



Safety versus Economic Cost-efficiency of tunnel safety measures

Session 4: Cost-efficient fire design of tunnels

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Ministry of the Interior

**Department of Firefighters, Public Rescue and Civil Defence
Central Directorate for Prevention And Technical Safety**

Directive 2004/54/CE on minimum safety requirements for tunnels in the Trans-European Road Network

transposed in the Italian
Legislative Decree 264/2006:

Exposed population: users, operational staff, rescue teams

Objective of the Directive is to prevent accidents endangering human life, the environment and tunnel installations.

Moreover, it aims at improving self-rescue conditions for people involved in serious accidents, like large-scale fires.

The Directive defines a set of standards relating to the organisation, the roles and responsibilities of the various bodies in charge of safety in tunnels as well as technical standards for tunnel infrastructure, operation, traffic rules and user information.

THE FIRE PREVENTION

$$\text{RISK} = \text{FREQUENCY} \times \text{DAMAGE}$$

ITALIAN FIRE BRIGADE IS ENGAGED IN:

- PUBLICATION OF NATIONAL FIRE PREVENTION REGULATIONS AND CONTRIBUTIONS TO INTERNATIONAL REGULATIONS TOO, ALSO ABOUT PRODUCTS
- CONTROL AND SUPERVISION FOR FIRE PREVENTION IN CIVIL, COMMERCIAL, INDUSTRIAL ACTIVITIES
- INSPECTIONS AND ABILITATION OF LABORATORIES FOR FIRE TESTS
- TESTS, STUDIES AND RESEARCH IN FIRE WITH MEETINGS WITH FIRE PREVENTION TECHNICAL EXPERTS
- TRAINING FOR OUR FIREMEN, PRIVATE COMPANIES FIREMEN, WORKERS, PROFESSIONALS

