Stretto di Messina

Concessionaria per la progettazione, realizzazione e gestione del collegamento stabile tra la Sicilia e il Continente Organismo di Diritto Pubblico
(Legge n° 1158 del 17 dicembre 1971, modificata dal D.Lgs. n°114 del 24 aprile 2003)

EurolinK

PONTE SULLO STRETTO DI MESSINA

PROGETTO DEFINITIVO

EUROLINK S.C.p.A.

IMPREGILO S.p.A. (MANDATARIA)
SOCIETÀ ITALIANA PER CONDOTTE D'ACQUA S.p.A. (MANDANTE)
COOPERATIVA MURATORI E CEMENTISTI - C.M.C. DI RAVENNA SOC. COOP. A.R.L. (MANDANTE)
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IL PROGETTISTA	IL CONTRAENTE GENERALE	STRETTO DI MESSINA	STRETTO DI MESSINA
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Titolo del documento	Risk evaluation principles: brief notes on the Report of COWI issued on 19.05.2010

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Risk evaluation principles: brief notes on the Report of COWI issued on 19.05.2010

Milano 15 giugno 2010
Riunione c\o Eurolink S.C.p.A.

Risk evaluation principles: brief notes on the Report of COWI edited on 19.05.2010

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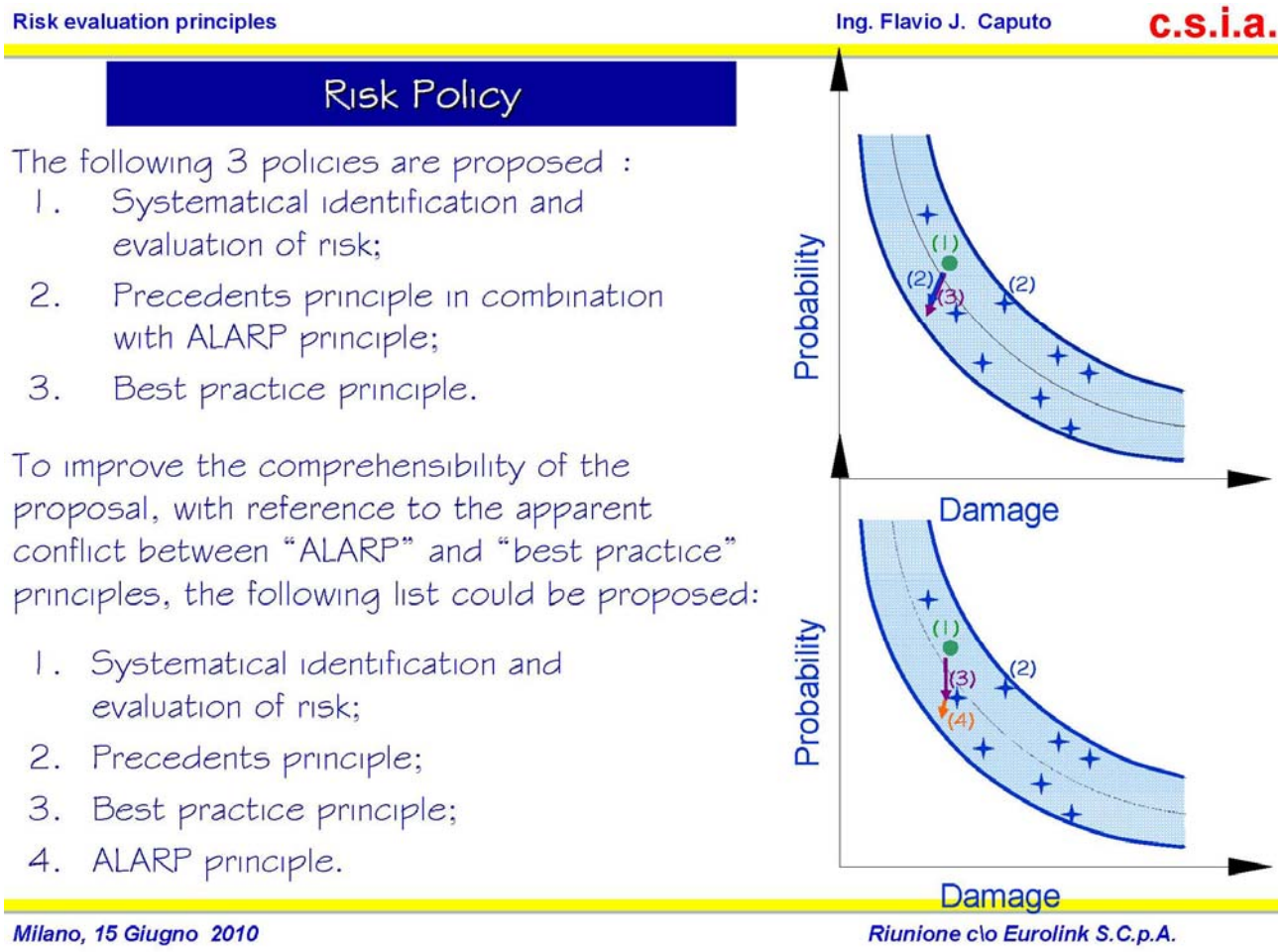
Risk evaluation principles
Ing. Flavio J. Caputo
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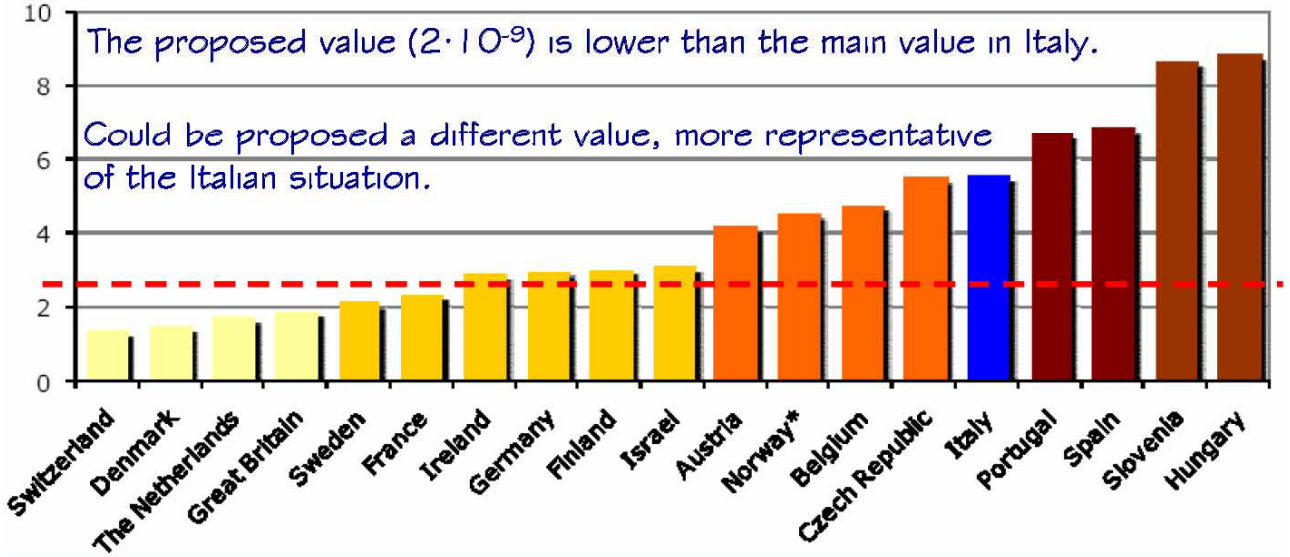
Risk Policy
The following 3 policies are proposed :
1. Systematical identification and evaluation of risk;
2. Precedents principle in combination with ALARP principle;
3. Best practice principle.
To improve the comprehensibility of the proposal, with reference to the apparent conflict between "ALARP" and "best practice" principles, the following list could be proposed:
1. Systematical identification and evaluation of risk;
2. Precedents principle;
3. Best practice principle;
4. ALARP principle.
Probability
Damage
(1)
(2)
(3)
(4)
Milano, 15 Giugno 2010
Riunione c\o Eurolink S.C.p.A.

