How to define "Minimal Operating Requirements" ?

Session :
Strategic issues regarding tunnel safety officers' tasks and functions

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Second European Forum of Road Tunnel Safety Officers - 18 January 2012, Brussels

Presentation schedule

- **The regulatory and institutional framework**
- **Degraded operation situations**
- **Relationship with safety functions**
- **Instruction book**

The TSO tasks

Why is it important to adopt a clear definition of Minimal Operating Requirements (MORs) ?

Ref article 6:

(a) ensure coordination with emergency services and take part in the preparation of operational schemes;

(c) take part in the definition of safety schemes and the specification of the structure, equipment and operation in respect of both new tunnels and modifications to existing tunnels;

(e) give advice on the commissioning of the structure, equipment and operation of tunnels;

(g) take part in the evaluation of any significant incident or accident as referred to in Article 5(3) and (4).

The TSO tasks

How to define Minimal Operating Requirements (MORs) ?

- In consistency with *principles for actions* defined in the *Emergency Response Plan (ERP)*
- In connection with *degraded operating modes*
- With the objective of a clear definition of *situations for which the tunnel should be closed*

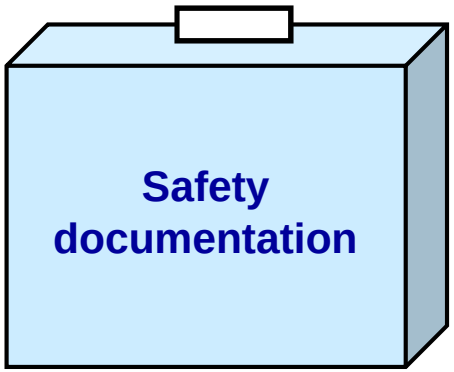
- … relevant *instructions* will be derived for these situations

The regulatory and institutional framework

Safety in road tunnels

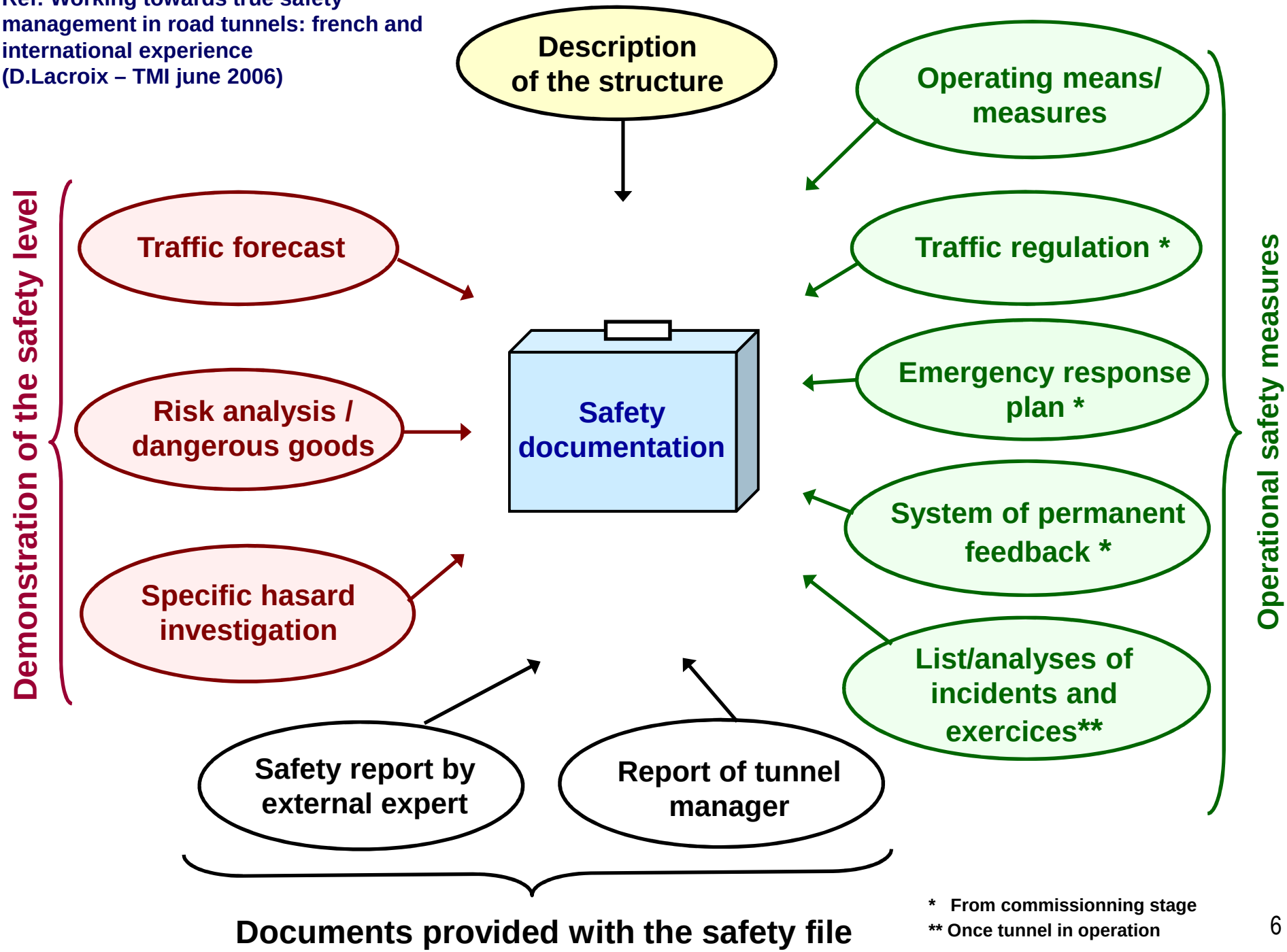
French regulatory and institutional framework :