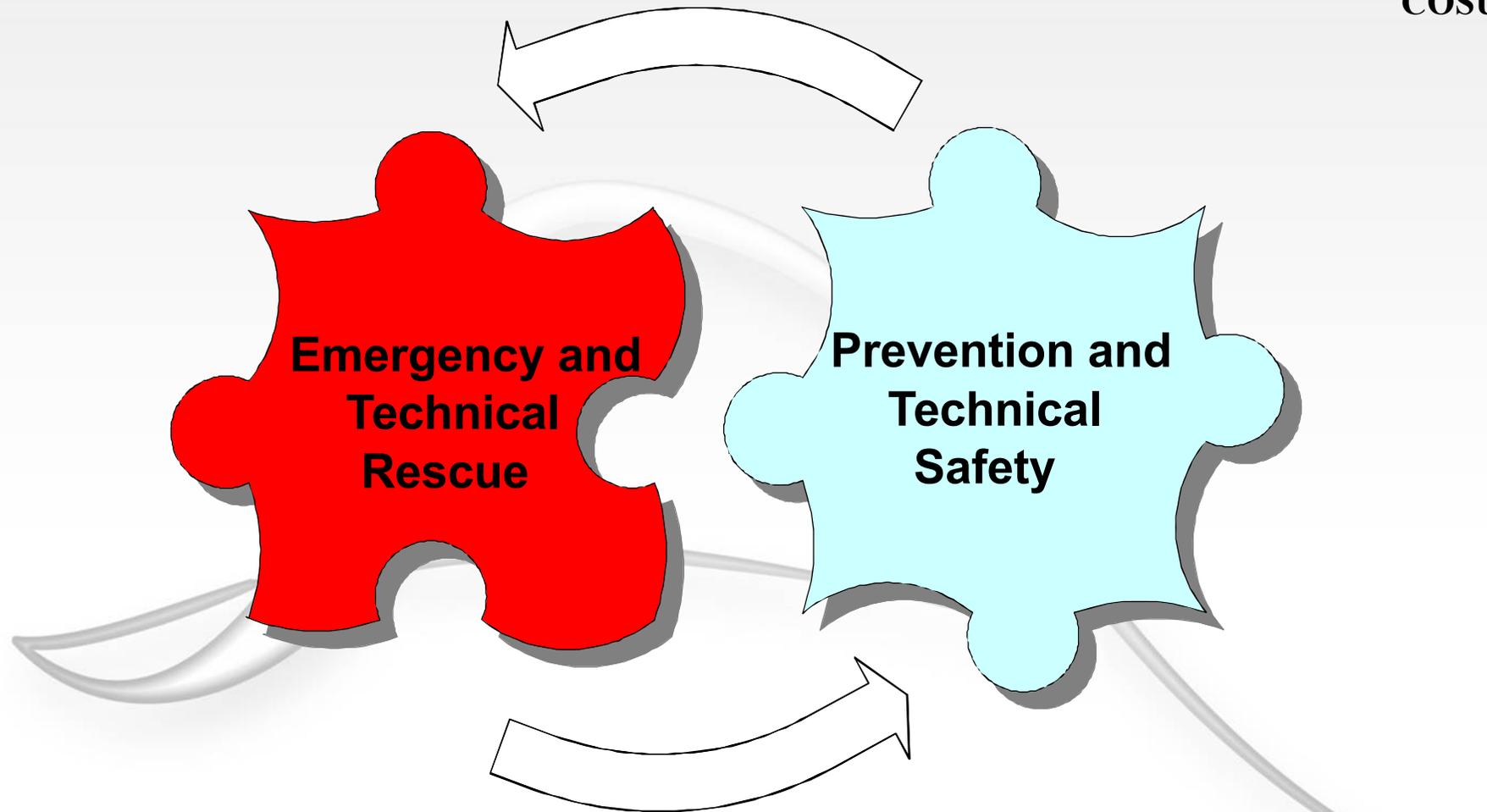


MINISTERO
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Prevention and Rescue

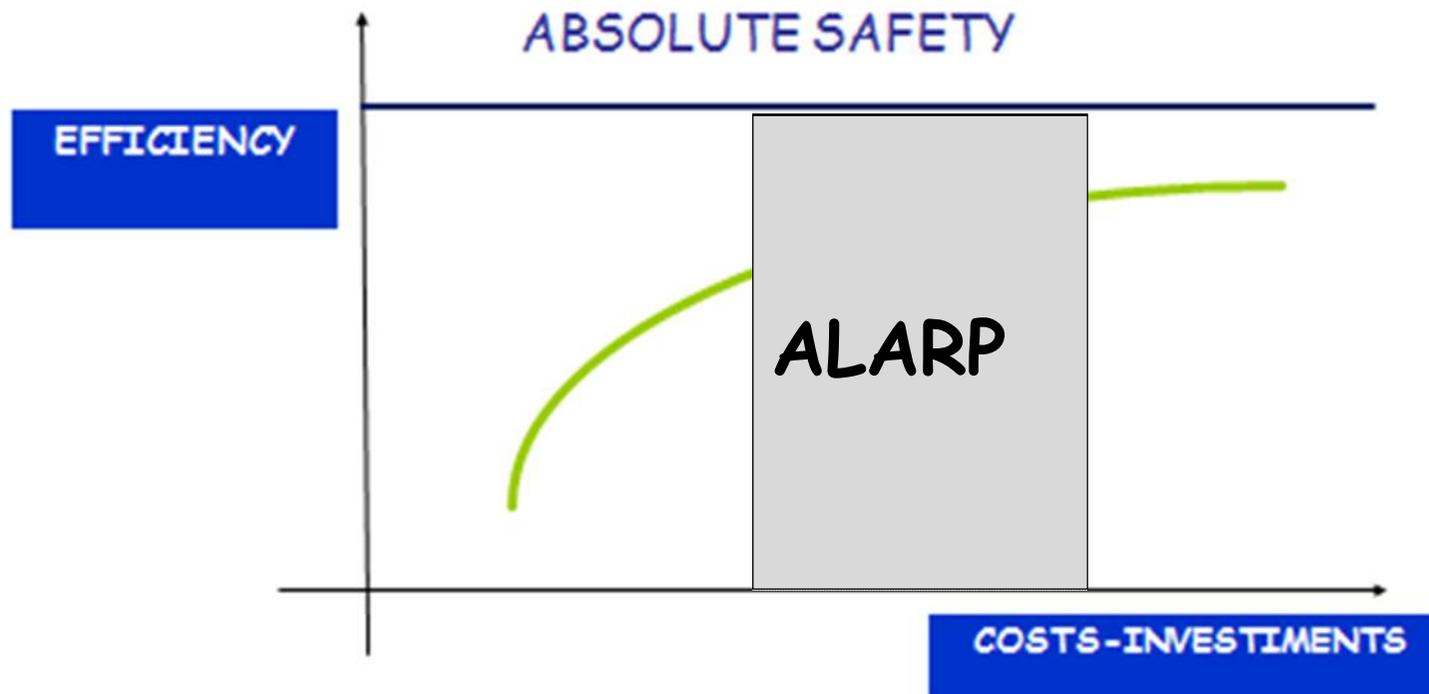


COSUF



Italian Firefighters are responsible both for Fire Prevention and for Technical Rescue