Individual risk benchmark value for road users

The following value is proposed : $6 \cdot 10^{-9}$ fatalities/passages.

To compare the risk value on the bridge with risk value of other parts of the system it could be better to express the individual risk in fatalities/passages·km. If the proposed value is referred to the bridge (L≈3km), it's equivalent to $2 \cdot 10^{-9}$ fatalities/passages·km.

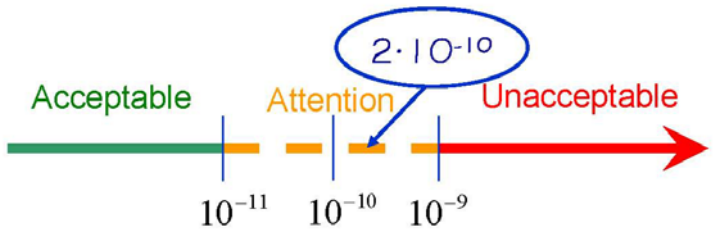


Milano, 15 Giugno 2010 — Riunione c\o Eurolink S.C.p.A.

Individual risk benchmark value for rail users

The following value is proposed : $6 \cdot 10^{-10}$ fatalities/passages.
To compare the risk value on the bridge with risk value of other parts of the system it could be better to express the individual risk in fatalities/passages·km. If the proposed value is referred to the bridge (L≈3km), it's equivalent to $2 \cdot 10^{-10}$ fatalities/passages·km.

The Italian law on Risk in rail tunnels (D.M. del 28/10/2005 «Sicurezza nelle gallerie ferroviarie») evaluates the individual risk in rail tunnel in $1 \cdot 10^{-9}$ fatalities/passages·km, and proposes the following terms of acceptability:



The proposed value ($2 \cdot 10^{-10}$) is in the high part of the "attention zone" assumed by law for rail tunnels.
A different value could be proposed, in consideration of law's requests (even if for a different situation, v. tunnel).

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Monetary value of fatalities & injuries

The following value is proposed : $2,15 \cdot 10^6$ €/fatality in 2009, corresponding to:

- $3,1 \cdot 10^6$ €/fatality in 2018;
- $4,6 \cdot 10^6$ €/fatality in 2038 (*).

The proposed value for injuries is 1/10 of values for fatalities, and therefore:

- $0,31 \cdot 10^6$ €/injury in 2018;
- $0,67 \cdot 10^6$ €/injury in 2038.

Studies made in Italy on ISTAT database evaluated: $1,3 \cdot 10^6$ €/fatality and $0,045 \cdot 10^6$ €/injury in 2002, corresponding to:

- $2,4 \cdot 10^6$ €/fatality and $0,084 \cdot 10^6$ €/injury in 2018;
- $5,3 \cdot 10^6$ €/fatality and $0,19 \cdot 10^6$ €/injury in 2038.

Between the two set of values there are differences, in particular as far as the value of injuries is concerned. Therefore values more representative should be proposed.

(*) With an annual rate of 4% the value $2,15 \cdot 10^6$ €/fatality in 2009 result of $6,7 \cdot 10^6$ €/fatality in 2038>$4,6 \cdot 10^6$ €/fatality.

Risk evaluation principles **Ing. Flavio J. Caputo** **c.s.i.a.**

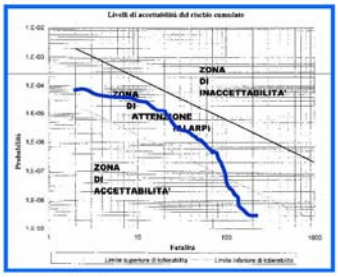
Societal risk

It is proposed to represent the societal risk with an FN curve, as cumulative risk of fatalities, composed of the:

- Risk to road users;
- Risk to rail users;
- Third parts risk.

