a long production period → grow up of the uncertainty about products quality
- Releasing uncertainty too late may lead to manage a major scrap (thousands of defective products)

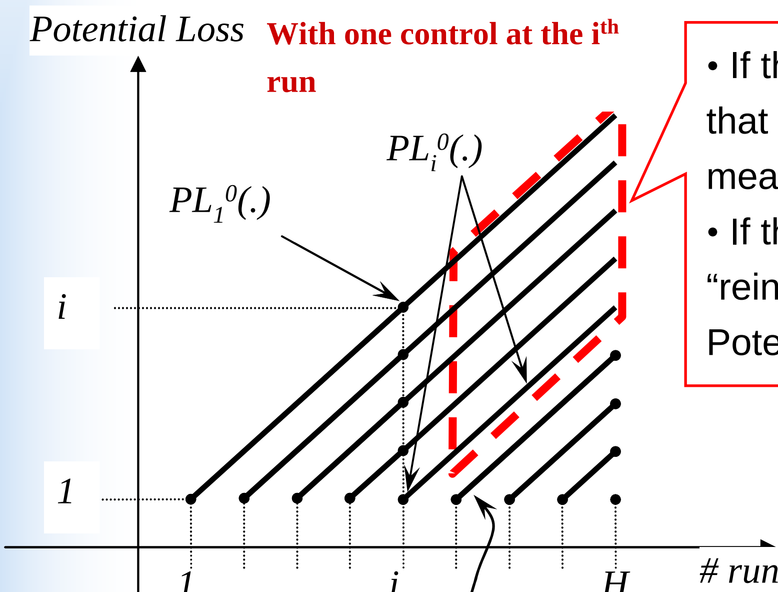


Problem statement (2/2)

- An effective monitoring of uncertainty logically leads to the limitation of risk exposure in terms of products potentially loss
- How to monitor products uncertainty?
- How to link risks to control plans design?

Uncertainty monitoring

- Assumption: once the NDE occurs it impacts production until being fixed
- Uncertainty→ number of products potentially lost



• If the measure at ith run is "OK" → no need to consider PL that corresponds to a NDE occurrence previous to the measurement instant

• If the measure is "not OK", an action is imminent which will "reinitialize or modify" the Probability of the NDE and the Potential Loss becomes "Probable Loss" or "Proven Loss"

PL evolution **if** the NDE occurs at the (i+1)th run **and** a control is planned at the the ith run

Operational risks evaluation (1/3)

- Notations
  - $R^0(.)$: risk evolution during a considered horizon (H) without any control
  - $R^X(.)$: risk evolution during the considered horizon (H) with control plan X
  - $PL_j^X(.)$: Potential Loss evolution with control plan X if the NDE occurs in the j^{th} run
  - Pr_j: probability of occurrence of the NDE at j^{th} run
  - $AV^X = f(R^0(.), R^X(.))$: added value of control plan X
    - Example: $AV^X = \text{Max } R^0(.) - \text{Max } R^X(.)$

Operational risks evaluation (2/3)