SAFETY VERSUS ECONOMICS



SAFETY:



COSUF

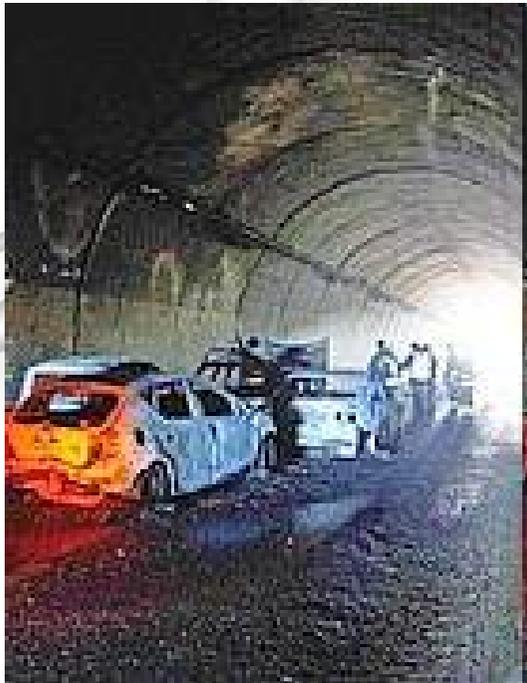
Risk analysis techniques imply
uncertainty and randomness factors

Scenario

Parameters of system

*Models used in the evaluation
(events and effects)*

Tunnels accidents:
the most relevant accident scenario
is the **FIRE**, with termic effects and
release of toxic smokes



Fire of 27/02/2012 in a road tunnel in Rome

Tunnels Safety: PREVENTION and PROTECTION

The development of real accident show that generally adopted prevention and protection measures are not adequate, unless the fire is extinguished in a very short time

Tunnels Fire Safety

Main prevention/protection measures:

- Fire resistance
- Emergency exits
- Ventilation (smoke and heat control systems)
- Extinction plants
- Safety management (human behaviour)

Fire resistance of tunnels

Fire test conducted in Italian Firefighters installation



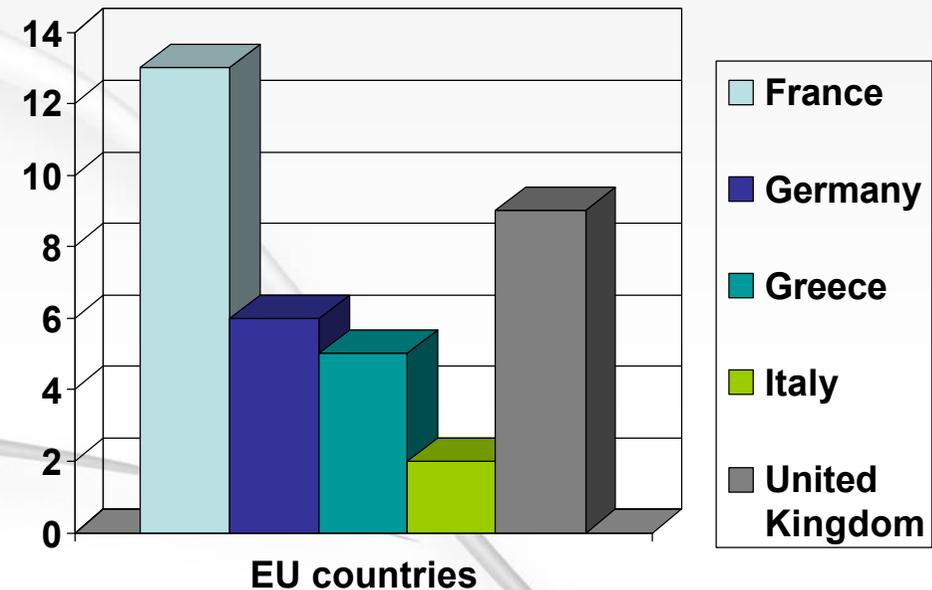
Fire resistance of tunnels

Fire test conducted in Italian Firefighters installation: spalling of concrete





- Experience shows that the cost of fire prevention is lower than the costs due to an accident (considering loss of human lives, of property, the environmental damage, costs for restoring facilities and infrastructures)
- In Italy the number of deaths due to fire is lower, in comparison with other European countries



n° deaths due to fire/million inhabitants

More prevention → **less costs**

... **THANK YOU FOR YOUR
ATTENTION!**

