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ROAD MANAGEMENT SYSTEM BASED ON HDM-4

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SUBJECTS ADDRESSED IN MEXICO'S NATIONAL REPORT

Initiatives for developing and/or applying asset management tools

Federal roads authority

- HDM-4 applications within the SCT General Directorate for Road Maintenance

FNI trustee

FNI network operator

- Pavement Management System Based on HDM-4 for the toll road network of the National Infrastructure Fund (FNI)

- Road Infrastructure Management System being developed by the SCT Sub-secretariat of Infrastructure

FACTS ABOUT THE FNI NETWORK

- Length: 3,765 km (90% of the network operated by CAPUFE, 50% of the toll-roads sub-network, 8% of the federal network)
- Includes mainly 4 or more lane motorways located mostly along trunk corridors
- 30% of the road length have traffic volumes in excess of 10,000 vehicles per day
- By definition, it must provide high quality road transport services
- Demand for accountability from users and other stakeholders is the highest in the country

OBJECTIVES OF THE PAVEMENT MANAGEMENT SYSTEM

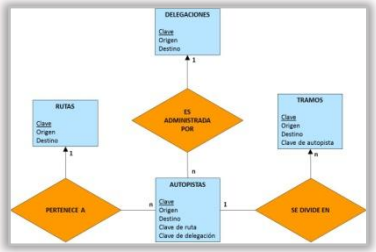
- Allocate efficiently the resources available for road maintenance
- Ensure a level of service consistent with user expectations
- Justify investments in road maintenance and improvement
- Develop procedures for assessing objectively and systematically road condition
- Evaluate road maintenance alternatives both technically and economically
- Formulate the annual preliminary work programme and budget for network maintenance and rehabilitation

