

- FORESEE -

Future proofing strategies FOr RESilient transport networks against Extreme Events



- Deliverable 1.3 -Examples of using Levels of Service and resilience in governance

Integration of Level of Service and resilience measures for governance.

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1 EXECUTIVE SUMMARY.

The overall objective of the project FORESEE is to develop, demonstrate and validate a set of reliable and easily implemented tools, in order to provide short and long-term resilience measures in rail corridors, roads and multimodal terminals in the face of disruptive and / or extreme events.

In order to apply these measures, it is necessary to introduce and evaluate in the general infrastructure governance processes, the service level and resilience measures in the case of extreme events.

Thus, the particular objective of the Task 1.3 " Integration of Level of Service and resilience measures for governance" (M1-M15), is to integrate to the infrastructure governance decision-making, service level and resilience considerations, in the case of disruptive and / or extreme events, so that they can be used by the different organizations in their management mechanisms throughout the entire life cycle.

To achieve this goal, this proposal uses the governance tool developed in the RAGTIME¹ project, based on simple management principles, in which the service level and resilience measures are introduced, through its expression with indicators and targets, defined in the deliverables D1.1. and D1.2. It will be later in the project implemented in the platform "FORESEE Response, Mitigation and Adaptation Toolkit", to be developed in WP5 and it will be validated with the different case studies to present in WP6.

2 INTRODUCTION.

This deliverable is based on D1.1 and D1.2, integrates the concepts of resilience and level of service in the case of disruptive and / or extreme events, in infrastructure governance, using a decision-making methodology, which includes the resilience indicators defined in D1.1 and the targets defined in D1.2¹, based on the defined concepts of service and resilience.

To achieve this objective, the governance bases defined in the RAGTIME project are used, where the indicators and governance targets are complemented with those of service and resilience, establishing preference criteria, to compare and evaluate both the different technical solutions that solve the process, and the selection of external contractors involved in it.

Making use of this methodology by integrating the concepts of governance and those of service and resilience, complements governance by making it automatic, simple and transparent, for all stakeholders, and provides a rapid response of mitigation actions to disruptive and / or extreme events (even after the event), in addition to providing capabilities to all stakeholders, in all phases of the infrastructure life cycle.



¹ D1.2 only defines targets for the indicators required in life cycle O&M. D1.3 determine targets for the indicators required throughout the life cycle, (Annex 2 marked in yellow).

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2.1 SCOPE OF THIS DELIVERABLE.

The scope of this deliverable is to integrate the level of objective service and the resilience of the infrastructure defined in D1.1 and D1.2, in infrastructure governance tools based on simple management principles and formulated through open standards, which allow great data exchange capacity, to ensure the integrity of these assets against disruptive and / or extreme events. The output of this task will feed the platform, "FORESEE Response, Mitigation and Adaptation Toolkit", to be developed in WP5.

2.2 DELIVERABLE STRUCTURE.

The deliverable is structured in the following sections:

- Section 1 contains the executive summary of the deliverable.
- Section 2 presents the introduction of this deliverable, where the main objectives, purpose and structure of the same are described.
- Section 3 defines the problem and the state of the art, which involves introducing the terms
 of service and resilience, in the face of disruptive and / or extreme events, in governance
 decision-making measures, also proposes solutions to the problem, and concludes with the
 selection of a governance tool.
- Section 4 integrates the terms of service and resilience in the governance tool FORESEE, through the indicators and targets defined in D1.1 and D1.2.
- Section 5 implements the governance tool FORESEE in the case studies of the FORESEE project and in detail in case of study 3 Montabliz Viaduct, checking their resilience and level of service, in extreme and / or disruptive events throughout their life cycle.
- Section 6 shows the conclusions drawn from this deliverable.
- Section 7 provides additional information that complements the main body of the deliverable, through Annexes.
- And the last section indicates the base references, used in this deliverable.

3 SERVICE LEVEL AND RESILIENCE IN INFRASTRUCTURE GOVERNANCE.

Considering that present and future investments in transport infrastructure are one of the priorities of larger investment and longer life cycle of our societies, it is essential to provide them with resilience, capacity to prevent, absorb, withstand and recover from the negative effects caused by different disruptive and / or extreme events and maintain the level of service as much as possible.

And according to the definitions of service and resilience, given in D1.1 and D1.2, it can be said that these terms are taken into account in the governance of current infrastructure, in two very specific actions.

• In Decision Making by the owner and / or contractors and suppliers, to select the most appropriate technical solutions, in terms of fulfilling the required service levels and resilience, in the face of disruptive and / or extreme events.





 In the Decision Making by the owner, to select the experts, who can carry out the realization of the infrastructure, based on the required service levels and resilience, of the infrastructures made throughout their professional experience in the face of disruptive and / or extreme events.

But these terms of service and resilience:

- Are not used in a related way, are not related to disruptive events specifically, and are not evaluated in combination with each other.
- Are not used throughout the infrastructure life cycle, they are only used in the operation and maintenance phase, without an specific name and relationship.

However, if the concept of resilience were incorporated into the different phases of infrastructure governance, it would be expected that the impacts would decrease. For example, if emergency traffic routes are not blocked due to a disruptive event, collateral risks may be reduced or their restoration time may be shorter.

However, many of the governance objectives, in terms of making infrastructure more resilient, are based on information obtained from past experiences with failed / affected infrastructure, such failures are not statistically numerous, and the causes are varied. In order to determine the optimal actions that should be undertaken when infrastructures are exposed to different risks, it is necessary to evaluate the different contributing factors in a combined manner. (Annex 1).

3.1 EXAMPLES OF RESILIENCE USE IN GOVERNANCE - LESSONS FROM THE PAST.

The following example shows the use of the concepts of service and resilience in governance:

EXAMPLE - CONTRACTS FOR THE PROCUREMENT OF ROAD OPERATION AND MAINTENANCE PUBLIC WORKS.

In the public works concession contracts for the conservation and exploitation of infrastructure management, it incorporates in its "**technical specification**" the next points:

- General terms and conditions of the contract (regulations, concession period, asset operation, insurance)
- Rights and obligations of the concessionaire (general, operational and during operation)
- Development and monitoring of the execution of the contract (checks, works, operating management, head of operation, suspensions)
- Operational phase (check of works and facilities, receipt of infrastructure, warranty period)
- Contract regime (remuneration, regulation, variables: number of vehicles-kilometres, vehicle types, rates and indexation, Service level and correction of the Canon's annual amount, deductions for the state of the infrastructure and the quality of the quality of the amount serviced, calculation of the annual payment amount and payment procedure to the concessionaire, Termination of the amount serviced (calculation of the annual payment amount and payment procedure to the concessionaire,
- Termination of the contract (Causes of termination, delivery, receipt, warranty period)
- Development of projects, construction and conservation works
 Construction projects (projects, responsibilities, delay, penalties, responsibilities, responsibilitities, responsibilities, responsibilitit
- Construction projects (projects, responsibilities, delay penalties, responsibilities)
 Construction of works (plans, deadlines, verification and settlement)
- Construction of works (plans, deadlines, venification and settlement)
 Traffic measurement system (tramification, systems, operation and maintenance of equipment)
- Plan for the Conservation and Exploitation of infrastructures (scopes, conservation work, development of conservation work, routine maintenance and localized repairs, replenishment actions and major repairs, reinforcement of pavement, horizontal signage, conservation and replenishment of vertical signage, beaconing, barrier and fencing, signalling and support in case of accidents, surveillance, winter road plan, quality assurance plan (QAP)
- Penalties for conservation agreements, total or brown decrease in the traffic capacity of the Highway, damage and auxiliary)
- Dealer organization (Centre for Traffic Control and Conservation, personnel, machinery and auxiliary media, computer applications, other facilities, inventory of the elements of the Highway, risks of prevention of occupational prevention)





ANNEX 5 STATE AND QUALITY INDICATORS OF SERVICE:

As mentioned, it will be the obligation of the Dealer to maintain the conditions of road, safety, comfort, environmental respect, and survival that are typical of the type of roads that are the subject of the contract. In this sense some elements and some activities will be characterized by indicators that determine the degree of quality achieved by the Dealer

Indicators are the parameters defined and set objectively so that different elements of the road network can meet the optimum road conditions and service during the duration of the Contract.

Regardless of the fulfilment of these indicators throughout the contract, the works carried out on the roads (first establishment and refurbishments, as well as those of replacement and major maintenance) must be delivered in compliance with the requirements of the Private Technical Requirements of the corresponding construction project, the corresponding PG-3, and all current regulations, circular orders or recommendations governing the conditions of the work.

Thresholds are set for each indicator to be met over the duration of the Contract, and which, if not satisfied, must be acted upon before the expiry of the maximum period of action defined in the indicator itself.

In some of the indicators, the downward or upward corrections resulting from the deviation from the thresholds defined for each indicator are also reflected, deviations that reflect the degree of quality or level of compliance.

On a monthly basis, all correction factors, faith, obtained from the indicators in this Annex, will be calculated and the total correction factor, Ft, will be obtained from the base rate of the year as follows:

The corrected rate for the corresponding month will be obtained as follows:

$$Ft = 1 + \sum_{1}^{n} \frac{fci}{100}$$

Corrected rate = Base rate of the year x Ft

The Dealer is obliged to carry out all the activities that allow to obtain these indicators (auscultation, inspection, measurements, etc.) having any means necessary to undertake their obtaining within the indicated time and time.

Measurements shall be carried out with equipment approved by the GCC or by the contracting authority.

In order to carry out the measures, in cases where there are NLT standards or UNE standards, the methodologies described in them will be followed, complying with the indications of the standards that are currently in force. In the absence of an NL T or UNE standard, the GCC Folds that are in force and applicable shall be followed.

Each indicator describes the procedure for calculating up or down corrections and when penalty is incurred.