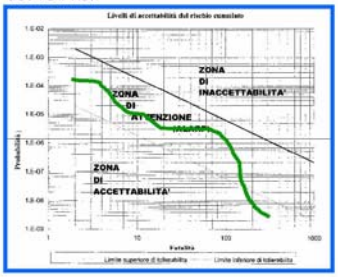
To compare the risk on the bridge with risk of other parts of the system (es. rail or road tunnels) it could be better to distinguish the societal risk on the bridge in the two modal components:

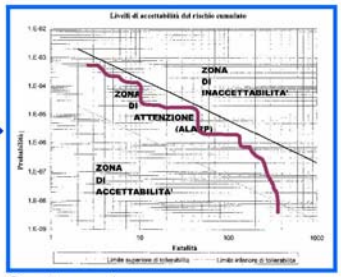
- Road risk;
- Rail risk.



Es. Road risk

Es. Rail risk





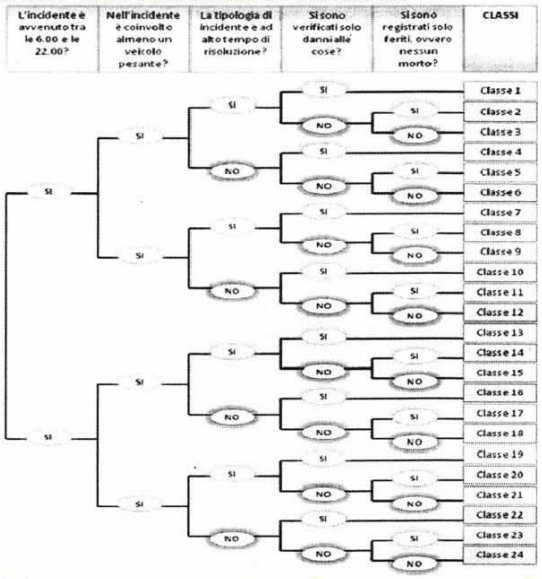
Cumulative risk

It would be ever possible to compose the two curves in a cumulative one.

Milano, 15 Giugno 2010 *Riunione c\o Eurolink S.C.p.A.*

Risk of disruption

For the operational risk analysis, CSIA will use a specific probabilistic model to evaluate the risk of traffic disruption due to accidents occurring on the bridge and on the accesses routes.



Classes	Average	Std. dev	Num.	Minimum	Max	P05	P15	P30	P50	P70	P85	P95
Class 1	115	71	19	18	275	17	47	64	96	129	188	241
Class 2	129	78	24	18	275	22	49	66	103	167	216	271
Class 3	161	49	14	108	273	108	109	122	144	173	213	237
Class 4	48	32	361	10	235	13	20	28	41	54	78	111
Class 5	76	43	201	11	258	26	40	52	68	87	106	158
Class 6	144	35	11	108	221	108	109	113	137	155	169	198
Class 7	73	21	11	36	103	30	44	58	73	83	91	102
Class 8	77	46	15	23	221	22	31	58	74	79	93	126
Class 9	154	39	12	108	249	104	117	122	153	161	175	218
Class 10	35	21	936	10	295	12	17	22	31	41	50	68
Class 11	50	23	490	10	177	16	29	37	46	58	73	89
Class 12	153	41	11	108	249	103	115	121	144	155	179	220
Class 13	182	69	10	80	261	73	88	110	199	209	257	261
Class 14	176	72	14	69	261	66	82	108	199	227	253	260
Class 15	161	49	14	108	273	108	109	122	144	173	213	237
Class 16	91	62	72	11	291	19	29	54	70	112	153	209
Class 17	112	56	45	36	284	42	54	68	102	134	151	228
Class 18	161	49	14	108	273	108	109	122	144	173	213	237
Class 19	77	38	33	23	221	25	36	56	77	87	101	122
Class 20	77	38	33	23	221	25	36	56	77	87	101	122
Class 21	154	39	12	108	249	104	117	122	153	161	175	218
Class 22	45	21	126	10	129	16	25	32	42	52	66	79
Class 23	62	37	75	14	264	22	34	46	53	65	93	124
Class 24	153	41	11	108	249	103	115	121	144	155	179	220

CSIA will evaluate the frequencies of different disruption's situations, with different time of disruption.