BACKGROUND: PILOT STUDY

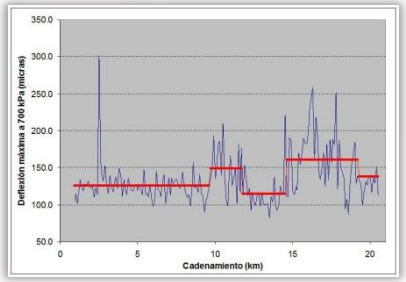
DRAFT MANAGEMENT CYCLE

350 km (9 %) of the network length

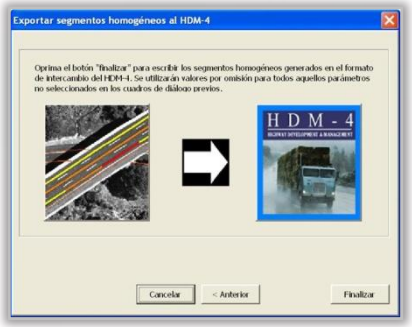
PRELIMINARY WORK PROGRAMME



DRAFT DATABASE LAYOUT



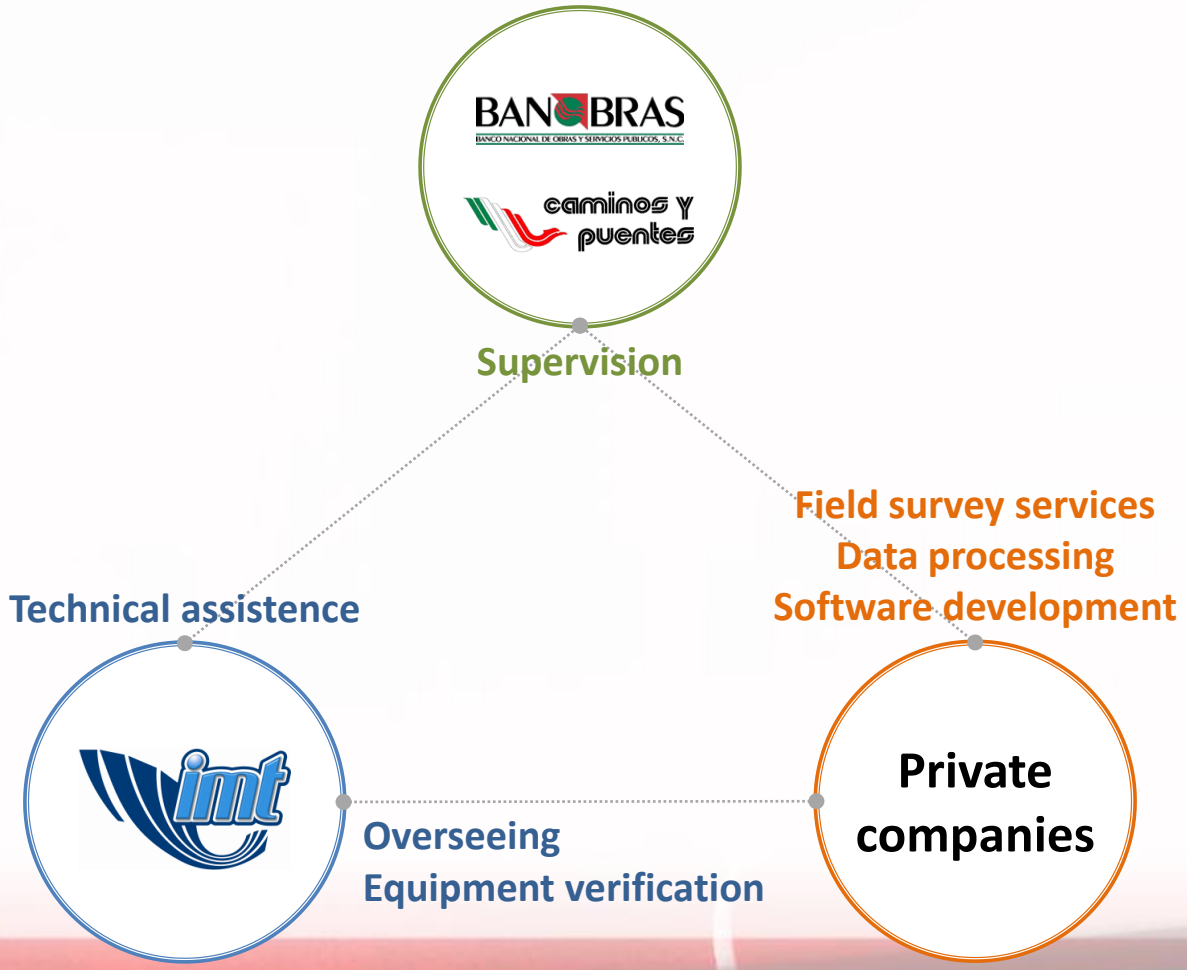
ALGORITHMS FOR DATA PROCESSING



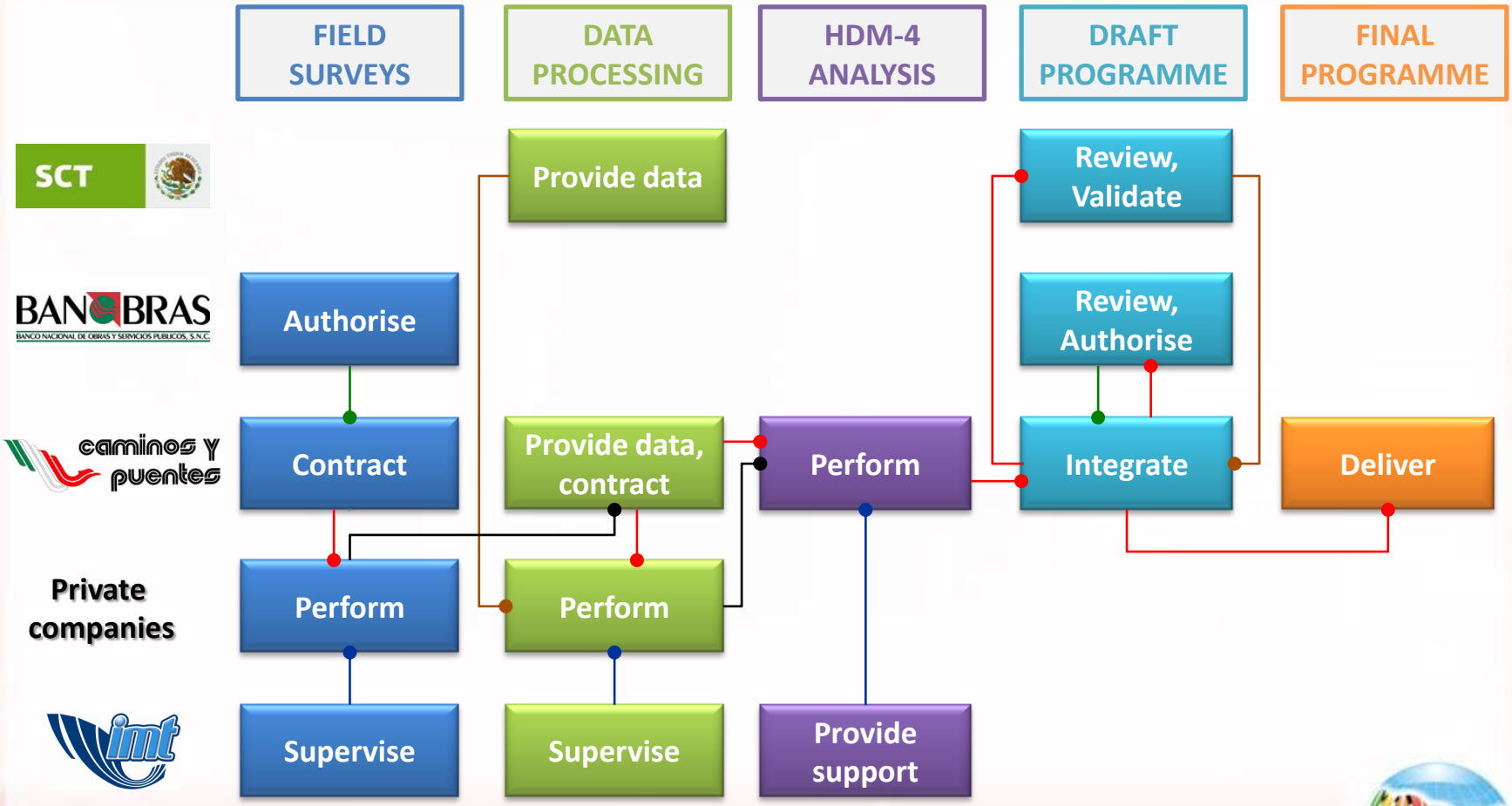
SEGMENTATION SOFTWARE

TERMS OF REFERENCE FOR SURVEYS

BUSINESS MODEL FOR SYSTEM DEVELOPMENT

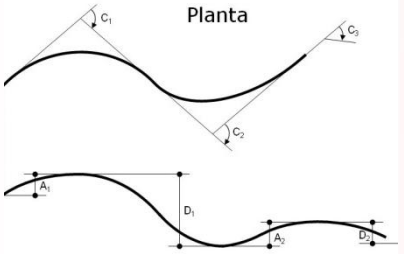