I1.	Pavement. Resistance to time	<i>I21.</i>	Marche Vials. Retroreflection
I2.	Pavement. Macrotexture	<i>I22.</i>	Marche Vials. Resistance to time
I3.	Pavement. Longitudinal application	I23.	Horizontal signage. Luminance
I4.	Pavement. Structural capacity	I24.	Vertical signage
<i>I5.</i>	Pavement. Transverse etc.	I25.	Cleaning margins and rest areas
<i>I6.</i>	Pavement. Cracking and fatigue	<i>I26.</i>	Cleaning and repairing drainage
I7.	Pavement. Concrete cracking	I27.	Lighting
<i>I8.</i>	Pavement. Load transfer	<i>I28.</i>	Tunnels. Structural elements
<i>I9.</i>	Pavement. Settlement	<i>I29.</i>	Tunnels. Finishes
<i>I10.</i>	Pavement. Bumps	<i>I30.</i>	Tunnels. Lighting
<i>I11.</i>	Pavement. Cleaning of firm draining	I31.	Tunnels. Ventilation
I12.	Slopes	<i>I32.</i>	Tunnels. Fire fighting systems
I13.	Mowing, pruning and clearing	<i>I33.</i>	Tunnels. Electric Installation
I14.	Plantation maintenance	<i>I34.</i>	Tunnels. communication System
I15.	Cleaning of roads and debris	<i>I35.</i>	Tunnels. surveillance System
I16.	Bridges	<i>I36.</i>	Tunnels. Clear emergency zones
I17.	Winter road	<i>I37.</i>	Barriers and containment elements
I18.	Safety. Endangerment	<i>I38.</i>	Attention to incidents and accidents
I19.	Safety. Mortality	<i>I39.</i>	Lane occupancy
I20.	Safety. Performances at TCA	<i>I40.</i>	Level of service
		<i>I41.</i>	Surveillance

Among the contract offers, the local government selected the construction and operation proposals that offered better value for money. Among the parameters that were considered in value for money, and in terms of governance with resilience considerations, the following sections were noteworthy:

• "Rate deductions based on infrastructure status and quality of service"

• "Penalties and damages for total or partial reduction in the traffic capacity of the highway"

Tariff deductions are a reduction in the amount to be collected by the infrastructure operator under certain indicators of infrastructure status and quality of service. Deductions are applied when the following indicators are below the reference values or when they are placed in inadmissible values for a certain period of time. The indicators used are:

• Surface regularity index (IRI)

• Cross-friction coefficient (CRT)

• bearing capacity (deflections)

• Cleaning of firm draining





- Horizontal signalling retroreflective index
- Quality of vertical signage
- State of enclosures
- Road safety and accident
 Attention to incidents and accidents

On the other hand, the total or partial decrease in the traffic capacity of the highway is considered when one or more lanes of the track or its links (entrances/exits) are closed to traffic. The causes of capacity reduction can be characterized as due to conservation efforts, causes attributable to national, regional or local government, weather causes or catastrophes of impossible foresight, traffic accidents or causes attributable to the dealer. Planned penalties will only affect in the latter case, i.e. when traffic restrictions are arising from infrastructure failures or failures in the conservation service. Delay in the reopening of traffic from lanes or branches subject to conservation and maintenance works whose execution time exceeds the provisions of the Conservation Plan is also penalized. The economic sanctions envisaged are proportional to the IMD, the hours of capacity reduction and an economic rate described in the contract.

As seen in most cases, disruptive or extreme events belong to a specific scope, but the trigger causes are multiple and complex. There are many ways to make an infrastructure more resilient to risk, avoiding the cascading effect on conditions, but how to predict its optimization can be complicated if you also want to evaluate multiple risks at once.

3.2 Decision Making by simple management principles.

Thus, once the problem has been defined and verified in the above example, it is concluded that the terms of service and resilience are not used in combination and much less throughout the life cycle of the infrastructure, nor for the whole of all events, but they are only raised for the operation and maintenance phase, and in the specific case of contracting through concession.

Therefore it is necessary to consider a form of integration and as it is indicated in the "Description of work and role of partners", it must be done through simple management principles.

To do this, **first of al**, the general flowchart of the FORESEE project has to be established, than to determine resilient infrastructure typologies, based on criteria of maintaining the level of service as much as possible, in the face of disruptive and / or extreme events, with governance being the one to make these decisions, among the possible responses, handling a multitude of variables, analysis, calculations and simulations, to provide the most appropriate solution.

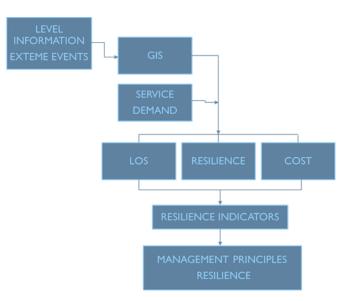


Figure 1. FORESEE Project Flow.



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Secondly, it is necessary to consider which possible solutions (based on simple management principles) are capable of adding a multitude of variables, analysis, calculations and simulations, to support the decision-making process. At present the principles of simple management that are handled are:

- QUALITATIVE: Expert Judgment the expert judgment is currently used, justified by the selection of experts outside the owner through the legal framework defined by the EU, public procurement or concession,
- QUANTITATIVE: Based on multicriteria analysis against multiple risks or "multi-risk", both
 for the selection of experts and for technical decision making. Or in the future based on
 empirical techniques and statistics fed with historical data such as Neural Networks,
 Machine Learning, which learn from unstructured historical data difficult to gather in assets,
 with a life cycle as long as infrastructure, and more in the future that must predict new
 scenarios, which face the performance after extreme events affected by changes, such as
 climate change.

And finally, it is decided that the most useful tool may be the one based on multicriteria, multi-risk analysis, the conclusion reached to solve the RAGTIME² Project's governance module, previous digitalization through indicators of the multitude of variables, analysis, calculations and simulations, which implies governance, in this case to represent the service and resilience in the face of extreme events, which has already been carried out in D1.1 and D1.2, establishing the relationship between both terms and their influence with disruptive and / or extreme events independently, for each type of event. (Annex 1).

Therefore, the solution is to adapt RAGTIME governance to Foresee governance, introducing the concepts of service and resilience in multi-risk decision-making, in the face of disruptive and / or extreme events, jointly, through the indicators defined in D1.1 and D1.2.

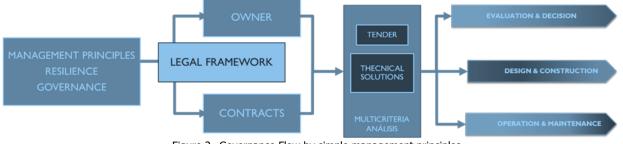


Figure 2. Governance Flow by simple management principles.

4 INTEGRATION OF LEVEL OF SERVICE AND RESILIENCE MEASURES FOR GOVERNANCE.

The way to integrate the terms of service level objective and resilience, in the face of disruptive / extreme events, and constitute FORESEE governance is:





First, specify at what moments in the infrastructure life cycle it is necessary to use these terms in decision making and in which technical documents are to be used.

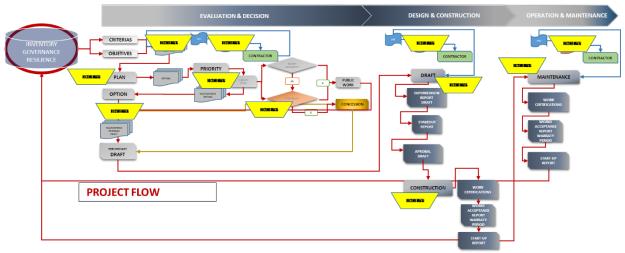
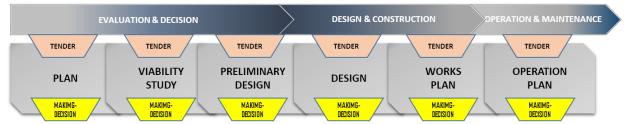


Figure 3. Management principles, life cycle assets infrastructure.

- In the Decision making and Evaluation phase, they are used to define resilient infrastructure necessary for citizens, based on disruptive / extreme events and the level of long-term and regional objective service. These levels are specified in the Plans, Feasibility Studies and Preliminary Designs.
- In the Design, Project and Construction phase, specifying solutions, typologies and constructive methodologies, which materialize the resilience of the infrastructure, compared to requests produced by these events, for an objective level of service and to a detail scale. These phases are specified in the Projects and in the construction itself.
- In the Operation and Maintenance Phase, where the conditions of service and resilience must be maintained, in the case of disruptive / extreme events, defined in the project and if altered, have alternatives that mitigate the damage and continue to provide service. The documents used are the operation and maintenance plans, winter maintenance plans and action protocols.
- And of course in all the selection processes, competitions of expert contractors, for the realization of these actions, either through Public Procurement or Concession



Second, articulate resilience indicators D1.1 with phases and documents. (Annex 1).



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Figure 4. Documents & Phases of the Project, with Tender & Decision Making.



Third, set weights, service level targets for each D1.2 indicator, either qualitative targets or quantitative targets. (Annex 2).

Fourth, create the FORESEE Governance tool, http://foresee.transmodalbots.com/3

And **fifth**, introduce indicators and targets for service and resilience decisions against disruptive and / or extreme events, jointly.

All this is checked in the following section, for the case studies that are handled in this project⁴.

5 IMPLEMENTATION EXAMPLE OF FORESEE GOVERNANCE. METHODOLOGIES TO CASE STUDY 3 MONTABLIZ VIADUCT.

In this section the different indicators and targets are implemented, for the entire life cycle of case study 3, Montabliz Viaduct, in order to check the operation of the proposed tool, with the conditions marked for it.