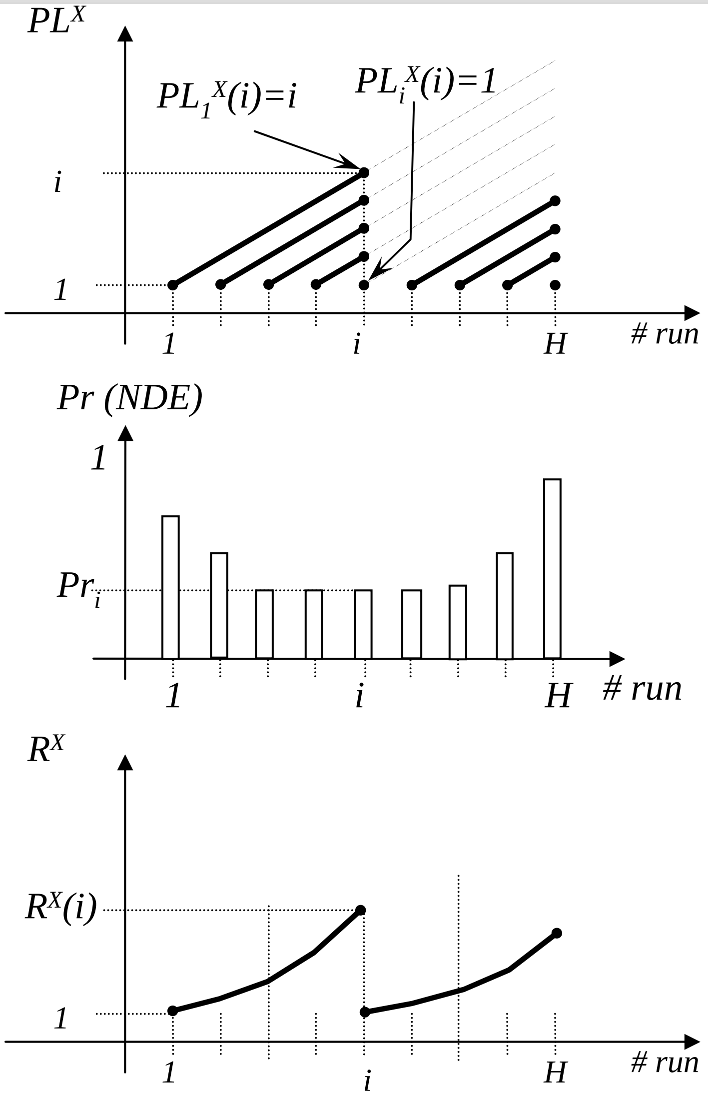
- Assumptions
  - PL linearly increase with the number of runs
  - A planned control (measures + corrective actions if detection) permit to change the Potential Loss evolution
  - Control efficiency is maximal: a NDE is surely detected when controlled

- False alarms add only a cost, but do not modify curves

Operational risks evaluation (3/3)

- From uncertainty monitoring to Risk evaluation

$$R^X(i) = i.\Pr(1) + (i-1).\Pr(2) + \ldots + 1.\Pr(i)$$
$$= PL_1^X(i).\Pr(1) + \ldots + PL_i^X(i).\Pr(i)$$
$$= \sum_{j=1}^{i} (i-j+1).PL_j^X(i).Pr_j$$

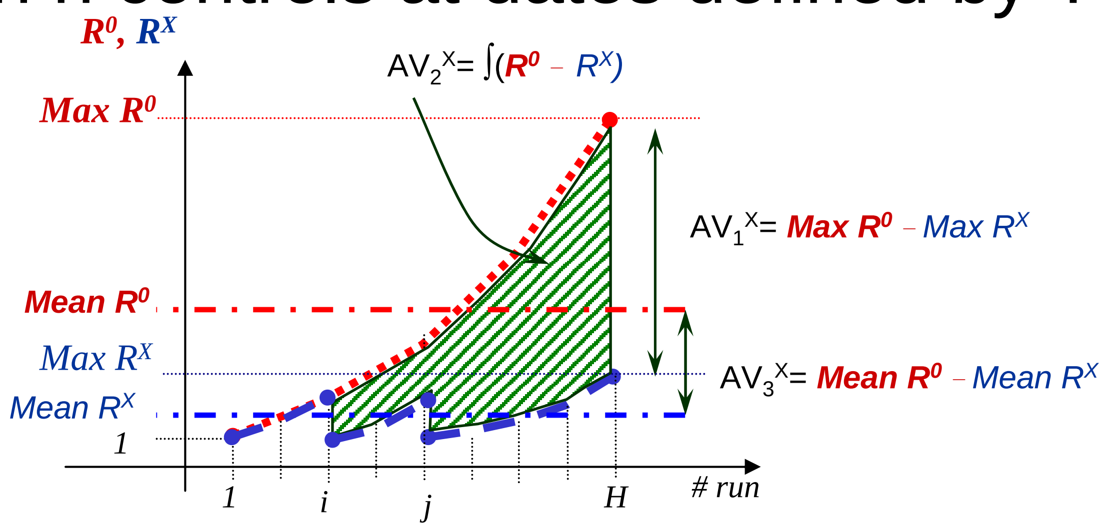


Control plan Added value

- Control plan X defined by
  - n the number of planned controls during the considered horizon
  - $T=(t_1,t_2,\ldots,t_n)$: planned dates of the n controls
- AV^X: added value of control plan X → difference between risk function without controls and risk function with n controls at dates defined by T