a safety management system based on the



… in accordance with the European Directive

Ref: Working towards true safety management in road tunnels: french and international experience
(D.Lacroix – TMI june 2006)



* From commissionning stage
** Once tunnel in operation

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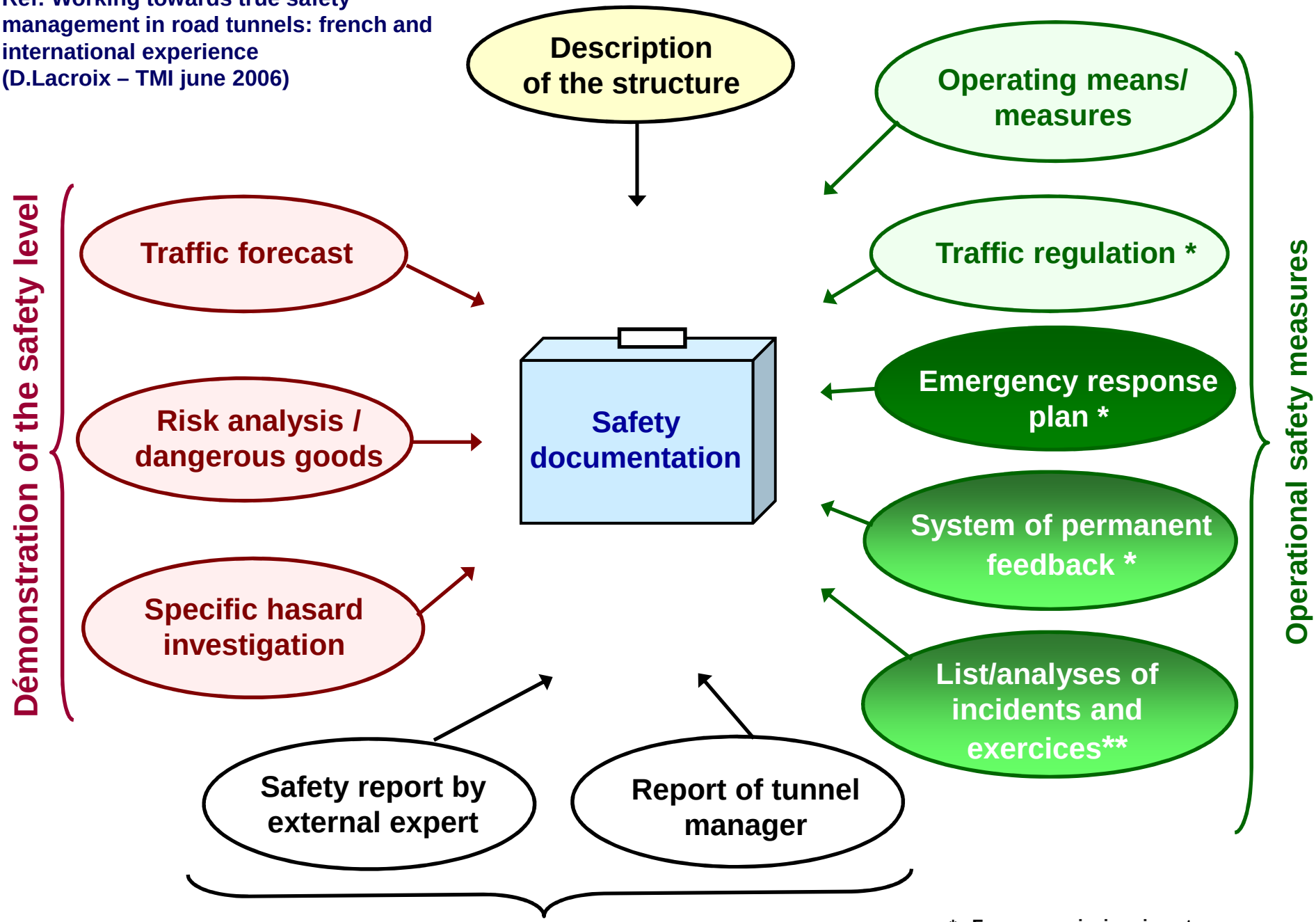


* From commissionning stage
** Once tunnel in operation

The regulatory and institutional framework

Who works out the ERP (1/2) ?

the tunnel manager (operating body)

in coordination with TSO and the emergency services (outside parties)

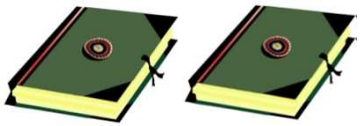
TSO

Préfecture

etc.