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FORESEE (No 769373)



FEATURES MONTABLIZ VIADUCT:

Short description	on of the pilot/c	ase s	tudy				
Case Study Data Sheet	Location: A-67 Hig Name: Montabliz N Pilot Owner: Minis of Spain	/iaduc		<i>Description</i> : This viaduct saves the big valley formed by a river in Cantabria Spain. It has a length of 721 m distributed in 5 spans (11 + 155 + 175 + 155 + 126), maximum light 175.00 m, radius of curvature in plant 700 m. Continuous board, formed by a monocellular drawer of prestressed concrete of variable edge between 4.30 and 11.00 m supported on single pile. The maximum height of the pile is 128.60 m, the highest in Spain and among the 6 largest in Europe (year 2008). The board has been built by the voussoirs system concreted "in situ" by cantilevered forward.			
Significant aspects	Criticalities and problems of the pilot Extreme events		-	e winter weather			
	Replication	5110					
Technical inform							
Monitoring Data			YES				
Maintenance Da	ta		YES				
Usage condition	S		Data storage				
Test							
Data Availability	1		Pier Movement Layout Design, Maintenance Plan, Shop drawing, Traffic data, SHM data				
Infrastructure P	eculiarities						
Preferred Time (e.g. due to spec	for testing activ cific conditions)	ities	Night				
	& Privacy Issues		Owner Ministerio Foment	o Government of Spain			



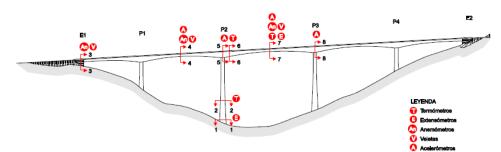


Figure 5. Case Study 3 MONTABLIZ Viaduct. Scheme.



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1.1 PHASE: EVALUATION & DECISION.

- DOCUMENT: EVALUATION & DECISION
- MAIKING DECISION: PREVIOUS DRAFT ALTERNATIVES
- STAKEHOLDER: **DESIGNER**

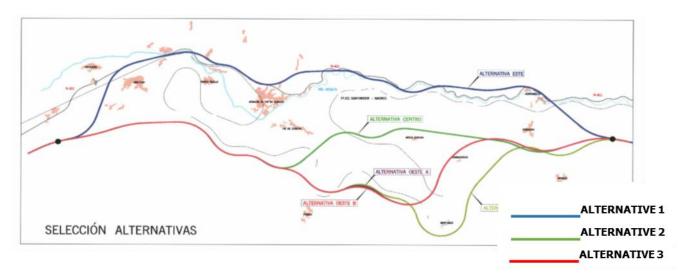


Figure 6. Case Study 3 MONTABLIZ Viaduct. Draft Alternatives.





- INPUTS:

	INFC					DOCUME MAIKING SATKEH	DECISION:	PREVIOUS PREVIOUS OWNER		TERNATIVE
		1				CASE STU Target.indic	DY 3	ALTERNATIVE 1	ALTERNATIVE 2	ALTERNATIVE 3
RISK	ID	Indicator	Number of possible values		Number of possible values Possible values and meaning	_BC	70	ALTERI	ALTERI	ALTERI
WIND	w									
WIND	<u></u>		1		0/2 No alternative ways		1		1	
	W1.2.2	The number of possible existing alternative ways to deviate vehicles	2		1/2 1 alternative way	2	100%	2	2	3
		alternative ways to deviate venicles	_		2/2 Multiple alternative ways					
					0/3 > 10 events per year					
	W.2.1.2	Frequency of past hazards	3		1/3 > 7, < 10 events per year		25%	4	4	2
					3/3 < 3 events per year					
					0/3 2 weeks					
	W.2.1.4	Frequency of future hazards	3		1/3 1-2 weeks	o	25%	3	3	2
			-		2/3 1 day- 1 week		23/0	-	- T	
			-		3/3 0 days 0/3 < 20% of capacity					
					1/3 > 20% < 50% of capacity					
	W.2.1.8	Traffic*	3		2/3 > 50%,< 80% of capacity	3	100%	2	3	2
					3/3 > 80% of capacity					
					0/2 Frequent dangerous goods					
	W.2.1.9	Hazards goods traffic*	2		1/2 Rare dangerous goods	2		3	2	1
					2/2 No dangerous goods					
FOG										
100	<u>.</u>		1 1		0/2 No alternative ways		1		r	1
	F1.2.2	The number of possible existing	2		1/2 1 alternative way	2	100%	2	2	3
		alternative ways to deviate vehicles			2/2 Multiple alternative ways					
					0/3 > 10 events per year					
	F.2.1.2	Frequency of past hazards	3		1/3 > 7, < 10 events per year	o	33%	2	1	2
					2/3 > 3, < 7 events per year			_		
					3/3 < 3 events per year					
					1/3 1-2 weeks					
	F.2.1.4	Frequency of future hazards	3		2/3 1 day-1 week		33%	3	3	3
					3/3 0 days					
					0/3 < 20% of capacity					
	F.2.1.7	Traffic*	3		1/3 > 20%,< 50% of capacity	1	50%	2	3	2
					2/3 > 50%,< 80% of capacity 3/3 > 80% of capacity					
			+		0/2 Frequent dangerous goods					
	F.2.1.8	Hazards goods traffic*	2		1/2 Rare dangerous goods	2	100%	2	2	3
					2/2 No dangerous goods					
	_									
SNOWFALL	<u>s</u>	T					1		-	
	S.1.2.2	The number of possible existing	2	3	0/2 No alternative ways 1/2 1 alternative way	2	100%	2	2	3
	3.1.2.2	alternative ways to deviate vehicles	2	5	2/2 Multiple alternative ways		100%	-	2	3
					0/3 > 5 events per year					
	6212	Frequency of past hazards	3	4	1/3 > 2, < 5 events per year	1	50%	1	3	2
	5.2.1.2	Frequency of past nazards	3	4	2/3 > 1, < 2 events per year	1	50%	1	3	2
					3/3 1 events per year					
					0/3 2 weeks					
	S.2.1.4	Frequency of future hazards	3	4	1/3 1-2 weeks 2/3 1 day- 1 week		25%	1	2	1
					3/3 0 days					
					0/3 < 20% of capacity					
	\$217	Traffic*	3	4	1/3 > 20%,< 50% of capacity	3	100%	1	3	2
	3.2.1.7	indine.	2	4	2/3 > 50%,< 80% of capacity	3	100%	1	3	-
					3/3 > 80% of capacity					
	\$219	Hazards goods traffic*	2	3	0/2 Frequent dangerous goods 1/2 Rare dangerous goods	2	100%	2	3	3
	3.2.1.0		-	5	2/2 No dangerous goods	²	10070	-		3
				1 2 6			l			

Table 2. Case Study 3 Index-Targets. E&D





- OUTPUTS:

$ ightarrow {f C}$ ($f A$ No seguro	foresee.transmodalbots.com:8080/	flowable-task/workflow/	#/apps/e	valuation-decis	ion/tasks Q	☆ 0)
FEE	Tasks Processes				Test Administrator 🛩		
wing your tasks, fillered	Revew Vialibity Results						
Create Task Newest first V	Assignee: Test Administrator Due: No due date Part of process:	Evaluation and Decision - November 21st 2019	Ended: 3 minute	is ago Duration: 1 minutes			
oposed draft Created 3 minutes ago pend Draft for project Case Study 3 - Montabiliz visdud igned to Test Administrator	No people involved No content items No comments N	sub tasks Show details					_
blic contract Created 3 minutes ago bio contract notice for project Case Study 3 - Montablic via igned to Test Administrator	Case Study 3 - Montabliz viaduct						
evew Vialibity Results Created 8 minutes ago	Concordance Matrix:		a1	a2	a3		
view multioriteria results for project Case Study 3 - Montabli igned to Test Administrator		21	0.0	0.3571	0.6		
Iculate KPIs for all options Created 8 minutes ago		#2 #3	1.0	0.0	0.7143		
ioulate KPIs for option 3	Discordance Matrix:		a1	a2	23		
igned to Test Administrator		21	0.0	1.0	1.0		
Iculate KPIs for all options Created 11 minutes ago		#2	0.0	0.0	1.0		
igned to Test Administrator		83	0.0	1.0	0.0		
iculate KPIs for all options Greated 14 minutes ago	Credibility Matric:	at	a1 0.0	a2 0.0	a3 0.0		
Joulate KPIs for option 1 Agreed to Test Administrator		*2	1.0	0.0	0.0		
fine criteria and objectives Created 20 minutes ago		83	1.0	0.0	0.0		
Ine oriteria and objectives for the director plan	Kemel:	a2	23				
igned to Test Administrator	Dominated:	a1					
oposed draft Created 2 months ago							
pend Draft for project pp igned to Test Administrator	Legend:						
blic contract Created 2 months app	s1> s2>	Alternative 1 Alternative 3					
his contract notice for project on Create Draft.	a2	Alternative 2					
igned to Test Administrator		I					1
wew Vialibity Results Created 2 months ago view multicriteria results for project pp ismed to Trail Administrator	Ranking 1st Alternative 3						
Iculate KPIs for all options Created 2 months ago	Ranking 2nd						1
Iculate KPIs for option 2 igned to Test Administrator	Atternative 2						11
Iculate KPIs for all options Created 2 months ago							÷ 1
culate KPIs for option 1	Ranking 3rd						. 1
igned to Test Administrator	Alternative 1						
fine criteria and objectives Created 2 months ago	Total cost of winning option						- 1
fine oriteria and objectives for the director plan igned to Test Administrator	1000000						11
							- 1
	Profitable						
	true						
-	in the second						>
FORESEE	× FORESEE Modeler	× 🚟 Ragtime Wor	ktlow	×	+		
\rightarrow C A No seguro	foresee.transmodalbots.com:8080/	flowable-task/workflow/	#/apps/e	aluation-decisi	ion/tasks Q	\$ O	
FORE	Tasks Processes				Test Administrative w		
wing your tasks, filtered	Propagad draft						
NUMBER ALIGNMENT (1)	Proposed draft Assigner: Test Administrator Our: No due date Part of process:	Evaluation and Decision - Monamber 21-1 2010	Same Same	a sea			
Create Task Newest Sist V			P-062 3 HIGG	a age - Location, o adconds			
oposed draft Created 3 minutes ago gend Draft for project Case Study 3 - Montabliz viaduct	No people involved No content items No comments N	Show details					
signed to Test Administrator ublic contract Created 3 minutes ago	Proposed option shoud go to pu	blig contract Vou chould	oronto -	ad annond - Di	DAET project Coo	Ctudu 2	

Table 3. Case Study 3. Results Draft Alternatives E&D





D&C

1.2 PHASE: DESIGN & CONSTRUCTION.

- DOCUMENT: DESIGN & CONTRUCTION
- MAIKING DECISION: SOLUTIONS DESIGN
- STAKEHOLDER: **DESIGNER & CONSTRUCTOR**
- INPUTS:

						DOCUME	NT:			
						MAIKING DECISI SATKEHOLDER	G DECISION:			
						SATKEH	OLDER	DESIGNE	R & CONSTI	RUCTOR
								_		
						CASE STU	DY 3	z	Z Z	SOLUTION 3
						Target.indic	%	6	9	2
RISK	ID	Indicator	Number of		Number of possible values Possible values and meaning	_BC	70	5	5	5
nish		indicator	possible values					ō	5	ī
									•,	•,
WIND	w									
	<u> </u>	Adequacy of hazard effect reduction	T T		0/1 Not adequate		1	1	r	1
	W1.3.1		1			1	100%	1	2	1
		system (barriers to wind)			1/1 Adequate		CASE STUDY3			
					0/3 > 10 events per year					
	W.2.1.2	Frequency of past hazards	3		1/3 > 7, < 10 events per year	0	25%	1	2	1
					2/3 > 3, < 7 events per year					
					3/3 < 3 events per year					
					0/3 2 weeks					
	W.2.1.4	Frequency of future hazards	3		1/3 1-2 weeks	0	25%	1	1	2
			-		2/3 1 day- 1 week			_	-	_
					3/3 0 days					
					0/3 Strong increase					
	W 2 1 5	Severity of future hazards	3		1/3 Soft increase	2	75%	2	1	1
	**.2.1.3	Sevency of future flazarda			2/3 Soft decrease	²	13/0	-		
					3/3 Strong decrease					
					0/3 < 20% of capacity					
					1/3 > 20%,< 50% of capacity	2	1000/	2		
	W.2.1.8	Traffic*	3		2/3 > 50%,< 80% of capacity	3	100%		1	1
					3/3 > 80% of capacity					
		•			• • • •					
FOG	H									
	Ē	Adequacy of hazard effect reduction	1 1				1		I	1
	F1.3.1	system (pavement lines and visibility	1		0/1 Not adequate		50%	1	2	2
	11.5.1	sticks)	-		1/1 Adequate		5070	-	-	-
		Sticksj			0/3 > 10 events per year					
					1/3 > 7, < 10 events per year		33%	3	3	
	F.2.1.2	Frequency of past hazards	3		2/3 > 3, < 7 events per year	0				4
					3/3 < 3 events per year					
					0/3 2 weeks			1		
	F.2.1.4	Frequency of future hazards	3		1/3 1-2 weeks	- 0	33%		2	2
					2/3 1 day- 1 week				-	
			_		3/3 0 days					
					0/3 Strong increase					
	E.2.1.5	Severity of future hazards	3		1/3 Soft increase	2	100%	1	2	2
	1.2.2.5	sevency of facare nazaras	5		2/3 Soft decrease	~	100/0	-	-	
					3/3 Strong decrease					
					0/3 < 20% of capacity					
	F.2.1.7	Traffic*	3		1/3 > 20%,< 50% of capacity	1	50%	2	3	3
	F.2.1./	iname.	3		2/3 > 50%,< 80% of capacity	1	30%	-	3	,
					3/3 > 80% of capacity					
SNOWFALL	<u>s</u>									
		Adequacy of hazard effect reduction			0/1 Not adequate		100%			
	S.1.3.1	system (barriers to snow)	1	2	1/1 Adequate	1	100%	1	2	1
					0/3 > 5 events per year					
					1/3 > 2, < 5 events per year					
	S.2.1.2	Frequency of past hazards	3	4	2/3 > 1, < 2 events per year	1	50%	2	2	1
					3/3 1 events per year					
					0/3 2 weeks					
					1/3 1-2 weeks					
			3	4	2/3 1 day- 1 week		25%	1	1	2
	S.2.1.4	Frequency of future hazards			3/3 0 days					
	S.2.1.4	Frequency of future hazards							4	
	5.2.1.4	Frequency of future hazards								
	-				0/3 Strong increase					
	-	Frequency of future hazards Severity of future hazards	3	4	0/3 Strong increase 1/3 Soft increase	0	25%	1	2	2
	-		3	4	0/3 Strong increase 1/3 Soft increase 2/3 Soft decrease	o	25%	1	2	2
	-		3	4	0/3 Strong increase 1/3 Soft increase 2/3 Soft decrease 3/3 Strong decrease	0	25%	1	2	2
	-		3	4	0/3 Strong increase 1/3 Soft increase 2/3 Soft decrease 3/3 Strong decrease 0/3 c20% of capacity	0	25%	1	2	2
	S.2.1.5		3	4	0/3 Strong increase 1/3 Soft increase 2/3 Soft decrease 3/3 Strong decrease 0/3 < 20% of capacity	0	25%	1	2	2
	S.2.1.5	Severity of future hazards			0/3 Strong increase 1/3 Soft increase 2/3 Soft decrease 3/3 Strong decrease 0/3 c20% of capacity					

 2/3
 > 30% of capacity

 Table 4.
 Case Study 3 Index-Targets. D&C





- OUTPUTS:

owing your tasks, no filter applied	Y	Revew Vialibity Result	s				_
Create Task	Newest first 🗸	Assignee: TestAdministrator Due: 1 November 21st 2019		process: Evaluat	ion and Decision -	Save	Complet
evew Vialibity Results o evew multioriteria results for project Ca	reated a few seconds ago see Study 3. Solutions	No people involved No content items	No comments	No sub tasks	Show details		
signed to Test Administrator							
		Project Name					
		Case Study 3, Solutions - Montabliz v	aduct				
		Concordance Matrix:		at	82	a3	
			at	0.0	0.2667	0.5333	
			a2	0.7333	0.0	1.0	_
			a3	0.7333	0.7333	0.0	
		Discordance Matrix:		at	82	a3	
			a1	0.0	1.0	0.8	
			a2	1.0	0.0	0.0	
			aJ	1.0	1.0	0.0	
		Credibility Matric		at	#2	al	
			a1	0.0	0.0	0.0	
			a2 a3	0.0	0.0	1.0	
					0.0	0.0	
		Kernel:	a1	a2			_
		Dominated:	a3	_			_
		Legend:					
		81 -> 82 ->	Solution 1 Solution 2				
		<u>ब</u> ्द क	Solution 2 Solution 3				_
		au	0000010				
		Ranking 1st					
		Solution 1					
		Ranking 2nd					
		Solution 2					
		Ranking 3rd					
		Solution 3					
	Tasks Process	es				Te	st Admini
	- -						
owing your tasks, no filter applied	T	Proposed draft				Save C	Complete
Create Task	Newest first 🗸	Assignee: Test Administrator Due: N	lo due date Part of j	process: Evaluation	on and Decision -	Care C	vomprese
	ealed a few seconds ago	November 21st 2019					
pend Draft for project Case Study 3, S		No people involved No content items	No comments	No sub tasks	Show details		
ssigned to Test Administrator							
		D		1.11			4.0
		Proposed option sh	loud go to p	ublic cor	ntract. You	should crea	ate
		and append a DRA	FT project .	Case Stu	udy 3. Solu	itions -	
		Montabliz viaduct a					
		MUNITARITZ MAUNCI A	In option S	UNUNITI			

Table 5. Case Study 3 Results Solutions Draft D&C





0&M

1.3 PHASE: OPERATION & MAINTENANCE.

- DOCUMENT: **TENDER OPERATOR**
- MAIKING DECISION: OPERATION & MAINTENANCE
- STAKEHOLDER: OWNER / OPERATORS (Ci)
- INPUTS:

						DOCUME MAIKING SATKEH	DECISION:	Tender OF OPERATIO	ON & MAIN	TENANCE A
						CASE STU Target.indic				
RISK	ID	Indicator	Number of possible values		Number of possible values Possible values and meaning	_BC	%	c1	c2	c3
WIND	w									
WIND	Ē				0/3 Strong increase					
	W 2 1 5	Severity of future hazards	3		1/3 Soft increase	2	75%	1	1	2
		sevency of fatare nazaras	5		2/3 Soft decrease		,5%	-	-	-
					3/3 Strong decrease 0/3 < 20% of capacity					
					1/3 > 20%,< 50% of capacity	2	4000/			
	W.2.1.8	Traffic*	3		2/3 > 50%,< 80% of capacity	3	100%	1	2	1
					3/3 > 80% of capacity					
		The average of an average of a second s	2		0/2 No plan	1		2	2	2
	W.3.1.1	The presence of an emergency plan	2		1/2 Generic plan 2/2 Operative plan (with tasks, resources,)	1		2	2	2
					0/4 No exercise					
					1/4 1 exercise every > than 2 years					
	W.3.1.2	Practice of the emergency plan	4		2/4 1 exercise every 2 years	0		1	3	3
					3/4 1 exercise every year					
			-		4/4 1 exercise every 6 months 0/2 < 2 years ago					
	W.3.1.3	Review/update of the emergency plan	2		1/2 < 5 years ago	0		2	2	3
					2/2 > 5 years ago					
FOG	н									
FOG	<u> </u>		1		0/3 Strong increase					
	F.2.1.5	Severity of future hazards	3		1/3 Soft increase	2	100%	1	2	2
	F.2.1.5	Sevency of future nazarus	3		2/3 Soft decrease	2	100%	1	2	2
					3/3 Strong decrease					
					0/3 < 20% of capacity 1/3 > 20% < 50% of capacity					
	F.2.1.7	Traffic*	3		2/3 > 50%,< 80% of capacity	1	50%	3	3	4
					3/3 > 80% of capacity					
					0/2 No plan					
	F.3.1.1	The presence of an emergency plan	2		1/2 Generic plan 2/2 Operative plan (with tasks, resources,)	2		1	2	1
			-		2/2 Operative plan (with tasks, resources,) 0/4 No exercise					
					1/4 1 exercise every > than 2 years					
	F.3.1.2	Practice of the emergency plan	4		2/4 1 exercise every 2 years	1		2	3	3
					3/4 1 exercise every year					
					4/4 1 exercise every 6 months					
	5212	Review/update of the emergency plan	2		0/2 < 2 years ago 1/2 < 5 years ago	0		1	2	3
	1.5.1.5	netretty applate of the emergency plan	-		2/2 > 5 years ago			1	2	3
					· · · · · · · · · · · · · · · · · · ·					
SNOWFALL	<u>s</u>		1	1	0/3 Strong increase					
					1/3 Soft increase					
	S.2.1.5	Severity of future hazards	3	4	2/3 Soft decrease	- 0	25%	1	2	1
					3/3 Strong decrease					
					0/3 < 20% of capacity					
	S.2.1.7	Traffic*	3	4	1/3 > 20%,< 50% of capacity 2/3 > 50%,< 80% of capacity	3	100%	3	2	2
					2/3 > 50%,< 80% of capacity 3/3 > 80% of capacity					
					0/2 No interventions					
	\$3.1.3	The extent of interventions executed prior to the event	2	3	1/2 Partial interventions	2	100%	1	2	3
			L	L	2/2 Full interventions					
					0/4 No exercise					
	\$3.1.5	Practice of the emergency plan	4	5	1/4 1 exercise every > than 2 years 2/4 1 exercise every 2 years	1		2	3	3
	33.1.3	indeate of the energency plan	-	5	3/4 1 exercise every 2 years			2	3	3
					4/4 1 exercise every 6 months					
					0/2 > 5 years ago					
	\$3.1.6	Review/update of the emergency plan	2	3	1/2 < 5 years ago	1		1	2	3
			1	1	2/2 < 2 years ago		1			

