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A mechanical and economical based framework to help decision-makers for natural hazards and malicious events impact on infrastructure prevention.

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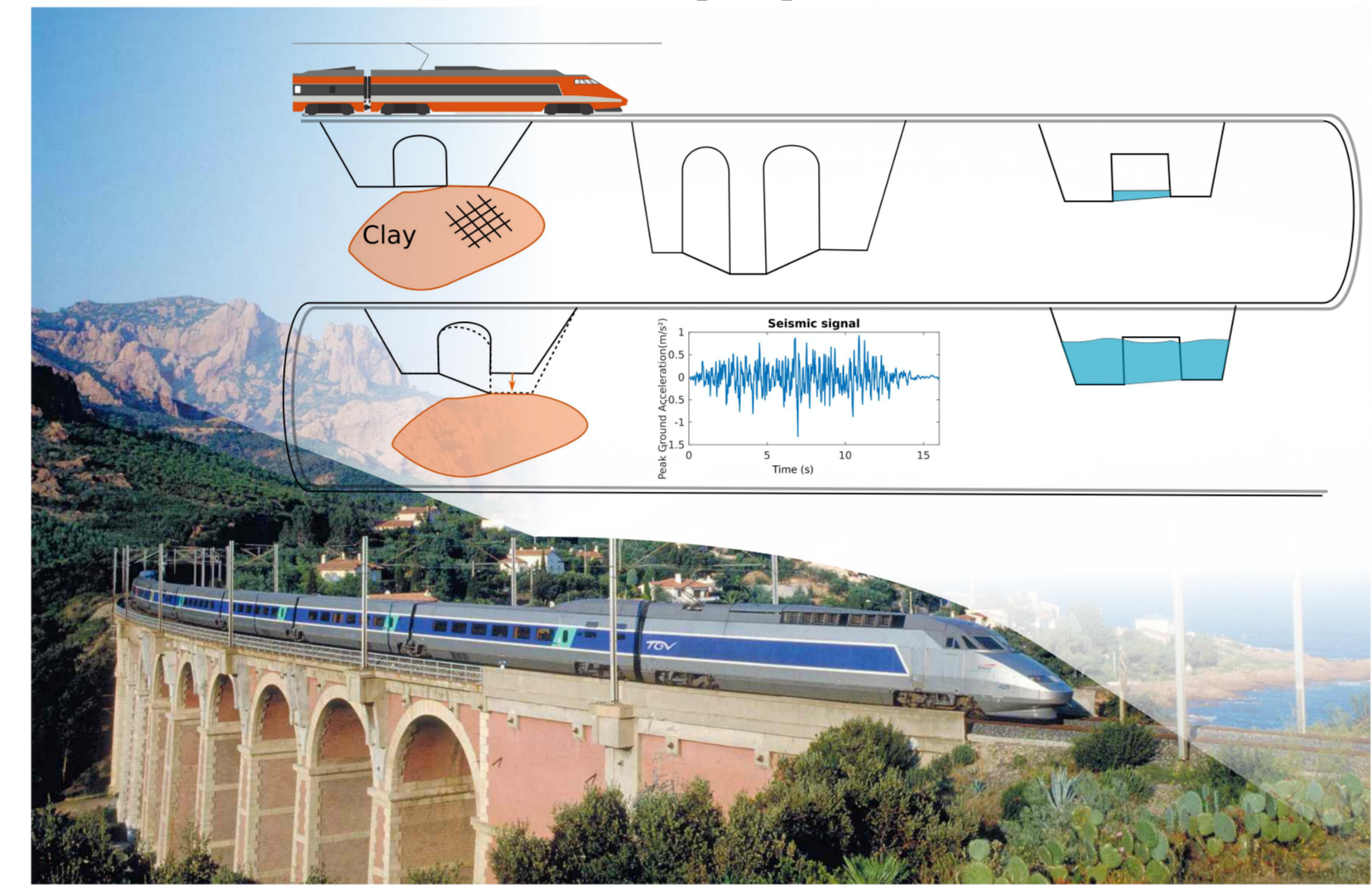
Context