Societal cost of disruption

The following value is proposed : $0{,}9 \cdot 10^6$ €/day in 2018.

Different studies in literature are available; an example of values is reported in the following table.

Tipe of user	Time value (euro/h)
Truck	29,50
Articulated	41,35
Van	15,07
Car	10,14

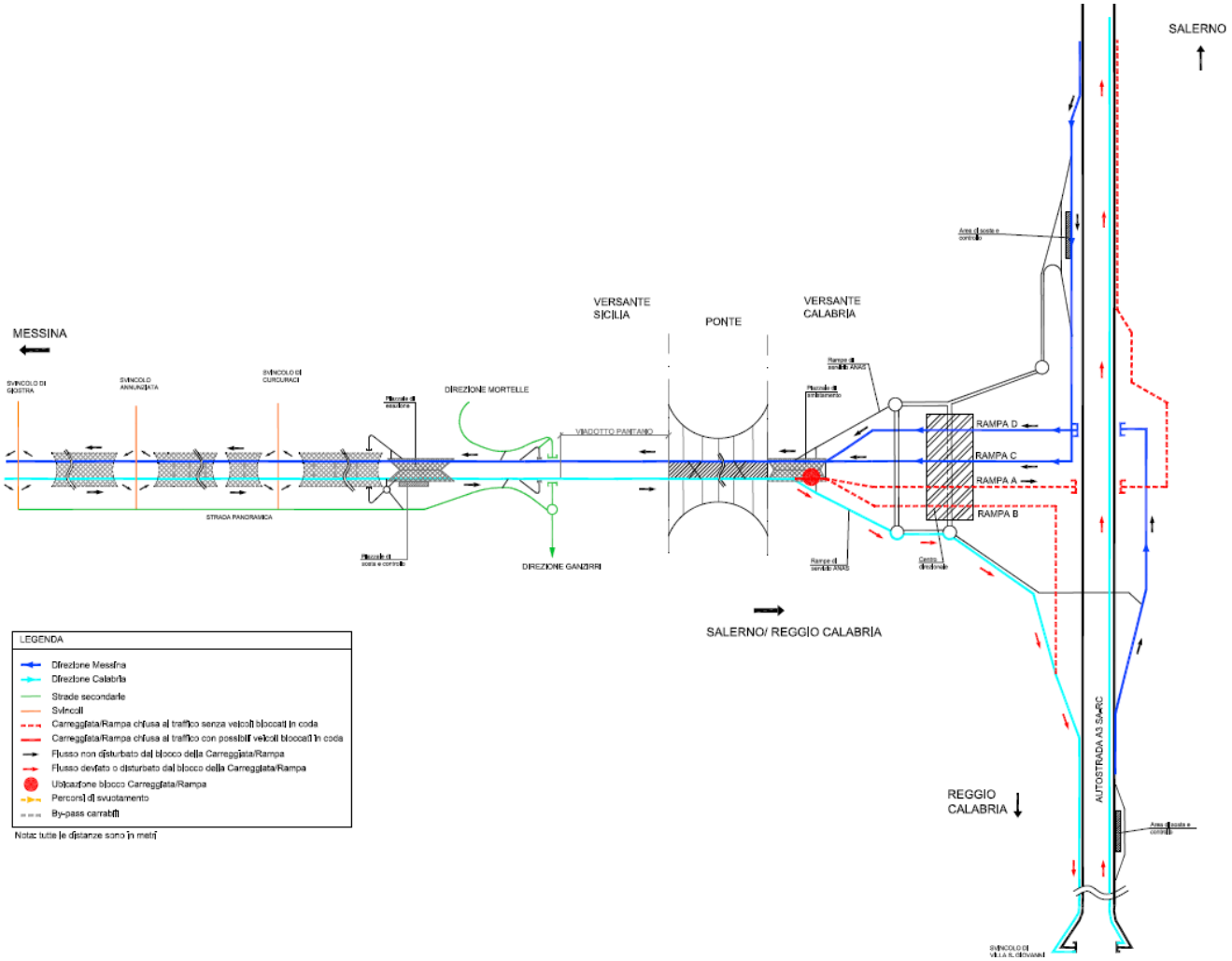
A deepening is deemed necessary to verify the congruence of the proposed value with disruption frequencies on the bridge and accesses routes due to accidents and other causes.