Table 6. Case Study 3 Index-Targets O&M





- OUTPUTS:

owing your tasks, no filter applied	Ŧ	Review tender ranking				0	0
Create Task	Newest first \checkmark	Assignee: Test Administrator Due: No 2019	due date Part o	f process: Tender	Process - Novembe	ar 21st	Complete
Review tender ranking Cre lesults of tender process Operation and M ssigned to Test Administrator	ated a few seconds ago Aaintanance Tender	No people involved No content items	No comments	No sub tasks	Show details		
		Tender Identifier					
		Operation and Maintanance Tender					
		Concordance Matrix:		a1	a2	a3	
			a1	0.0	0.4118	0.4708	
			a2	0.7647	0.0	0.8235	
			a3	0.7647	0.7847	0.0	
		Discordance Matrix:		a1	a2	a3	
			a1	0.0	1.0	1.0	
			a2	0.5714	0.0	1.0	
			a3	0.5714	1.0	0.0	
		Credibility Matrix:		a1	a2	a3	
			a1	0.0	0.0	0.0	
			a2	1.0	0.0	0.0	
			a3	1.0	0.0	0.0	
		Kernel:	a2	a3			
		Dominated:	a1				
		Legend:			c1		
		32>			c2		
		a3>			c3		
		Ranking 1st c2 Ranking 2nd					
		c3					
		Ranking 3rd					

Table 7. Case Study 3 Results Tender Operator O&M





6 CONCLUSIONS.

It can therefore be concluded that this deliverable describes how to include resilience and the level of service in the governance of infrastructure assets, in the case of different extreme events, by including the resilience indicators defined in D1.1 and D1.2, in a multi-risk (multi-criteria) methodology, which facilitates the inclusion of such considerations in governance procedures and is resolved by adapting the governance tool developed in the RAGTIME project.

The application of this methodology is implemented in the case studies of FORESEE, and is specified in particular for case 3 Montabliz Viaduct, by using the online solution that serves to help infrastructure owners and contractors incorporate resilience in the management of infrastructure assets throughout the life cycle, introducing these concepts through specific indicators, that would be completed in reality with governance indicators.

The integration of these concepts in governance, improves performance of th infrastructure, as a tool is provided in order to prevent the behaviour and use of infrastructure, from its planning, to the operation and maintenance of the same, through its definition and construction, and possible subsequent actions against extreme events, and it is concluded that:

- The level of objective service and resilience to extreme / disruptive events have been integrated into the governance of infrastructure assets.
- D1.1 and D1.2 definitions and indicators of infrastructure resilience and target service level have been used as input of this task.
- The place of these terms in the asset's life cycle has been identified.
- A simple management methodology that solves the combined use of these terms in governance has been selected.
- A solution methodology has been described according to the multi-criteria, multi-risk proposal for the management of infrastructure asset governance.
- The use of the tool has been verified in the case studies, especially in the 3 Montabliz Viaduct, demonstrating that its use is adequate, that it provides an effective, transparent and automatic aid to the governance of the service and resilience of infrastructures in the face of extreme events, which can be used by all stakeholders and that contemplates the complete life cycle, even at post-event cases.

And finally, a governance module is obtained as an output with integration of the level of service and resilience of infrastructures against disruptive and / or extreme events, to be implemented in the "WP5 FORESEE Response, Mitigation and Adaptation Toolkit", where the FORESEE project objective will be developed, providing short and long term resilience measures in rail corridors, roads and multimodal terminals, in the face of extreme events.

All this given that the FORESEE project, which studies in detail the influence of extreme events, (external risks: natural and man-made), on the resilience and level of service of the infrastructures, is a complement to the overall project of infrastructure management that is the RAGTIME project, therefore FORESEE, should be based on the overall structure of the RAGTIME project.





LIFE CYCLE DESIGN & CONSTRUCTION

7 ANNEX.

7.1 ANNEX 1

	D Indicator	Number of	Number of possible values Possible values and meaning	PLAN	VIABILITY STUDY	PREVIOUS DRAFT	DRAFT	WORK PLAN	OPERATION PLAN		
		possible values									
		Indicity possible values Number of possible values Possible values e of replacement of the warning 3 1/2 2-50%, 80% of papertol file time achieved** 1/2 2-50%, 80% of papertol file time achieved** 3/2 2-50%, 80% of papertol file time achieved** 1/2 2-50%, 80% of papertol file time achieved** 3/2 2-25%, 80% of papertol file time achieved** 1/2 2-25%, 80% of papertol file time achieved** 3/2 2-25%, 80% of papertol file time achieved** 1/2 2-25%, 80% of papertol file time achieved** 3/2 2-25%, 80% of papertol file time achieved** 1/2 1/2 2-25% of stagetted life time achieved** 3/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 <									
<u>w</u>	-1	1		-				1			
	Are / Are of conjacoment of the warping		0/3 > 80% of the expected life time achieved** 1/2 > 50% < 80% of expected life time achieved**	-							
W1.		3	2/3 > 20% < 50% of expected life time achieved	-					1		
	system		3/3 < 20% of expected life time achieved**	-							
			Condition Cares & Red (A condition to which is to endowed). It is about								
				ic							
	Condition state of protective			_							
W1.	structures/systems	5	3/5 Condition State 3: Good (A condition in which it is unlikely that the						1		
			systems would fail under normal traffic loads over the flext 20 years)	-							
			the systems would fail under normal traffic loads over the next 20 years								
			Condition State 1: Excellent A condition in which it is extremely unlikely	-							
			years								
	The possibility of using another means to	Indicity Double values Number of possible values / Possible val									
W1.	U D D D D D D W 1.11 Age / Age of replacement of the warning pythm 3		1	1	1	1		1			
	10 Indicator possible values Number of possible values into a set of the supercised life time achieved*** 11.11 Age / Age of replacement of the warring spitem 3	0/2 No alternative ways									
W1.	Number of possible values Number of possible values and meaning 1.1 Apel / Age of replacement of the warning system 3 10 20% of the expacted life time achieved** 1.2 Second Sec	1	1	1	1		1				
									-		
W1	7.3 The presence of a warning system	2		-			1	1	1		
	The presence of a warning system	~		Intending PLM VABILITYSTUDY PREVIOUS GRAFT DEAT WORK PLM OPERATION PLM Image: Problem in the	-						
	Adequacy of bazard effect reduction								OPERATION PLAN		
W1.		1					1				
			0/2 > 3meters								
W.2.	.1.1 Height*	2		1	1	1	1	1	1		
			2/2 At the same level								
			0/3 > 10 events per year								
W.2	.1.2 Frequency of past hazards	3		1	1	1	1	1	1		
				_							
				-							
W.2.	.1.3 Severity of past hazards	3	7/3 Minor damage	1	1	1	1	1	1		
W 2	1.4 Frequency of future bazards	3		1	1	1	1	1	1		
		-				1	-	-	-		
	W.2.12 Frequency of past hazards W.2.13 Severity of past hazards W.2.14 Frequency of future hazards W.2.15 Severity of future hazards		3/3 0 days								
			U/3 Strong increase	-							
W.2.	.1.5 Severity of future hazards	3		1	1	1	1	1	1		
		1									
W.2.	1.6 Extent of past damages due to hazards	2	2/3 Minor damage	1	1	1	1	1	1		
W.2.	.1.7 Duration of past down time due to hazards	2	1/2 1-3 days	1	1	1	1		1		
		l		_							
				_							
W.2.	.1.8 Traffic*	3	1/3 > 20% < 50% of capacity 7/3 > 50% < 80% of capacity	1	1	1	1		1		
				-							
W.2.	1.9 Hazards goods traffic*	2	1/2 Rare dangerous goods	1	1	1	1		1		
			0/2 No plan								
	.1.1 The presence of an emergency plan	2		4					1		
W.3.				-							
W.3.		1	U/4 No exercise	-							
W.3.				1				1			
-	U Number of possible values Number of possible values are invested. W Image / Age of replacement of the warning path of possible values. Image / Age of replacement of the warning path of possible values. Image / Age of replacement of the warning path of possible values. W1.1.1 Age / Age of replacement of the warning path of possible values. Image / Age of replacement of the warning path of possible values. Image / Age of replacement of the warning path of possible values. W1.1.2 Condition state of protective tructures/lystems Image / Age of replacement of the warning path of the path of the possible values. Image / Age of replacement of the warning path of the pat	2/4 4									
-		2/4 1 exercise every 2 years	-					1			
-	.1.2 Practice of the emergency plan	4	2/4 1 exercise every 2 years 3/4 1 exercise every year	7					1		
-	.1.2 Practice of the emergency plan	4	2/4 1 exercise every 2 years 3/4 1 exercise every year 4/4 1 exercise every 6 months						1		
w.3.			2/4 1 exercise every 2 years 3/4 1 exercise every year 4/4 1 exercise every 6 months 0/2 < 2 years ago	_							

Table 8. WIND Index & Life cycle Project Documents.