External intervention services

Police, firemen, emergency medical services



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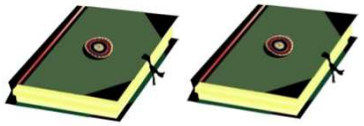

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The ERP achievement

Who works out the ERP (2/2) ?

The participants :

Tunnel operating body	Outside (of tunnel operation service) parties
• Duty operator • Duty operation manager • In house intervention services : - Patrols - Dedicated fire fighters • Maintenance services	• Prefet (Administrative Authority) • TSO • Services responsible for managing the route on which the tunnel is located and other road networks • External control centers • External intervention services: – law enforcement – public emergency services • Other parties (roadside assistance services, subcontractors)

The ERP objectives

What are the ERP objectives ?

To define

- the organisation and duty of the tunnel operating body's staff for situations likely to question people's safety
- the modalities for alerting outside intervention services

- The general action principles of the tunnel operating body
- Their interaction with the Police own procedures and Public rescue services' own procedures

To act

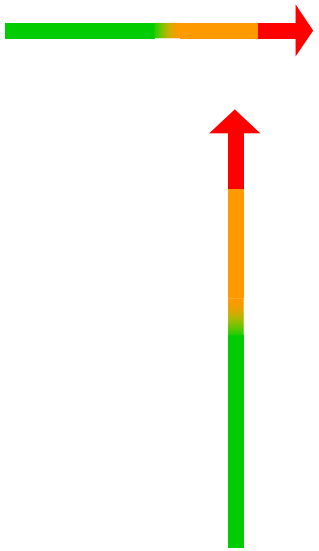
as promptly as possible and under the best possible conditions for each situation

Presentation schedule

- The regulatory and institutional framework
- Degraded operation situations
- Relationship with safety functions
- Instruction book

Events affecting safety

How can the events likely to question people's safety be identified ?



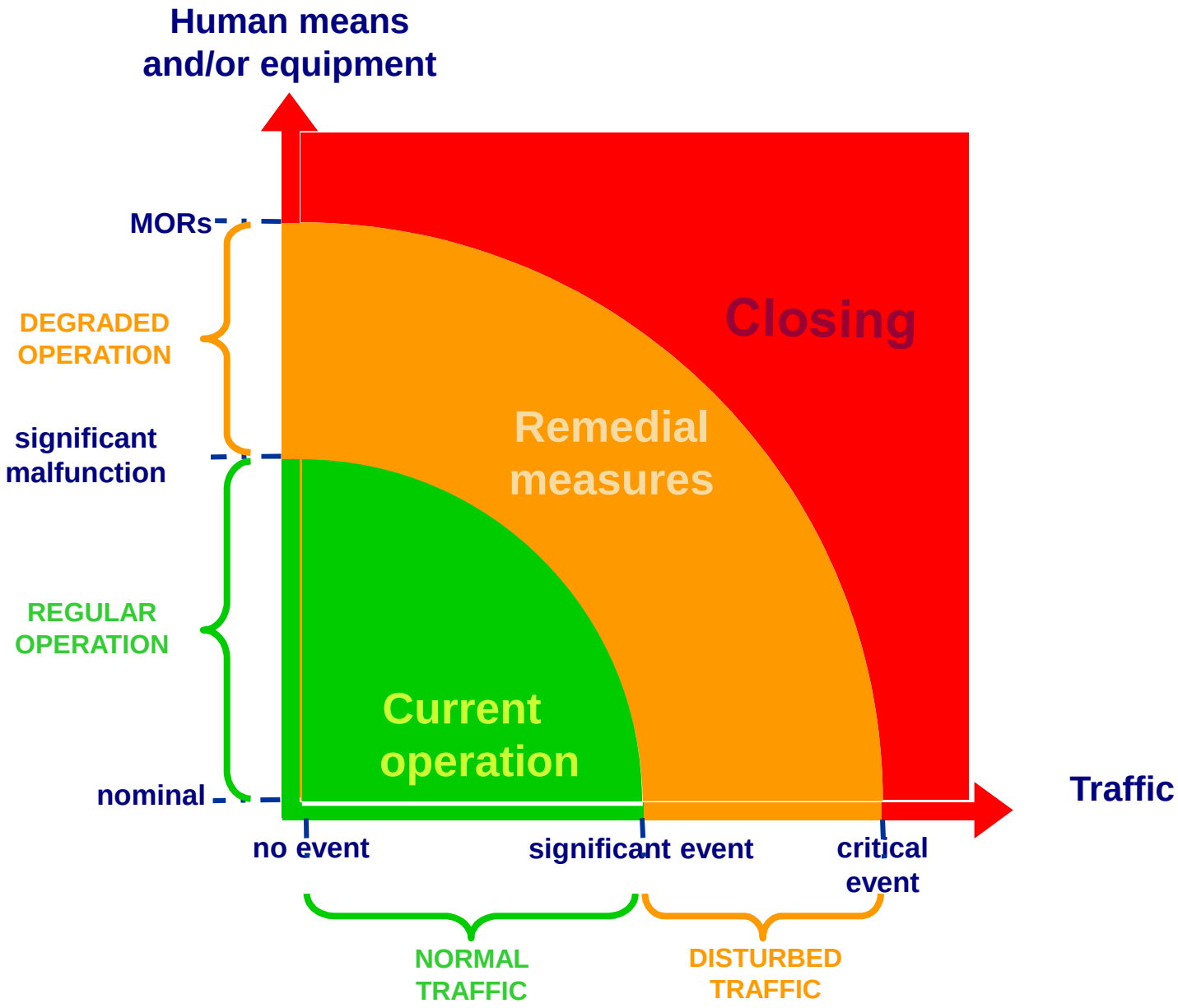
- In connection with traffic or environment
- Relative to the available operating means … (equipments – people)