MANAGEMENT CYCLE: PROGRAMME GENERATION



DATA REQUIREMENTS: INFORMATION AVAILABLE ON DOCUMENTARY SOURCES

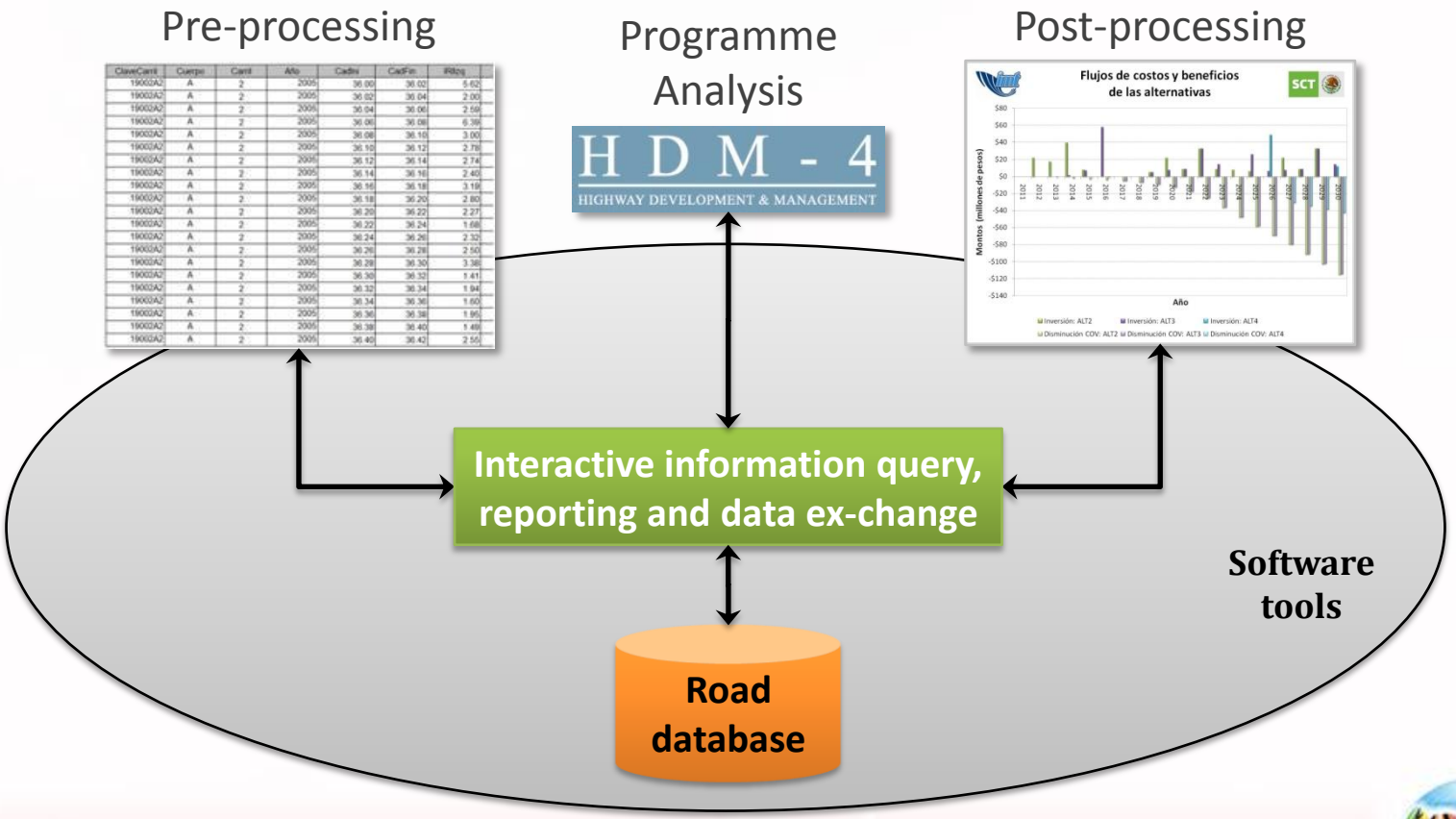
- Geometric design parameters: cross section, horizontal and vertical alignments, altitude (CAPUFE)
- Construction and maintenance history (CAPUFE)
- Climate information (IMT)
- Traffic (SCT, CAPUFE)
- Inputs for calculating vehicle operating costs (IMT)
- Surface roughness (SCT)
- Rut depth (SCT)