						EVALUATION & DEC	ISSION	LIFE CYCL DESIGN & C	E	OPERATION & MAINTENANCI
бК ІД	Indicator	Number of possible values		Number of possible values Possible values and meaning	PLAN	VIABILITY STUDY	PREVIOUS DRAFT	DRAFT	WORK PLAN	OPERATION PLAN
н										
				> 80% of the expected life time achieved**			1		1	
F1.1.1	Indicator possible value Age / Age of replacement of the warning vytem 3 Condition state of protective structures/systems 5 Condition state of protective structures/systems 2 The possibility of using another means to astery transport demand 2 The number of possible existing alternative varys to deviate vehicles 2 The presence of a warning system 2 Adequacy of past heards 3 Severity of past heards 3 Severity of past heards 3 Severity of future haards 3 Duration of past down time due to haards 2 Traffic* 3 Preacters of an emergency plan 2	3	1/3	> 50%,< 80% of expected life time achieved**						1
	system	possible values (7) 5 80% (- 3)/2 1/2 5 00% (- 3)/2 5 00% (- 2)/2 5 00% (- 3)/2 2 1/2 5 00% (- 3)/2 6 00% (- 2)/2 6 00% (- 2)/2 2 1/2 5 00% (- 3)/2 6 00% (- 2)/2 6 00% (- 2)/2 6 00% (- 2)/2 2 1/2 1/2 1/2 1/2 1/2 2 1/2 1/2 1/2 1/2 1/2 4/3 Conditioned (- 1/2 1/2 1/2 1/2 1/2 4/3 Conditioned (- 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2 1/2								
		Indicator possible values Number of possible values i Avsible values and m / Age of replacement of the warning om 3 0/2 > 80% of the expected life time achieved** 10 > 20%, 25% of expected life time achieved** 10 > 20%, 25% of expected life time achieved** 11 > 20%, 25% of expected life time achieved** 10 > 20%, 25% of expected life time achieved** 12 > 20%, 25% of expected life time achieved** 10 > 20%, 25% of expected life time achieved** 13 20% of 25% of expected life time achieved** 10 20%	Condition State 5: A condition in which it is highly likely that the systems							
	Indicator possible values Number of possible values and m Age / Age of replacement of the warning system 3 0.2 > 50%, 40%, of expected life time actieved** 10 > 50%, 40%, of expected life time actieved** 10 > 50%, 40%, of expected life time actieved** 10 > 50%, 40%, of expected life time actieved** 10 > 50%, 40%, of expected life time actieved** 10 > 50%, 40%, of expected life time actieved** 10 Some actieved life time actieved** 10 Some actieved life time actieved** 10 Some actieved life time actieved** 10 Some actieved life time actieved** 10 Some actieved life time actieved** 10 Some actieve life time actieved** 10 Some actieve life time actieved** 10 Some actieve life time actieved** 10 Some actieve life time actieved** 10 Some actieve life time actieved** 10 Some actieve life time actieved** 10 Some actieve life time actieved** 20 Condition State 3: Bad (A condition in which it is unite actieved** 11 Some actieve actieve life time actieved** 20 20 Some actieve life time actieved**	would fail under normal traffic loads over the next 20 years								
			1/5							
			-							
			2/5							
F1.1.	structures/systems	5	3/5							1
	0 Number of pecide values Number of pecide values 1 App / App of replacement of the warning period 3 $\frac{20}{22}$ $\frac{20}{20}$ \frac									
			4/5	the systems would fail under normal traffic loads over the next 20 years)						
		years								
	F1.12 structures/systems 5 35 Condition Sate 3: Good A condition in which it is unlety systems would all under normal traffic bads over the nex systems would all under normal traffic bads over the nex systems would all under normal traffic bads over the systems would all under normal traffic bads over the system sould all all traffic bads over the system sould all dat		1	1	1	1		1		
F1.2.	satisfy transport demand	4/3 the systems would fall unverters possibility of using another means to fy transport demand 2 1/2 No alternative means 2/2 1/2 1/2 No alternative means number of possible soliting alternative and the systems would fall 0/2 No alternative ways 2/2 1/2 1 alternative means 1/2 1/2 1 alternative ways 1/2 1 alternative ways 1/2 1 alternative ways 1/2 1 warning system 2/2 1/2 1 warning system 1/2 1/2 auxord effect reduction 1/2 1/2 1/2 1/2 memory of past hazards 3 1/2 2/2 1/2 1/2 1/2 2/2 1/2 1/2 1/2 1/2			1	1	1	1		1
	The number of percible existing alternative	1/2 5 < 50%, c 50% of equity 2/3 5 50%, c 50% of equity 3/3 2 20%, 50% of equity 3/4 2 20% of condition State 3.6 3/4 2 3 meters 4/5 Condition State 3.6 3/4 2 3 meters 4/5 Condition State 3.6 4/5 Condition State 3.6 4/5 Condi	No alternative ways							
F1.2.2	F1.2. The possibility of using another means to satisfy transport demand 2 17.2. 17.2. 10.2. 17.2. 10.2. 17.2.<		1 alternative way	1	1	1	1		1	
F1.2.3	The presence of a warning system	2						1	1	1
	Adequacy of hazard effect reduction		0/1	Not adequate				1		1
F1.3.	system (pavement lines and visibility sticks)	1	1/1	Adequate				1		1
			0/2	> 3meters						
F.2.1.	1 Height*	2			1	1	1	1		1
	2 Free states of an at beyonds				1	1	1	1	1	1
r.z.i.	2 Frequency of pasc nazarus	3			1	-	1	-	-	-
	2 Country of and barrade				1	1	1	1	1	1
P.2.1.	F1.3.1 Adequacy of hazard effect reduction system (pavement lines and visibility st) system (pavement lines and visibility st) F.2.1.1 Height* F.2.1.2 Frequency of past hazards F.2.1.3 Severity of past hazards	3		2/3 Minor damage	1	1	1	1	1	1
					1	1	1	1	1	1
P.2.1.	4 Frequency of future nazards	3			1	1	1	1	1	1
					1	1	1	1	1	1
F.Z.1.	s sevency of future nazards	3	2/3	Soft decrease	1	1	1	1	1	1
	1.11 Age / Age of replacement of the warning system 3 ¹⁰ / ₂ > 50% 50% consected life time time time time time time time tim									
F.2.1.			1	1	1	1	1	1		
	10 Indicator possible values Number of possible values 11.11 Age / Age of replacement of the warning system 3	> than 3 days								
F.2.1.	7 Traffic*	3			1	1	1	1		1
			3/3	> 80% of capacity						
	0				1	1	1	1		1
P.Z.1.	nazards goods traine.	2			1	1	1	1		1
		1	0/2	No plan						
F.3.1.	1 The presence of an emergency plan	2							1	1
	-				<u> </u>		1		<u> </u>	
			1/4	1 exercise every > than 2 years						
F.3.1.	2 Practice of the emergency plan	4	2/4	ystems would all outer normal traffic loads over the rest 20 years Condition State 1: Severe good Accordition which it is screened your likely that the systems would fail under normal traffic loads over the next 20 years Condition State 1: Screenet Accordition which it is screened your likely that the systems would fail under normal traffic loads over the next 20 years 2: No alternative means 2: Not alternative means 2: Not alternative ways 2: I alternative ways 3: I a					1	1
	condition state of protective tructures/systems 5						1			
	1		0/2	< 2 years ago			1		1	
F.3.1.	3 Review/update of the emergency plan	2	1/2	< 5 years ago						1
		1	2/2	> 5 years ago			1		1	

 Table 9. FOG Index & Life cycle Project Documents.