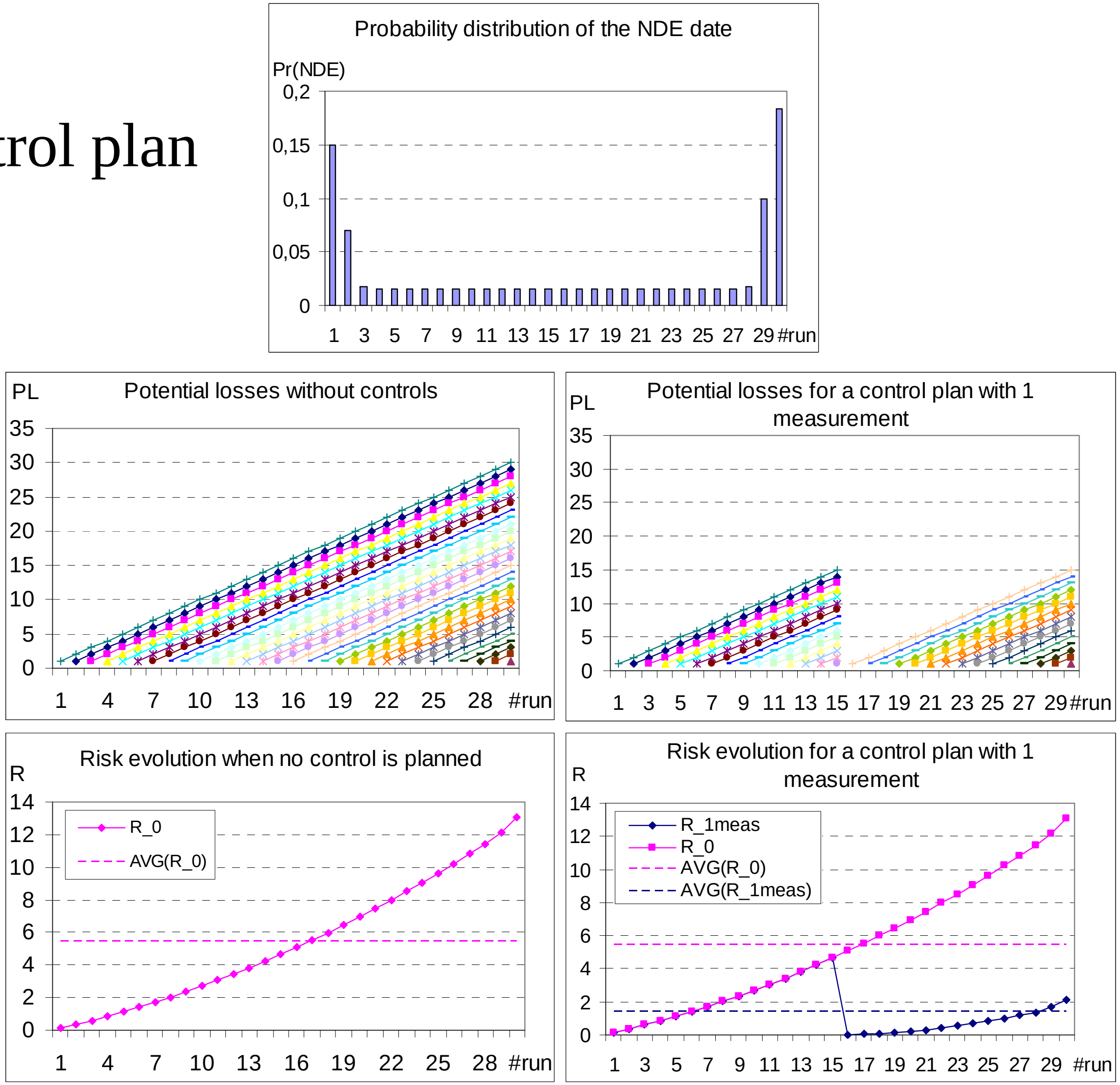
Control plan X:

n=2 ; T=(i,j)