Severity thresholds

minor **important** **critical**

…. MOR

Various operating situations



Degraded operating modes

- **Nominal mode 100%** of the available resources
- **Degraded mode** : defined by 3 criteria

  - ➡ **qualification** and **quantification** of the unavailable operating means (equipment family(ies) or personnel)
  - ➡ **remedial measure(s)** to warrant a sufficient safety level and maintain traffic inside the tunnel
  - ➡ **time limit after which the degraded mode is no longer acceptable**

- **Critical mode** : **minimal operating requirements** (**MOR**) or minimal availability condition beneath which the tunnel must be **closed to traffic**

(i.e. as soon as one of the 3 criteria is no more observed)

Degraded operating modes

They give rise to specific operating measures :

- initiate maintenance action
- request intervention of external intervention services
- require implementation of **remedial measures** that ensure an adequate level of safety and allow traffic through the tunnel

EXAMPLES

Lane closure

Implementation of contra-flow measures outside of the tunnel

Speed control

Ban a category of traffic

More frequent patrols

Presentation schedule

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Relationship with safety functions

Relationship between:

Prevention and protection means

X

Safety functions

Relationship with safety functions

F1 Preventing incidents / accidents
F 1.1 Monitoring the tunnel, its equipment and the traffic in it
F 1.1 Monitoring weather conditions, traffic and the external environment
F 1.1 Ensuring safe, comfortable driving conditions
F 1.1 Keeping users informed about traffic conditions
F 2 Detection
F 2.1 Detecting an incident / accident
F 2.2 Classifying the incident / the accident
F 3 Alerts and information given by the tunnel operating body
F 3.1 Alerting the emergency services
F 3.2 Alerting users in the tunnels and at the tunnel portals
F 3.3 Informing users on the network outside the tunnel
F 4 Limiting the consequences of the incident
F 4.1 Minimising the number of users in the tunnel and avoiding further accidents
F 4.2 Limiting escalation of the incident while waiting for the emergency services to arrive
F 4.3 Aiding evacuation, getting users to safety (self evacuation)
F 4.4 Aiding and supporting access and action by emergency services
F 5 Ensuring a return to normal
Checking the condition of the tunnel and carrying out any necessary emergency work to restore traffic flows

Relationship with safety functions

Resources (prevention and protection means)

- Civil engineering
- Tunnel management system
- Power supplies
- Lighting
- Ventilation
- Fire fighting equipment
- Incident and fire detection
- Communication
- Traffic signs
- Human resources connected to the tunnel
- External human resources