						EVALUATION & DEC	ISSION	LIFE CYCL DESIGN & C	E ONSTRUCTION	OPERATION & MAINTENANCE
RISK ID	Indicator	Number of possible values		Number of possible values Possible values and meaning	PLAN	VIABILITY STUDY	PREVIOUS DRAFT	DRAFT	WORK PLAN	OPERATION PLAN
		possible values								
NFALL S		1	0/3	> 80% of the expected life time achieved**						
5.1.1.1	Age / Age of replacement of the warning system	3	2/3	> 50%,< 80% of expected life time achieved** > 20%,< 50% of expected life time achieved**						1
			3/3	< 20% of expected life time achieved** Condition State 5: A condition in which it is highly likely that the systems						
			0/5	would fail under normal traffic loads over the next 20 years I don't know. No information are available on the condition state of the						
			1/5	infrastructure.						
			2/5	Condition State 4: Bad (A condition in which it is moderately likely that the systems would fail under normal traffic loads over the next 20 years)						
5.1.1.2	Condition state of protective structures/systems	5	3/5	Condition State 3: Good (A condition in which it is unlikely that the						1
				systems would fail under normal traffic loads over the next 20 years) Condition State 2: Very good (A condition in which it is very unlikely that						
			4/5	the systems would fail under normal traffic loads over the next 20 years)						
			5/5	Condition State 1: Excellent A condition in which it is extremely unlikely that the systems would fail under normal traffic loads over the next 20						
	The possibility of using another means to		0/2	years No alternative means						
5.1.2.1	satisfy transport demand	2		1 alternative mean Multiple alternative means	1	1	1	1		1
5.1.2.2	The number of possible existing alternative	2	0/2	No alternative ways 1 alternative way	1	1	1	1		1
	ways to deviate vehicles	-	2/2	Nultiple alternative ways No warning systems	-	-	•	-		-
5.1.2.3	The presence of a warning system	2	1/2	1 warning system				1		1
S.1.3.1	Adequacy of hazard effect reduction	1	0/1	Multiple warning systems Not adequate				1		1
	system (barriers to snow)		0/2	Adequate >3meters						
5.2.1.1	Height*	2		<3meters At the same level	1	1	1	1		1
			0/3	> 5 events per year > 2, < 5 events per year						
5.2.1.2	Frequency of past hazards	3	2/3	> 1, < 2 events per year 1 events per year	1	1	1	1	1	1
			0/3	Serious damage						
S.2.1.3	Severity of past hazards	3	2/3	Minor damage	1	1	1	1	1	1
			0/3	Aesthetic damages 2 weeks						
5.2.1.4	Frequency of future hazards	3	1/3 2/3	1-2 weeks 1 day- 1 week	1	1	1	1	1	1
				0 days Strong increase						
5.2.1.5	Severity of future hazards	3	1/3	Soft increase Soft decrease	1	1	1	1	1	1
			3/3	Strong decrease						
5.2.1.6	Duration of past down time due to hazards	2	1/2	< than 1 day 1-3 days	1	1	1	1	1	1
			0/3	> than 3 days < 20% of capacity						
S.2.1.7	Traffic*	3		> 20%,< 50% of capacity > 50%,< 80% of capacity	1	1	1	1		1
				> 80% of capacity Frequent dangerous goods						
S.2.1.8	Hazards goods traffic*	2	1/2	Rare dangerous goods No dangerous goods	1	1	1	1		1
\$3.1.1	The presence of a monitoring strategy	1	0/1	No strategy Presence of a strategy				1	1	1
\$3.1.2	The presence of an maintenance strategy	1	0/1	No strategy Presence of a strategy				1		1
\$3.1.3	The extent of interventions executed prior	2	0/2	No interventions Partial interventions						1
53.1.3	to the event	2	2/2	Full interventions						1
\$3.1.4	The presence of an emergency plan	2	1/2	No plan Generic plan						1
		1	0/4	Operative plan (with tasks, resources,) No exercise						
\$3.1.5	Practice of the emergency plan	4		1 exercise every > than 2 years 1 exercise every 2 years						1
			3/4 4/4	1 exercise every year						
\$3.1.6	Review/update of the emergency plan	2	0/2	> 5 years ago < 5 years ago						1
	Bend Plan	<u> </u>	2/2	 2 years ago 2 years ago No redundancy 						
	Availability of approximate intervelo		1/4	Redundancy <20% of work forces						
\$3.1.7	Availability of appropriate labour force	4	3/4	Redundancy >20%, <50% of work forces Redundancy >50%, <80% of work forces						1
			0/4	Redundancy >80% of work forces No possibility to hire						
\$3.1.8	Flexibility in hiring appropriate work force	4	2/4	>80% of the estimated time to repair (ETTR) to hire >80% of ETTR to hire						1
				>50%, <80% of ETTR to hire < than 20% of ETTR to hire						
			0/4	No redundancy Redundancy <20% of material						
\$3.1.9	Availability of materials	4	2/4	Redundancy >20% of material Redundancy >20% <50% of material Redundancy >50% <80% of material						1
		ļ	4/4	Redundancy >80% of material						
			1/4	No possibility to order >80% of the estimated time to repair (ETTR) to hire						
\$3.1.10	Expected time for material delivery	4	3/4	>80% of ETTR to order >50%, <80% of ETTR to order						1
			4/4 0/4	< than 20% of ETTR to order No redundancy						
\$3.1.11	Availability of construction equipment	4	1/4	Redundancy <20% of equipment Redundancy >20%, <50% of equipment						1
			3/4	Redundancy >50%, <80% of equipment Redundancy >50%, <80% of equipment Redundancy >80% of work equipment						
			0/4	No possibility to rent >80% of the estimated time to repair (ETTR) to hire						
\$3.1.12	Expected time for construction equipment delivery	4	2/4	>80% of ETTR to rent						1
			3/4 4/4	>50%, <80% of ETTR to rent < than 20% of ETTR to rent	ł					

 Table 10. SNOWFALL Index & Life cycle Project Documents.





7.2 ANNEX 2

				Ser&Res.Target	Target.indic.	%	Ser&Res.Targe	Targe
	Indicator	Number of possible values	Number of possible values Possible values and meaning	s_no BC	_no BC	~	s_BC	-
		possible values						
v								
-			0/3 > 80% of the expected life time achieved**		Γ		T	Т
W1.1.1	Age / Age of replacement of the warning	3	1/3 > 50%,< 80% of expected life time achieved**		2			
VV 1. 1. 1	system	3	2/3 > 20%,< 50% of expected life time achieved**		2			
			3/3 < 20% of expected life time achieved**					
			0/5 Condition State 5: A condition in which it is highly likely that the systems					
			would fail under normal traffic loads over the next 20 years					
			1/5 I don't know. No information are available on the condition state of the					
			infrastructure.					
			Condition State 4: Bad (A condition in which it is moderately likely that the					
			2/5 systems would fail under normal traffic loads over the next 20 years)					
W1.1.2	Condition state of protective	5	Condition State 3: Good (A condition in which it is unlikely that the		3			
VV 1. 1. Z	structures/systems	5	3/5 systems would fail under normal traffic loads over the next 20 years)		5			
			4/5 Condition State 2: Very good (A condition in which it is very unlikely that					
			^{4/3} the systems would fail under normal traffic loads over the next 20 years)					
			Condition State 1: Excellent A condition in which it is extremely unlikely	1			1	1
			5/5 that the systems would fail under normal traffic loads over the next 20				1	1
			years				1	1
	The apprication of the second barry of		0/2 No alternative means	İ	1		1	1
W1.2.1	The possibility of using another means to	2	1/2 1 alternative mean	1	1			1
	satisfy transport demand		2/2 Multiple alternative means	<u> </u>				
	The number of possible existing alternative		0/2 No alternative ways					
W1.2.2	ways to deviate vehicles	2	1/2 1 alternative way	l	1	67%	1	1
	in ays to deviate vehicles		2/2 Multiple alternative ways				1	
			0/2 No warning systems					1
W1.2.3	The presence of a warning system	2	1/2 1 warning system	l	2		1	1
			2/2 Multiple warning systems					1
W1.3.1	Adequacy of hazard effect reduction	1	0/1 Not adequate	ł	1	100%		1
	system (barriers to wind)		1/1 Adequate		I		+	+
	11-1-648	_	0/2 > 3meters				1	1
w.z.1.1	Height*	2	1/2 < 3meters	1	0		1	1
	1		2/2 At the same level				+	
			0/3 > 10 events per year 1/3 > 7, < 10 events per year				1	
N.2.1.2	Frequency of past hazards	3	2/3 > 3, < 7 events per year		0	25%		
			3/3 < 3 events per year					
			0/3 Infrastructure's collapse					
		3	1/3 Serious damage			254		
N.2.1.3	Severity of past hazards	3	2/3 Minor damage	1	0	25%		
			3/3 Aesthetic damages					
			0/3 2 weeks					
N.2.1.4	Frequency of future hazards	3	1/3 1-2 weeks		0	25%		
			2/3 1 day- 1 week				1	
	+		3/3 0 days		L			
			0/3 Strong increase				1	
N.2.1.5	Severity of future hazards	3	1/3 Soft increase		0	25%		
			2/3 Soft decrease 3/3 Strong decrease					
	1		1/3 Serious damage				+	-
N.2.1.6	Extent of past damages due to hazards	2	2/3 Minor damage	1	0		1	1
		-	3/3 Aesthetic damages	1	Ĩ		1	1
	1	l	0/2 < than 1 day			-	1	t
N.2.1.7	Duration of past down time due to hazards	2	1/2 1-3 days	1	0			1
			2/2 > than 3 days					L
			0/3 < 20% of capacity					Γ
N 2 1 0	Traffic*	3	1/3 > 20%,< 50% of capacity		2	75%		1
		3	2/3 > 50%,< 80% of capacity		_	1 370	1	1
	1		3/3 > 80% of capacity					
			0/2 Frequent dangerous goods				1	1
V.2.1.9	Hazards goods traffic*	2	1/2 Rare dangerous goods		1	67%	1	1
			2/2 No dangerous goods		L			1
		_	0/2 No plan					1
N.3.1.1	The presence of an emergency plan	2	1/2 Generic plan	ļ	2			1
	+		2/2 Operative plan (with tasks, resources,)		I		+	+-
			0/4 No exercise				1	1
N 2 1 7	Practice of the emergency plan	4	1/4 1 exercise every > than 2 years		2			1
w.ə.1.2	Practice of the emergency plan	4	2/4 1 exercise every 2 years	1	2 ²		1	1
			3/4 1 exercise every year 4/4 1 exercise every 6 months	1			1	1
	1		4/4 1 exercise every 6 months 0/2 < 2 years ago				-	1
	Review/update of the emergency plan	2	1/2 < 5 years ago	1	1			
		- 4			1 [±]		1	1

Table 11. WIND Targets Case Study 3.