- Infrastructure components are vulnerable to natural hazards and malicious events.
- A relevant prevention plan should be based on relevant indicators
- Few indicators are based on mechanical and economical information
- Their objectivity is discutable

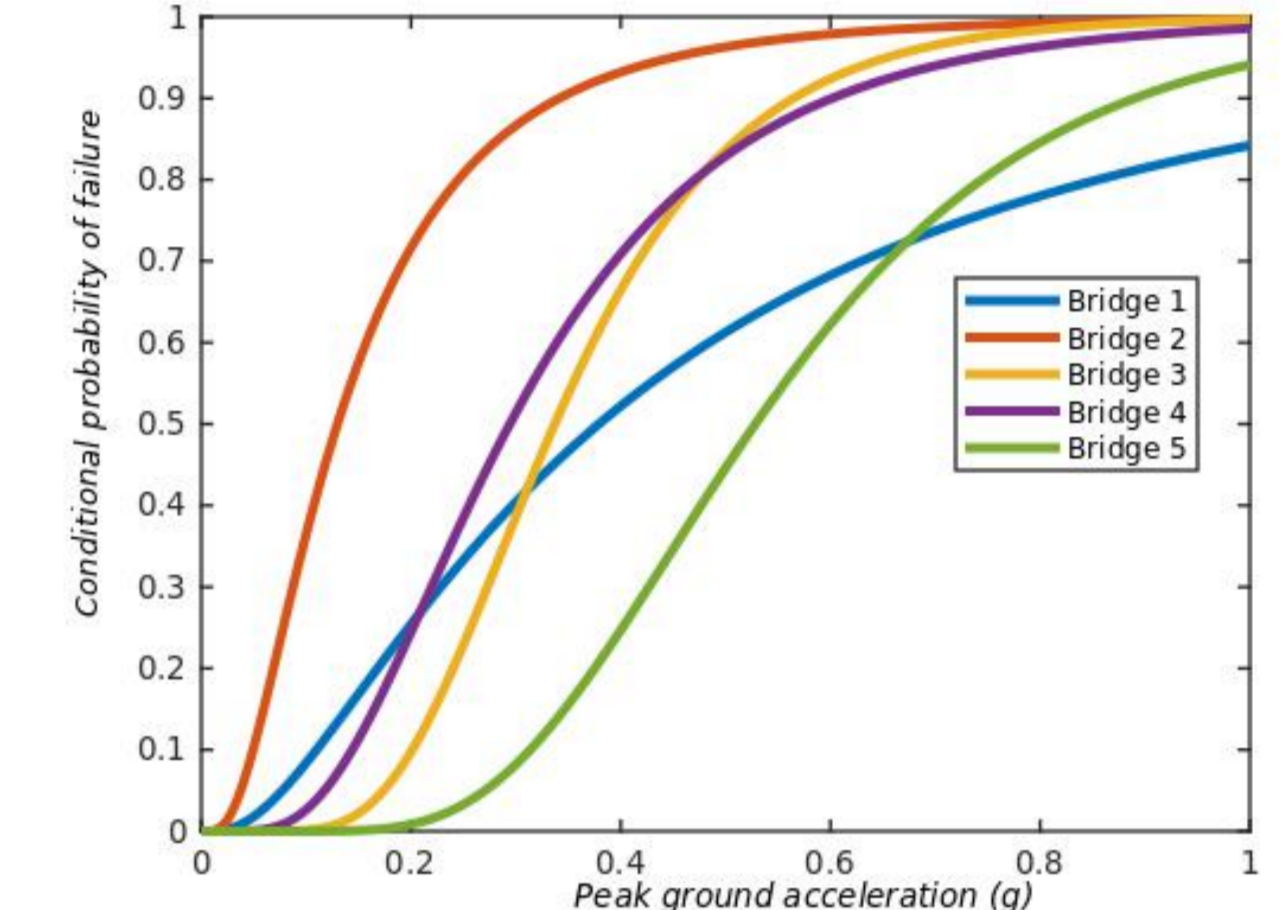
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Formulation of relevant and objective indicators to classify events and infrastructure components

Mechanical approach (Fragility curves and failure probability)