Relationship with safety functions

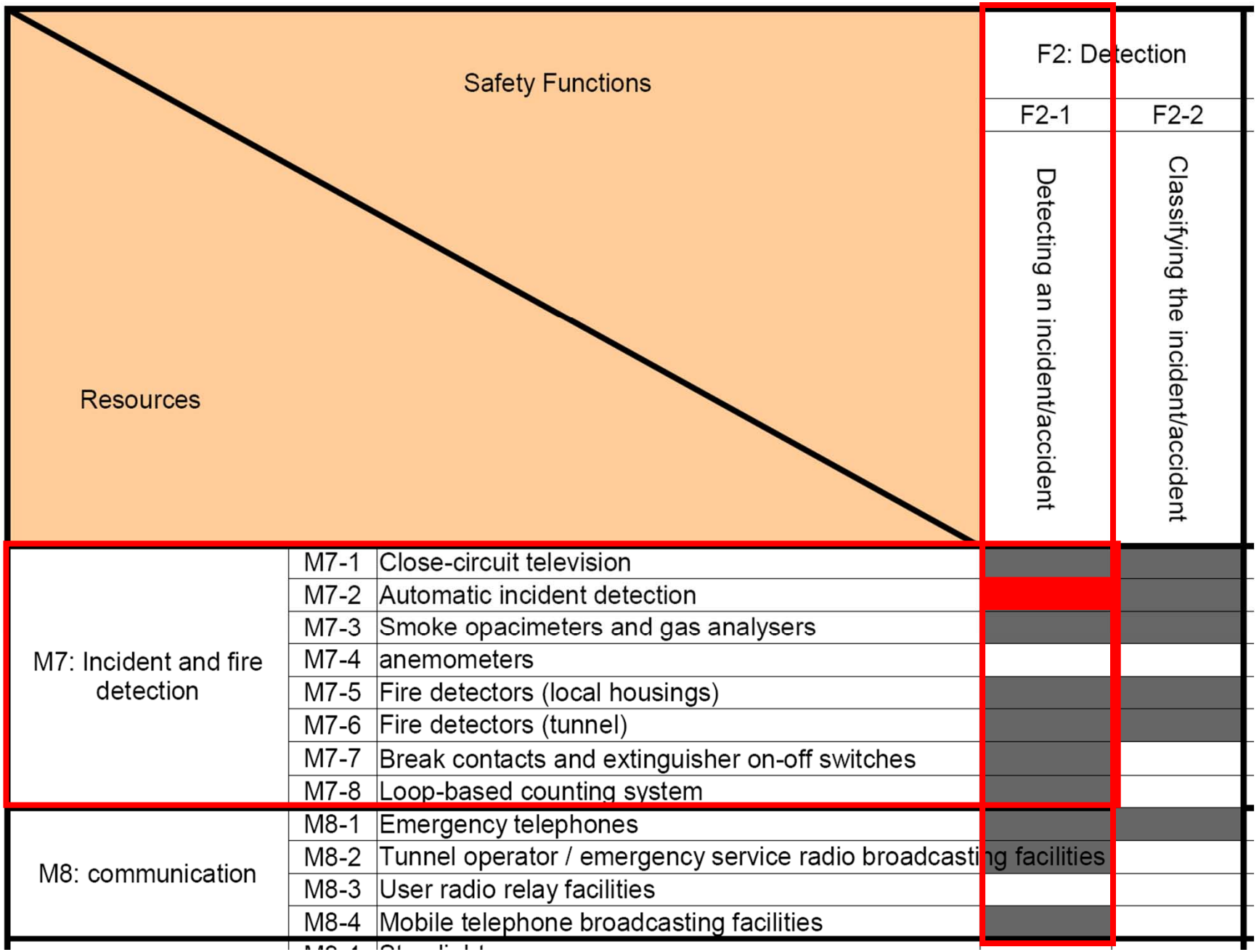
Resources \ Safety Functions			F1: Preventing incidents/accidents				F2: Detection		F3: Alerts and information given by the tunnel operating body			F4: Limiting the consequences of the incident				F5: Ensuring a return to normal
			F1-1 Monitoring the tunnel, its equipment and the traffic in it	F1-2 Monitoring weather conditions, traffic and the external environment	F1-3 Ensuring safe, comfortable driving conditions	F1-4 Keeping users informed about traffic conditions	F2-1 Detecting an incident/accident	F2-2 Classifying the incident/accident	F3-1 Alerting the emergency services	F3-2 Alerting users in the tunnels and at tunnel portals	F3-3 Informing users on the network outside the tunnel	F4-1 Minimising the number of users in the tunnel and avoiding further Accidents	F4-2 Limiting escalation of the incident while waiting for the emergency services to arrive	F4-3 Aiding evacuation, getting users to safety (self-evacuation)	F4-4 Aiding and supporting access and action by emergency services	Checking the condition of the tunnel and carrying out any necessary emergency work to restore traffic flows
M1: Civil engineering	M1-1	Roadway and emergency stopping lanes			■							■		■	■	
	M1-2	walkways			■								■		■	
	M1-3	Drainage systems			■								■		■	
	M1-4	Emergency exits - shelters												■	■	
M2: Tunnel management system	M2-1	Sensors and actuators	■	■	■	■	■	■		■	■	■	■	■	■	■
	M2-2	Site network	■	■	■	■	■	■		■	■	■	■	■	■	■
	M2-3	Industrial programmable logic controler	■	■	■	■	■	■		■	■	■	■	■	■	■
	M2-4	Transport / transmission network	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	M2-5	Tunnel control centre (supervision)	■	■	■	■	■	■	■	■	■	■	■	■	■	■
M3: Power supplies	M3-1	External power supply	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	M3-2	Power substations / low voltage master distribution panel	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	M3-3	Uninterruptible emergency power supply	■	■	■	■	■	■	■	■	■	■	■	■	■	■
	M3-4	Water supply											■		■	
M4: lighting	M4-1	Normal lighting	■		■		■	■				■	■	■	■	■
	M4-2	emergency lighting	■		■		■	■				■	■	■	■	■
	M4-3	Emergency-evacuation equipment lighting												■	■	■
	M4-4	Marker lights			■									■	■	
M5: Ventilation	M5-1	sanitary			■											■
	M5-2	Smoke extraction											■	■	■	
	M5-3	Emergency exits - shelters												■	■	■
M6: Fire fighting equipment	M6-1	Fire extinguishers											■			
	M6-2	Fire pipe and hydrant											■		■	
M7: Incident and fire detection	M7-1	Close-circuit television	■	■			■	■					■	■	■	■
	M7-2	Automatic incident detection					■	■					■	■	■	■
	M7-3	Smoke opacimeters and gas analysers	■		■		■	■					■	■	■	■
	M7-4	anemometers	■		■								■	■	■	■
	M7-5	Fire detectors (local housings)	■				■	■								
	M7-6	Fire detectors (tunnel)					■	■					■	■	■	
	M7-7	Break contacts and extinguisher on-off switches	■				■									
	M7-8	Loop-based counting system		■			■									
M8: communication	M8-1	Emergency telephones					■	■						■		
	M8-2	Tunnel operator / emergency service radio broadcasting facilities			■		■						■		■	■
	M8-3	User radio relay facilities			■	■				■				■		■
	M8-4	Mobile telephone broadcasting facilities					■									
M9: Traffic signs	M9-1	Stop light										■				
	M9-2	Tunnel closure barriers										■				
	M9-3	Variable message signs			■	■				■	■	■				■
	M9-4	Lane allocation signals			■							■				■
	M9-5	Safety and evacuation equipment signage												■		
M10: human resources connected to the tunnel	M10-1	Tunnel operator	■	■	■	■	■	■	■	■		■	■	■	■	■
	M10-2	Patrols	■	■		■	■	■		■		■	■	■	■	
	M10-3	Trouble shooting team														■
	M10-4	In-house fire service											■			
M11: External human resources	M11-1	Emergency services														
	M11-2	Law enforcement services			■	■						■			■	■
	M11-3	Traffic control centre		■	■	■	■				■				■	■