Analysis of the emergencies

CSIA will identify different emergencies scenarios.

For every scenario it will be evaluated:

- The access path for rescue services;
- The time needed to rescue services to arrive to the accident place;
- Traffic control criteria to limit the duration and the consequences of traffic disruption.



Operational Road risk – probabilistic analysis 1/3

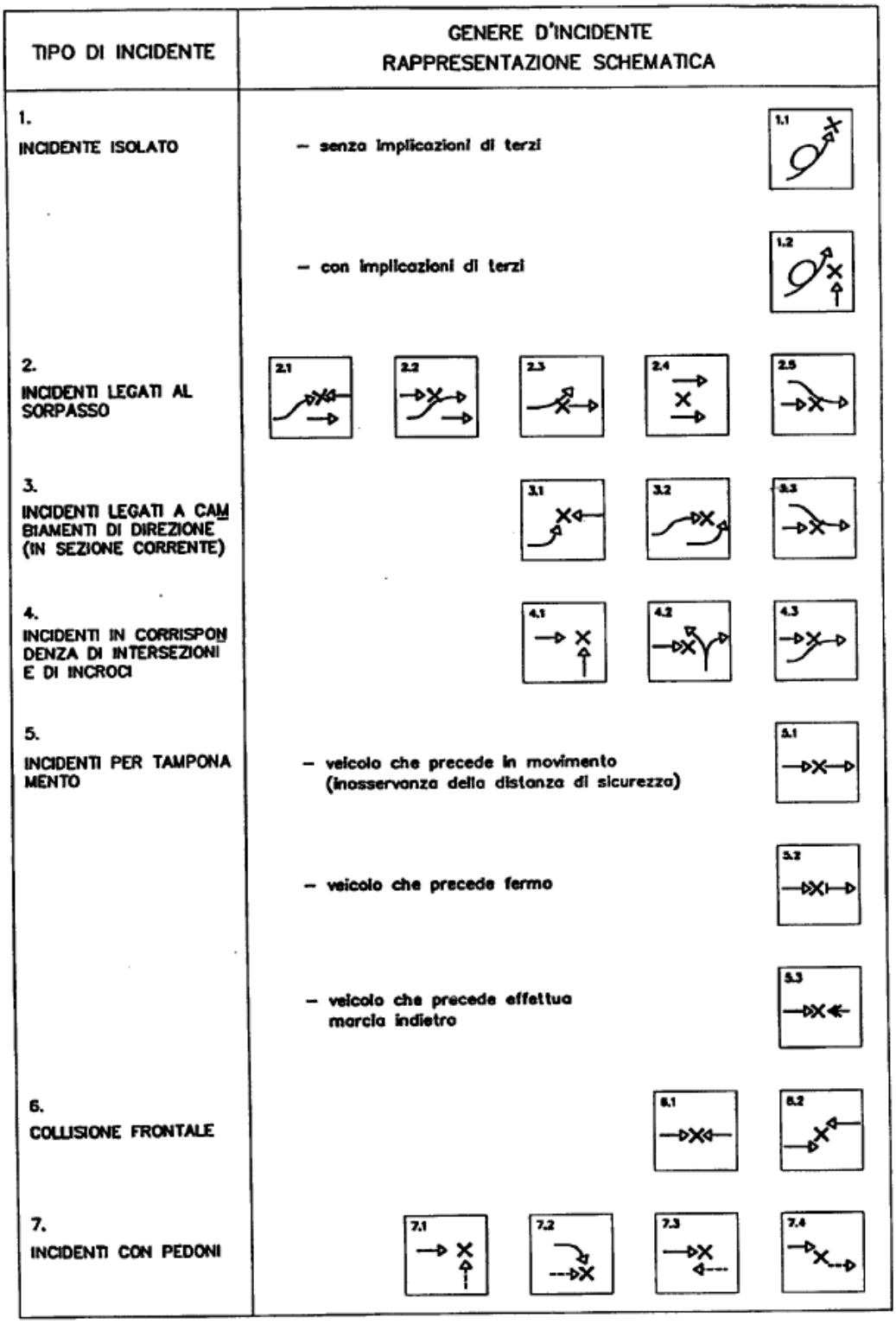
CSIA will evaluate the accident's frequency.