						C	Western Statis		STUDY 3	Warness to die	
RISK	ID	Indicator	Number of		Number of possible values Possible values and meaning	Ser&Res.Target s_no BC	Target.indic. _no BC	%	Ser&Res.Target s_BC	Target.indic. _BC	%
NJK		indicator	possible values								
G	H	1				1			1		
		Are (Are of replacement of the warping			> 80% of the expected life time achieved** > 50%,< 80% of expected life time achieved**	-					
	F1.1.1		3		> 50%,< 80% of expected life time achieved**	1	1		1	1	
		system			< 20% of expected life time achieved**						
					Condition State 5: A condition in which it is highly likely that the systems						
				0/5	would fail under normal traffic loads over the next 20 years						
				1/5	I don't know. No information are available on the condition state of the	1					
				1/5	infrastructure.						
		Age / Age of replacement of the warning system Age / Age of replacement of the warning system Condition state of protective structures/systems The possibility of using another means to satisfy transport demand The number of possible existing alternative ways to deviate vehicles The presence of a warning system Adequacy of hazard effect reduction system (pavement lines and visibility sticks) Height* Frequency of past hazards Severity of past hazards Severity of future hazards Duration of past down time due to hazards Traffic*			Condition State 4: Bad (A condition in which it is moderately likely that the						
				2/5	systems would fail under normal traffic loads over the next 20 years)						
	F1.1.2	Condition state of protective	5								
	F1.1.2	structures/systems	5	3/5	Condition State 3: Good (A condition in which it is unlikely that the systems would fail under normal traffic loads over the next 20 years)		2		4	4	
						-					
				4/5	Condition State 2: Very good (A condition in which it is very unlikely that						
				4/5	the systems would fail under normal traffic loads over the next 20 years)						
					Condition State 1: Excellent A condition in which it is extremely unlikely	1					
		1 satisfy transport demand 2 The number of possible existing alternative ways to deviate vehicles		5/5	that the systems would fail under normal traffic loads over the next 20						
					years						
		The possibility of using another means to			No alternative means						
	F1.2.1		2		1 alternative mean		1		3	3	
		,			Multiple alternative means						
	F1.2.2	The number of possible existing alternative	2		No alternative ways	-	1	67%	2	2	100
	F1.2.2	ways to deviate vehicles	2		1 alternative way Multiple alternative ways	-	1	0770	2	2	10
					No warning systems						
	F1.2.3	The presence of a warning system	2		1 warning system		2		2	2	
					Multiple warning systems	1					
		Adams and the second offerst and others			Not adequate						
	F1.3.1		1	0/1	Not adequate		1	50%	0		50
		system (pavement lines and visibility sticks)			Adequate						
					> 3meters						
	F.2.1.1	Height*	2		< 3meters	4	0				
					At the same level						
					> 10 events per year > 7, < 10 events per year	4					
	F.2.1.2	Frequency of past hazards	3		> 3, < 7 events per year		0	33%		0	33
					< 3 events per year						
					Infrastructure's collapse						-
	6212	Soverity of past bazards	3	1/3	Serious damage	1	0	25%		2	75
	F.2.1.5	Sevency of past nazards	3	2/3	Minor damage		Ŭ	23/0		2	/3
					Aesthetic damages						
					2 weeks	-					
	F.2.1.4	Frequency of future hazards	3		1-2 weeks	-	0	33%		0	33
					1 day- 1 week 0 days	1					
					0 days Strong increase				1		
					Soft increase	1					
	F.2.1.5	Severity of future hazards	3		Soft decrease	1	0	33%		2	10
					Strong decrease	<u> </u>					
				0/2	< than 1 day	[]					
	F.2.1.6	Duration of past down time due to hazards	2		1-3 days	4	0				
					> than 3 days						
					< 20% of capacity	4					
	F.2.1.7	Traffic*	3		> 20%,< 50% of capacity	1	2	75%		1	50
					> 50%,< 80% of capacity > 80% of capacity	1					
					Frequent dangerous goods						
	F.2.1.8	Hazards goods traffic*	2	1/2	Rare dangerous goods	1	1	67%		2	10
				2/2	No dangerous goods	1	*			1	
					No plan	1			1		
	F.3.1.1	The presence of an emergency plan	2		Generic plan]	2			2	
					Operative plan (with tasks, resources,)						
				0/4	No exercise						
					1 exercise every > than 2 years	4					
	F.3.1.2	Practice of the emergency plan	4		1 exercise every 2 years	4	2			1	
				3/4	1 exercise every year	4					
	<u> </u>				1 exercise every 6 months						
	6313	Review/update of the emergency plan	2	1/2	< 2 years ago < 5 years ago	1	1			0	
		incriew/update of the emergency plan	2	1/4	>) Years also	1			1	U	

Table 12. FOG Targets Case Study 3.





		Number of			Ser&Res.Target s_no BC	Target.indic. _no BC	%	Ser&Res.Targe s_BC	t Target.indic. _BC	•
ID	Indicator	possible values		Number of possible values Possible values and meaning	10000	_10 00		100		
			_							
2			0/3	> 80% of the expected life time achieved**]	1		1	1	Г
S.1.1.1	Age / Age of replacement of the warning system	3	1/3 2/3	> 50%,< 80% of expected life time achieved** > 20%,< 50% of expected life time achieved**		2			2	
	system			< 20% of expected life time achieved**						
			0/5	Condition State 5: A condition in which it is highly likely that the systems would fail under normal traffic loads over the next 20 years						
			1/5	I don't know. No information are available on the condition state of the						
			1/5	infrastructure.						
			2/5	Condition State 4: Bad (A condition in which it is moderately likely that the systems would fail under normal traffic loads over the next 20 years)						
S.1.1.2	Condition state of protective	5		Systems would fail under normal traffic loads over the next 20 years) Condition State 3: Good (A condition in which it is unlikely that the	-	3			4	
5.1.1.2	structures/systems	5	3/5	systems would fail under normal traffic loads over the next 20 years)		3			4	
			. /5	Condition State 2: Very good (A condition in which it is very unlikely that	1					
			4/5	the systems would fail under normal traffic loads over the next 20 years)						
			- (-	Condition State 1: Excellent A condition in which it is extremely unlikely						
			5/5	that the systems would fail under normal traffic loads over the next 20 years						
	The possibility of using another means to			No alternative means					3	
S.1.2.1	satisfy transport demand	2		1 alternative mean Multiple alternative means		1			3	
	The number of possible existing alternative		0/2	No alternative ways			6 ma (
S.1.2.2	ways to deviate vehicles	2		1 alternative way Multiple alternative ways		1	67%		2	
		_	0/2	No warning systems						
S.1.2.3	The presence of a warning system	2		1 warning system Multiple warning systems		2			0	
S.1.3.1	Adequacy of hazard effect reduction	1	0/1	Not adequate		1	100%		1	
	system (barriers to snow)	-		Adequate >3meters				-		+
S.2.1.1	Height*	2	1/2	<3meters	1					
				At the same level > 5 events per year						-
5.2.1.2	Frequency of past hazards	3	1/3	> 2, < 5 events per year			25%		1	
5.2.1.2	inequency of past naturals	-		> 1, < 2 events per year 1 events per year			2370		-	
-			0/3	Infrastructure's collapse						
S.2.1.3	Severity of past hazards	3		Serious damage			25%		1	
			3/3	Minor damage Aesthetic damages	1					
			0/3	2 weeks						
S.2.1.4	Frequency of future hazards	3		1-2 weeks 1 day- 1 week			25%		0	
			3/3	0 days				_		
S.2.1.5		3	0/3	Strong increase Soft increase	1					
5.2.1.5	Severity of future hazards	3	2/3	Soft decrease	1		25%		0	
-			3/3 0/2	Strong decrease < than 1 day						
S.2.1.6	Duration of past down time due to hazards	2	1/2	1-3 days						
			2/2	> than 3 days < 20% of capacity						
S.2.1.7	Traffic*	3	1/3	> 20%,< 50% of capacity		2	75%		3	
		-	2/3	> 50%,< 80% of capacity > 80% of capacity	-	-	,5,0		5	
			0/2	Frequent dangerous goods						t
S.2.1.8	Hazards goods traffic*	2		Rare dangerous goods No dangerous goods	-	1	67%		2	
\$3.1.1	The presence of a monitoring strategy	1	0/1	No strategy		1			1	t
				Presence of a strategy No strategy				-		+
\$3.1.2	The presence of an maintenance strategy	1	1/1	Presence of a strategy		1			1	L
\$3.1.3	The extent of interventions executed prior	2	0/2	No interventions Partial interventions	-	2	100%		2	
33.1.3	to the event	-	2/2	Full interventions		-	10070		-	
\$3.1.4	The presence of an emergency plan	2		No plan Generic plan		2			1	
	- Freedow of an enterBency plan	<u> </u>	2/2	Generic plan Operative plan (with tasks, resources,)	1	Ĺ				
				No exercise						Γ
\$3.1.5	Practice of the emergency plan	4	2/4	1 exercise every > than 2 years 1 exercise every 2 years	1	2			1	
			3/4	1 exercise every year	-					
	1		0/2	1 exercise every 6 months > 5 years ago		1		1	1	t
\$3.1.6	Review/update of the emergency plan	2	1/2	< 5 years ago	4	1			1	
	1			< 2 years ago No redundancy		-		-	-	+
	Augusta billion of a surger to the test of		1/4	Redundancy <20% of work forces	1	_				
\$3.1.7	Availability of appropriate labour force	4		Redundancy >20%, <50% of work forces Redundancy >50%, <80% of work forces	1	2			0	
			4/4	Redundancy >80% of work forces	1					1
				No possibility to hire >80% of the estimated time to repair (ETTR) to hire	ł					L
\$3.1.8	Flexibility in hiring appropriate work force	4	2/4	>80% of ETTR to hire	1	3			0	
				>50%, <80% of ETTR to hire < than 20% of ETTR to hire	ł					
			0/4	No redundancy					1	T
\$3.1.9	Availability of materials	4		Redundancy <20% of material Redundancy >20%, <50% of material	ł	1			0	L
			3/4	Redundancy >50%, <80% of material	1	1			Ĭ	L
<u> </u>	+		4/4	Redundancy >80% of material No possibility to order						╀
			1/4	>80% of the estimated time to repair (ETTR) to hire	1					L
\$3.1.10	Expected time for material delivery	4	2/4	>80% of ETTR to order	1	1			0	l
				>50%, <80% of ETTR to order < than 20% of ETTR to order	ł					
			0/4	No redundancy		1		1		T
\$3.1.11	Availability of construction equipment	4		Redundancy <20% of equipment Redundancy >20%, <50% of equipment	1	2			0	L
			3/4	Redundancy >50%, <80% of equipment	1					L
<u> </u>	+			Redundancy >80% of work equipment No possibility to rent						+
	Expected time for construction equipment		1/4	>80% of the estimated time to repair (ETTR) to hire	1					
\$3.1.12	delivery	4		>80% of ETTR to rent >50%, <80% of ETTR to rent	ł	2		1	1	

 4/4
 cthan 20% of ETTR to rent

 Table 13. SNOWFALL Targets Case Study 3.







REFERENCES.



¹ RAGTIME: Risk based approaches for Asset inteGrity multimodal Transport Infrastructure ManagEment.

² The governance module of the RAGTIME project was developed to mitigate internal infrastructure risks, based on governance, technical and financial indicators, FORESEE will apply this same module, but to decide the resilience and level of objective service based on indicators mitigated, external risks, disruptive events and/or extremes of a natural and/or mam-made nature.

³ Adapted FORESEE Governance Tool, from the RAGTIME Tool.

⁴ FORESEE Governance Tool conditions, 5 indexes.