Relationship with safety functions : EXAMPLE 1

- Total loss of AID

➢ Discriminant safety function (« Detecting an incident/accident »)

➢ Requires immediate tunnel closure

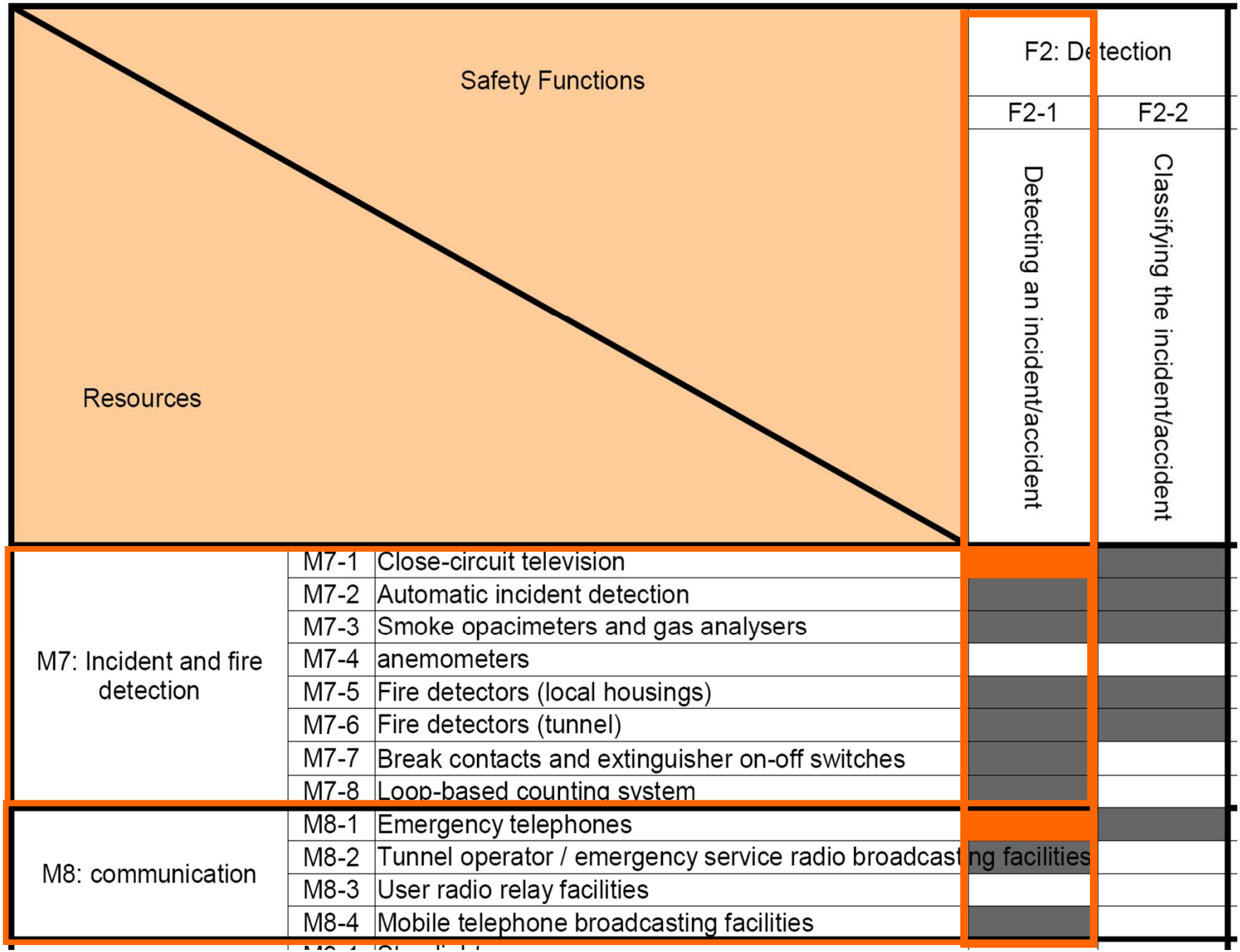

Safety Functions
Resources
F2: Detection
F2-1
F2-2
Detecting an incident/accident
Classifying the incident/accident
M7: Incident and fire detection
M7-1 Close-circuit television
M7-2 Automatic incident detection
M7-3 Smoke opacimeters and gas analysers
M7-4 anemometers
M7-5 Fire detectors (local housings)
M7-6 Fire detectors (tunnel)
M7-7 Break contacts and extinguisher on-off switches
M7-8 Loop-based counting system
M8: communication
M8-1 Emergency telephones
M8-2 Tunnel operator / emergency service radio broadcasting facilities
M8-3 User radio relay facilities
M8-4 Mobile telephone broadcasting facilities

Relationship with safety functions : EXAMPLE 2

- Partial loss of Emergency telephone
- Partial loss of closed-circuit TV

➢ 2 resources involved in the same safety function (« Detecting an incident/accident »)

➢ By associating the 2 resources, the safety function can be fulfilled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M8: communication
M8-1 Emergency telephones
M8-2 Tunnel operator / emergency service radio broadcasting facilities
M8-3 User radio relay facilities