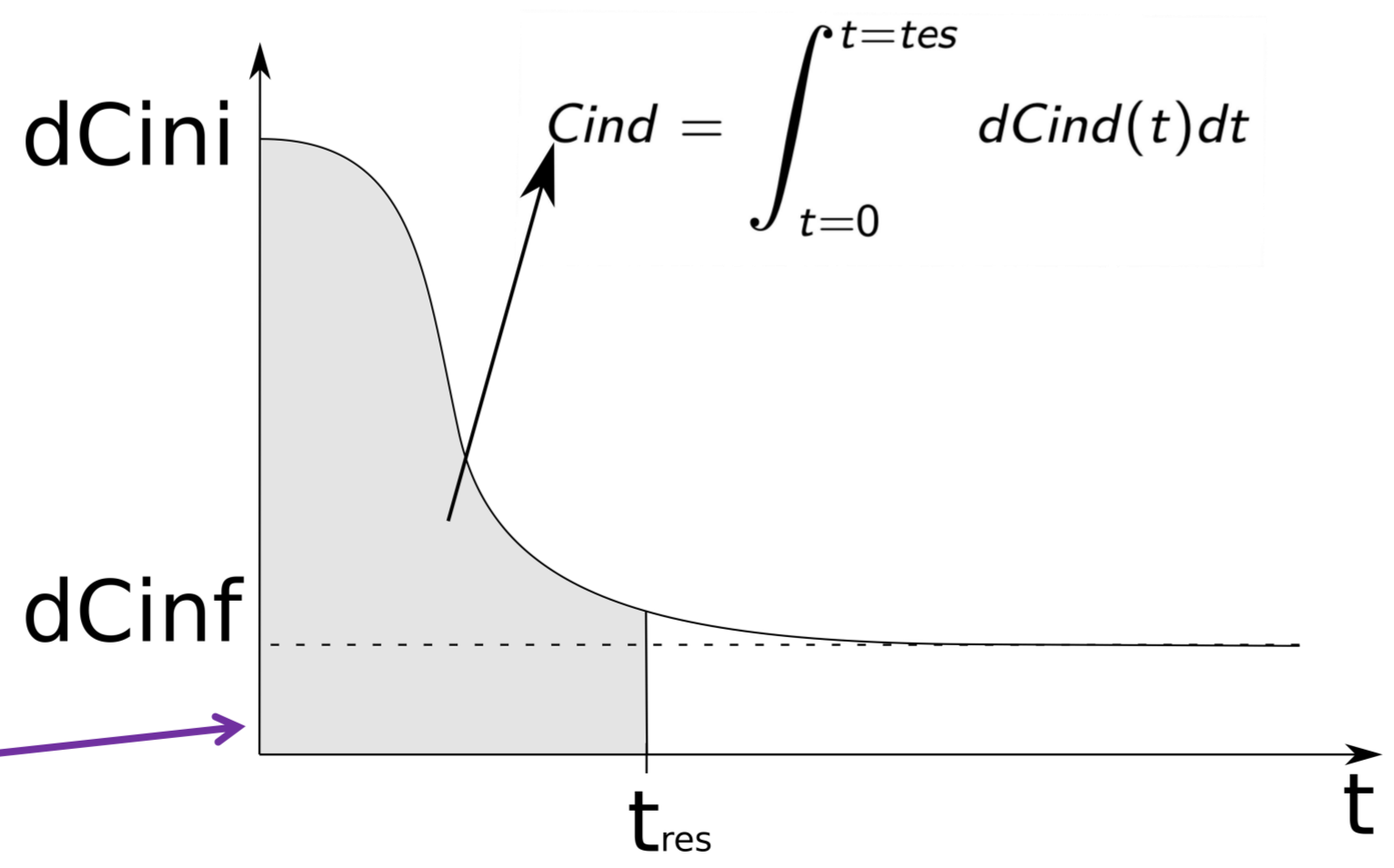
- Failure probability = mechanical vulnerability indicator of a component under an event.
- Probability mathematical framework = numerous information about failure probability, by event's intensity, by component and by group of component.
- Fragility is the conditional probability for a quantity to pass a threshold knowing the event intensity.