The evaluation of the accident's frequency will be made using predictive models that consider the traffic characteristics (traffic volume, composition, speed) and the road's geometrical characteristics.

The accident's frequency will be evaluated for three categories of accidents:

- Typical traffic accidents;
- Critical traffic accidents (HGV fire, DG's, etc.);
- Running off accidents with invasion of the railway track or collision against structural components (v. suspensions).

The typical traffic accident's frequency will be evaluated with reference to different types of road accidents.

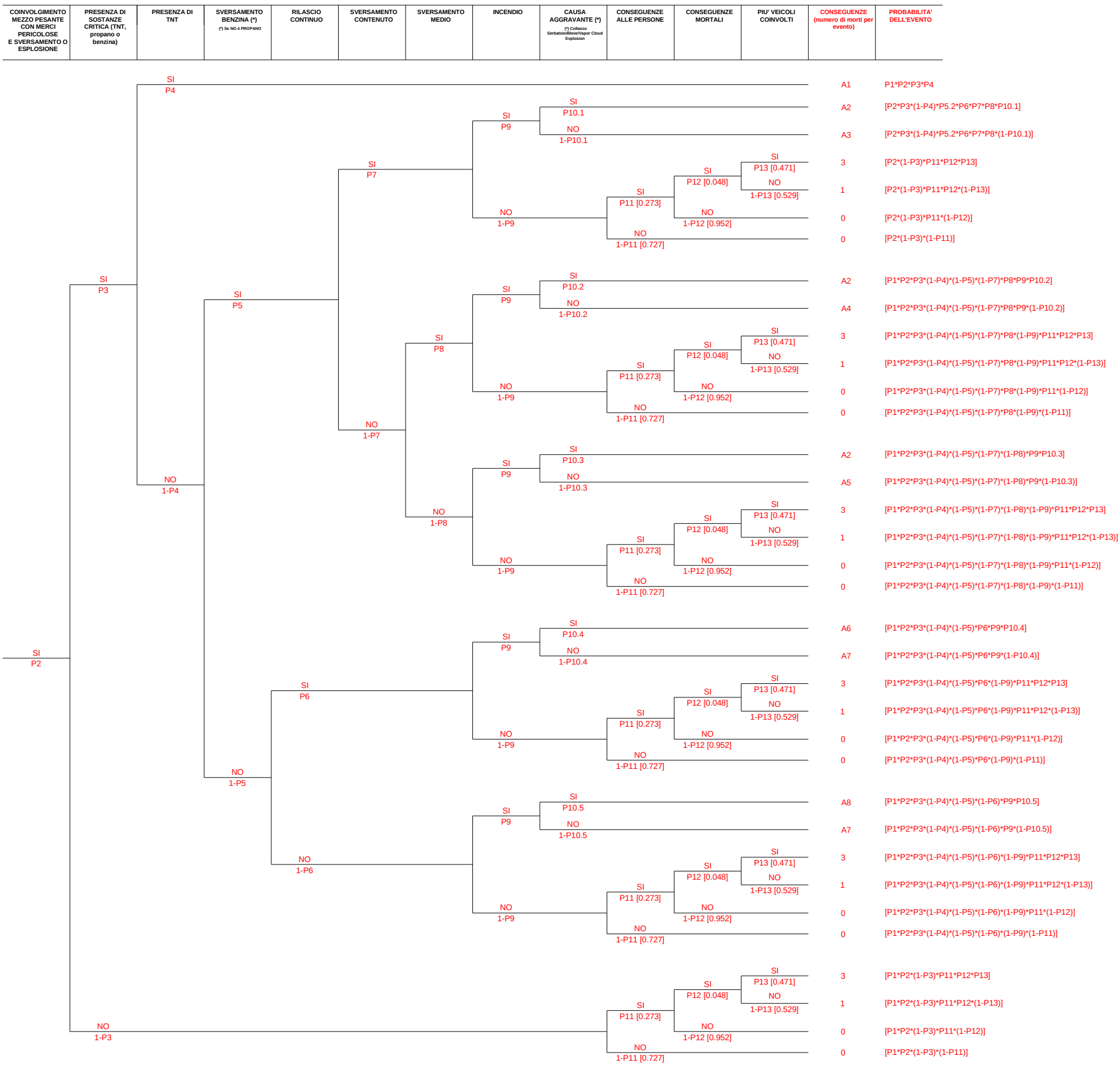


(Schema indicativo per l'impostazione dello studio)

Operational Road risk – probabilistic analysis 2/3

The critical traffic accident's frequency will be evaluated with reference to a defined group of different accident scenarios involving HGV (es. fire of HGV) or DG's.

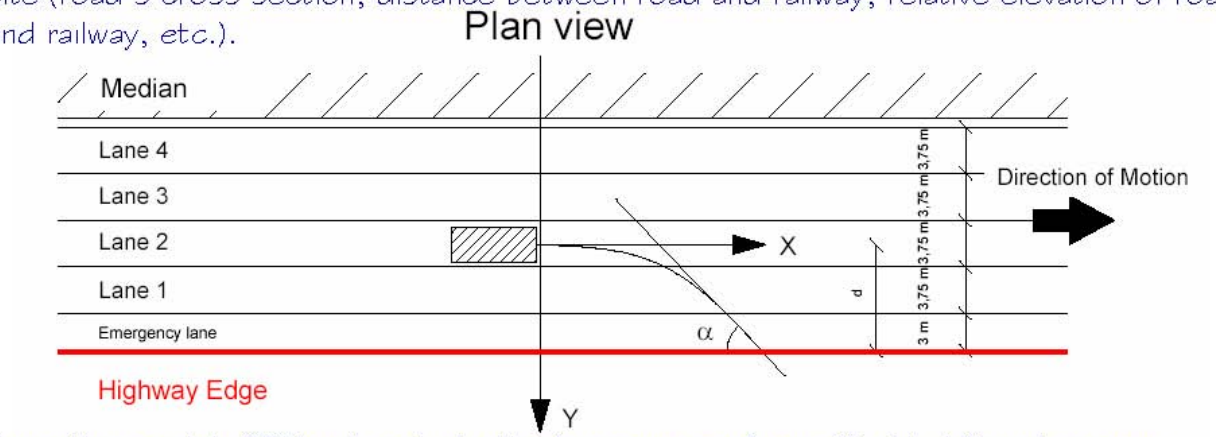
The choice of the scenarios will be made following the international practice and the informations (if available) on the DG's traffic in the area. The frequency of every scenario will be evaluated using the event's tree criteria and statistical data available in the international literature.



(Schema indicativo per l’impostazione dello studio)

Operational Road risk – probabilistic analysis 3/3

To evaluate the frequency of running off accidents, CSIA will use a cinematic and dynamic model (already used in safety analysis of multimodal corridors) that identify the probability of these events as a function of operative conditions (traffic volume and composition, actuated speeds, accident rate) and the physical characteristics of the site (road's cross section, distance between road and railway, relative elevation of road and railway, etc.).



Using this model, CSIA will evaluate the frequencies of run off with different energy levels, and than the frequency of invasion of the railway track by road vehicles, or (on the other side of the bridge) the frequency of possible collision with structural components (v. suspensions).