M8-4 Mobile telephone broadcasting facilities

Example

CCTV		
Condition	Definition of condition	Measures to be taken
Nominal	All cameras operational	N/A
Degraded 1	**Quantitative unavailability:** 10% (non-consecutive cameras) **Remedial measure:** none. **Maximum acceptable duration:** 1 week.	Schedule expedited maintenance.
Degraded 2	**Quantitative unavailability:** 30% (non-consecutive cameras) **Remedial measure:** emergency call system operational throughout tunnel. **Maximum acceptable duration:** 4 hours.	Schedule emergency maintenance. Check correct operation of emergency telephones.
MOR	**Quantitative unavailability threshold:** 2 consecutive cameras **Remedial measure:** corresponding emergency telephones operational; heightened surveillance on site. **Maximum acceptable duration:** 4 hours.	Schedule emergency maintenance. Check correct operation of emergency telephones concerned. Set up heightened surveillance.

In this example, under minimal operating requirements, if one of the criteria is no longer met, the tunnel must be closed to traffic immediately.

Presentation schedule

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Interaction between ERP and instruction book

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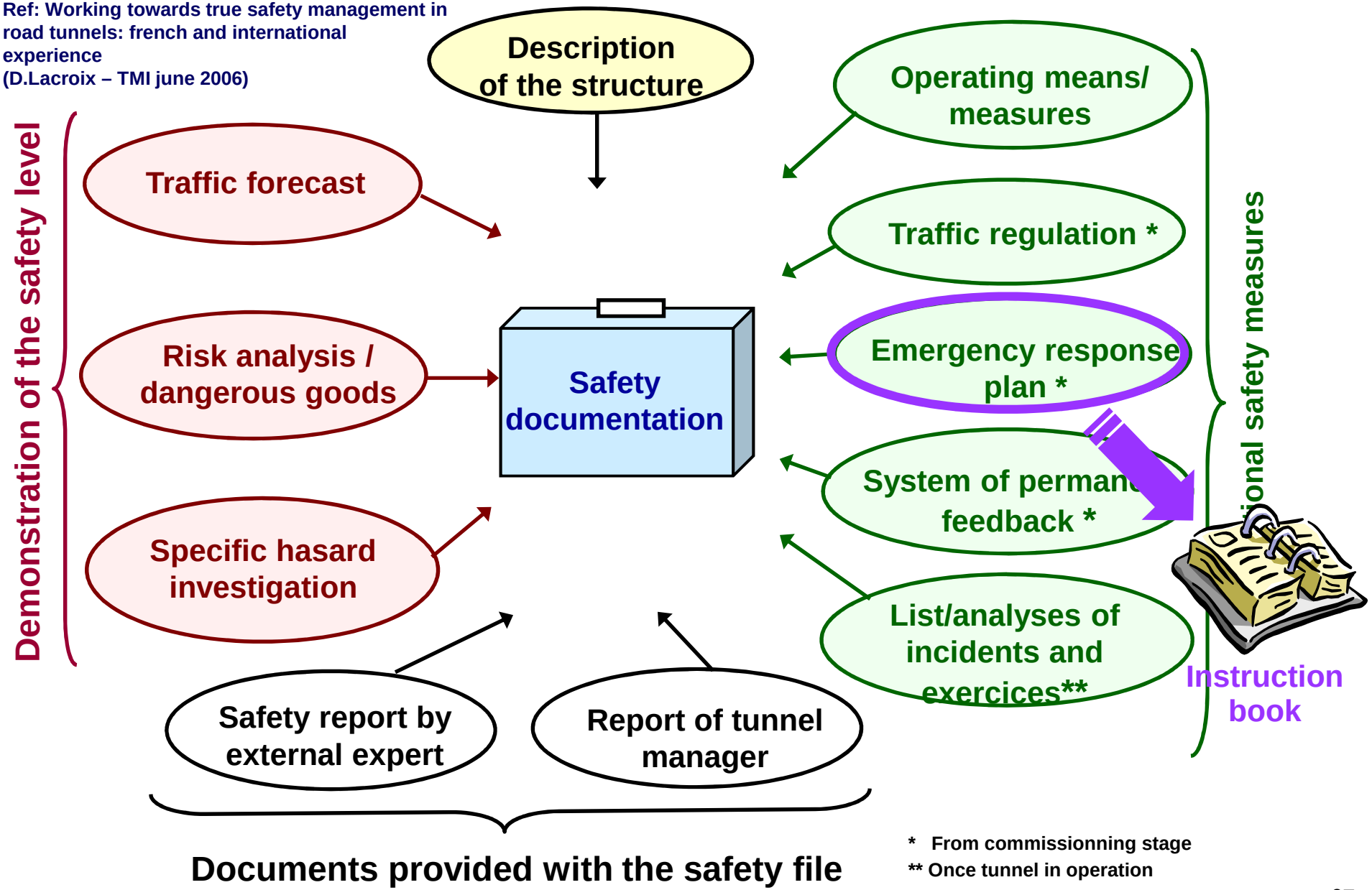