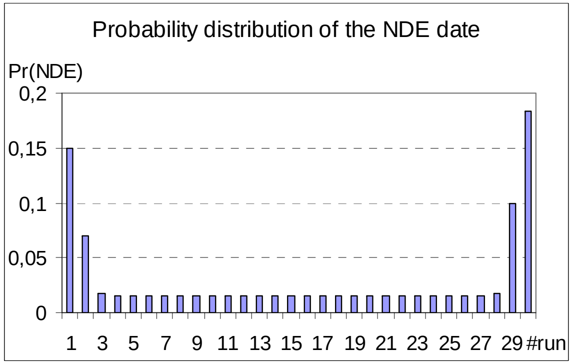
Example (1/2)

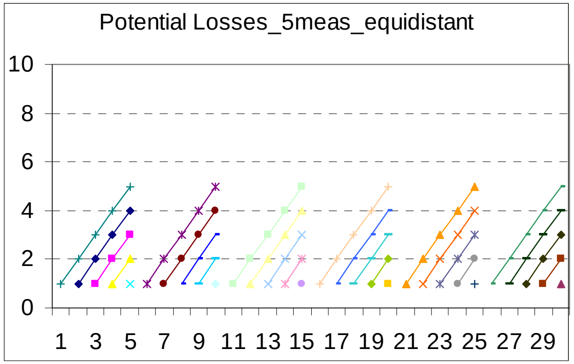
- Risk evaluation with/without control plan

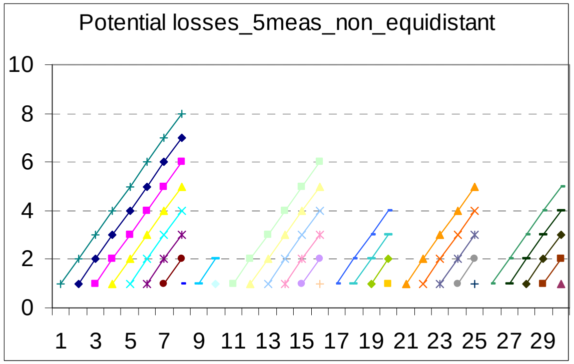


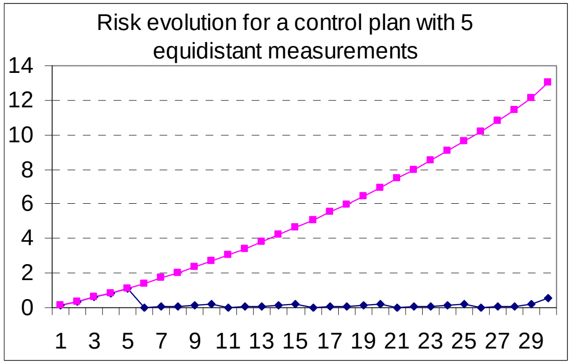
Example (2/2)

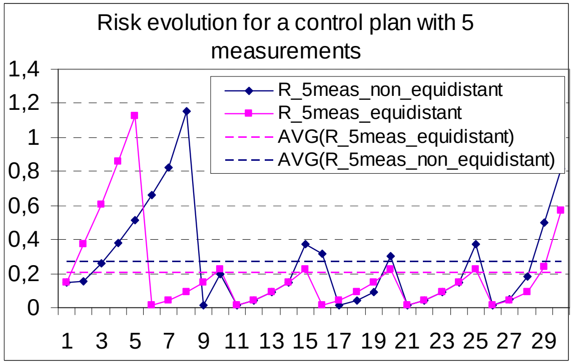
- Risk evaluation for different positions of controls











Conclusion

- An approach for risk evaluation based on Potential Losses evaluation and adjustment depending on planned controls
- An added value function to provisionally evaluate the control plan
- An optimized design of control plan (n^*, T^*) is possible when optimizing the added value function
- Capacity constraints could be taken into account which will influence n^* and T^*

Thank you for your attention ! Questions ?