- Failure probability can be obtained for :
 - a failure mode $P(A) = \sum_i (P(A/E_i)P(E_i))$
 - all failure mode $P(F) = \cup_i (P(F_i)) = 1 - \prod_i (1 - P(F_i))$

Economical approach (failure cost)

- Economic loss assessment can be split in different parts :
 - Repairing or rebuilding of damaged components
 - Tickets refunding and business interruption
 - Business loss due to reputation loss
 - GDP loss (casualties, economic flow interruption, ...)
 - ...
- Some are correlated to component cost, and some to duration of business interruption.

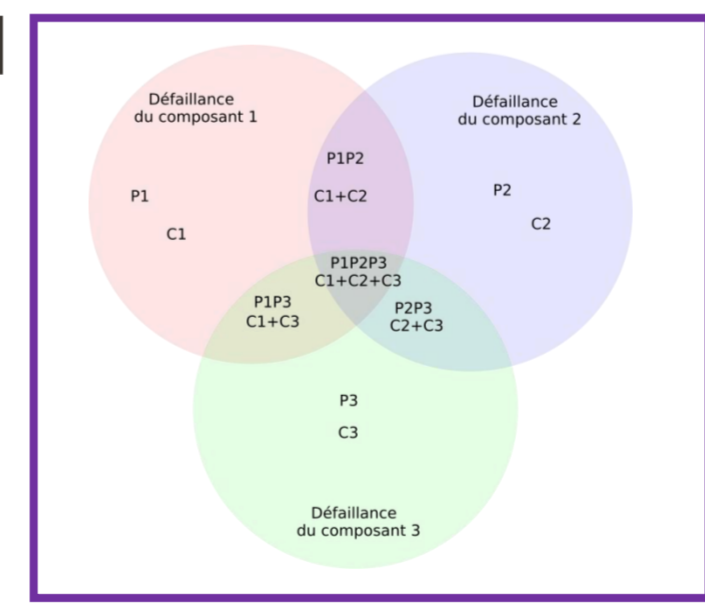


$$C = C_p(\text{component}) + C_T(\text{duration})$$

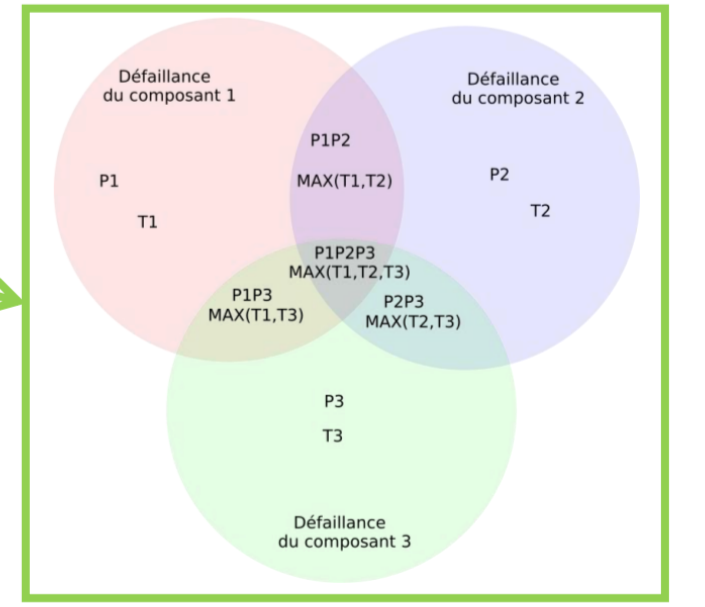
The cost of failure may consider a plenty of parameters. Decision-maker must choose the scale of economical loss computation.

Indicators (Probable cost of failure and participation factor)

- Probable failure cost = indicator of the money to save each year to attein equilibrium on long period



$$PC = C_p P_{failure} + C_t P_{failure}$$



- Probable cost = classification between railway line or railway network part
- Importance factor = participation of a component in line probable cost of failure

Next challenges

- Need database of different events probability of occurrence (Need to gether)
- Computation of all critical components fragility curves
- Cost computation for different scale (Infrastructure Manager, State, ...)