* From commissionning stage
** Once tunnel in operation

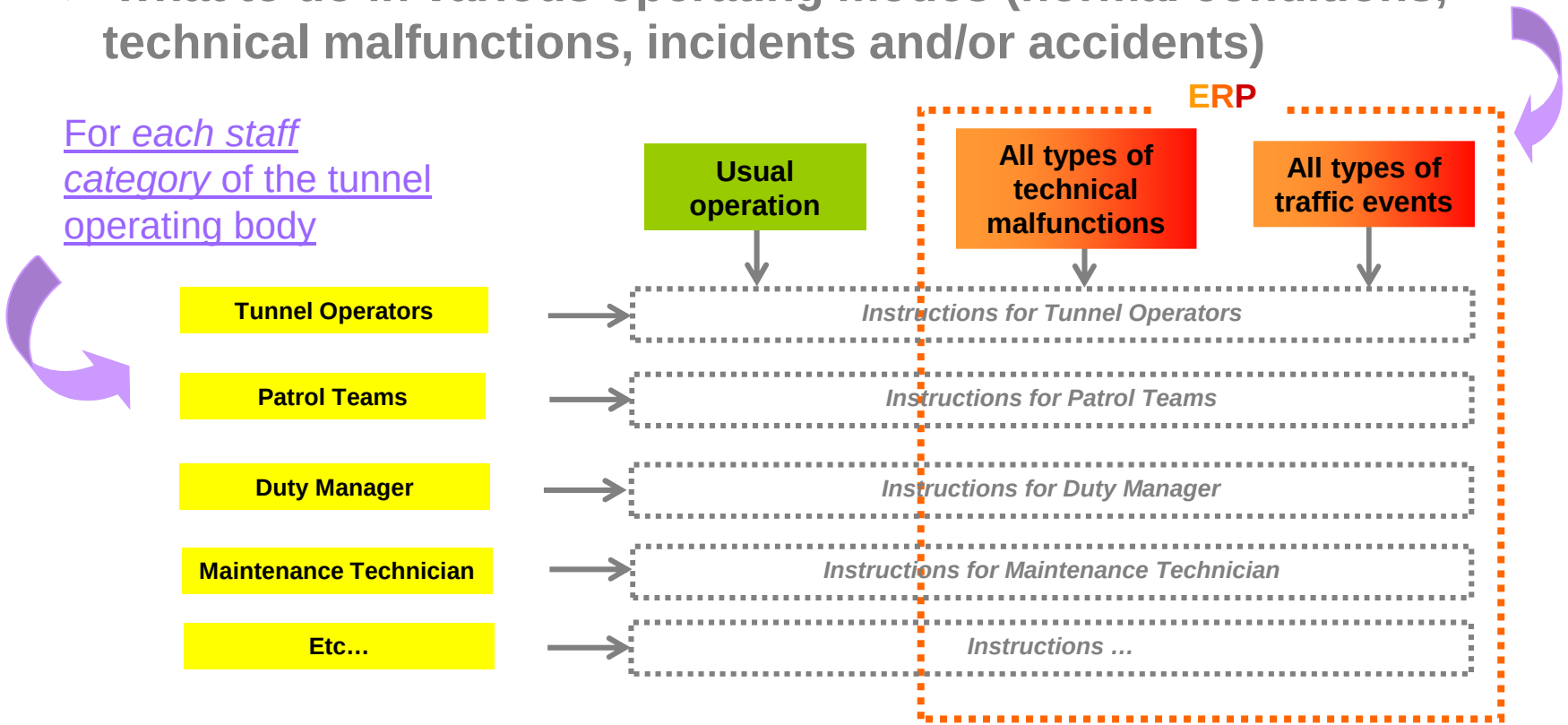
« Who? What? How? »

Instructions are defined by the tunnel operating body

They are derived from general principles for actions

They define :

- **the operation of, and how to use safety devices and equipment of the tunnel**
- **what to do in various operating modes (normal conditions, technical malfunctions, incidents and/or accidents)**



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