DATA REQUIREMENTS: FIELD SURVEYS

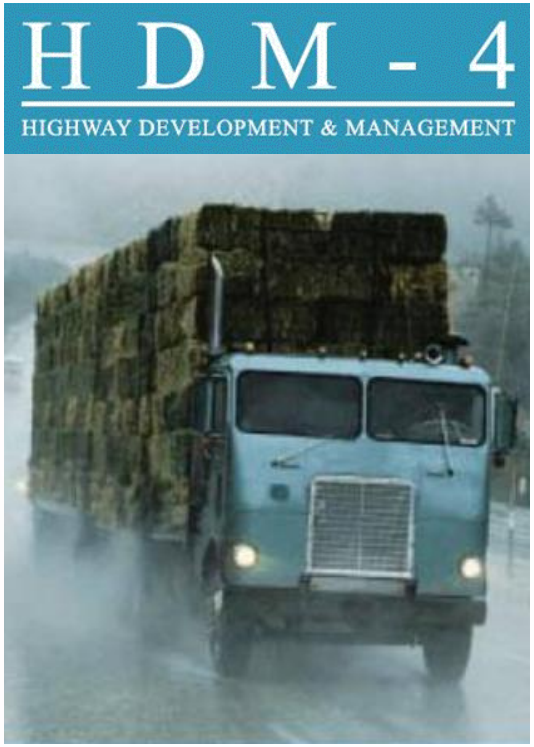
- Surface distresses: cracking, potholes, ravelling (video logging and processing)
- Pavement deflections (falling weight deflectometer)
- Pavement structural section (ground penetrating radar)
- Skid resistance (high performance equipment) and texture depth (sand patch)

BASIC ARCHITECTURE OF THE SOFTWARE TOOLS

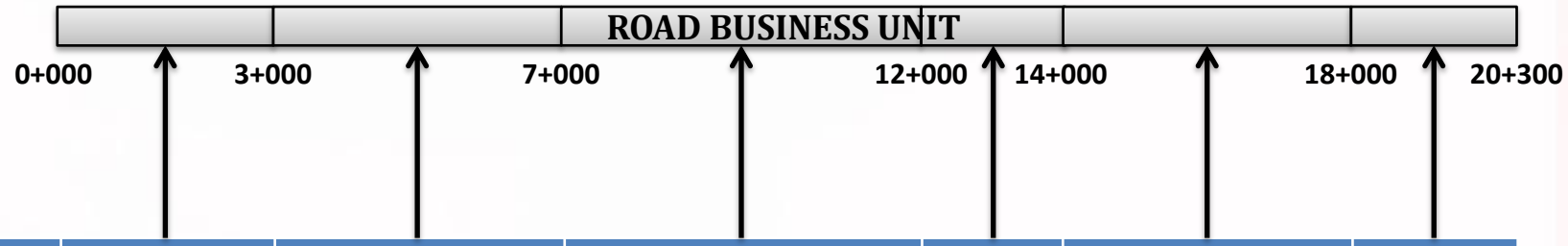


WHY HDM-4?

- It provides models to predict pavement deterioration and estimate user costs
- There is a sound platform for documentation, technical support and technology transfer
- It has highly relevant applications within SCT



APPLICATION OF HDM-4: OPTION EVALUATION BY HOMOGENEOUS SECTION (STANDARD APPROACH)



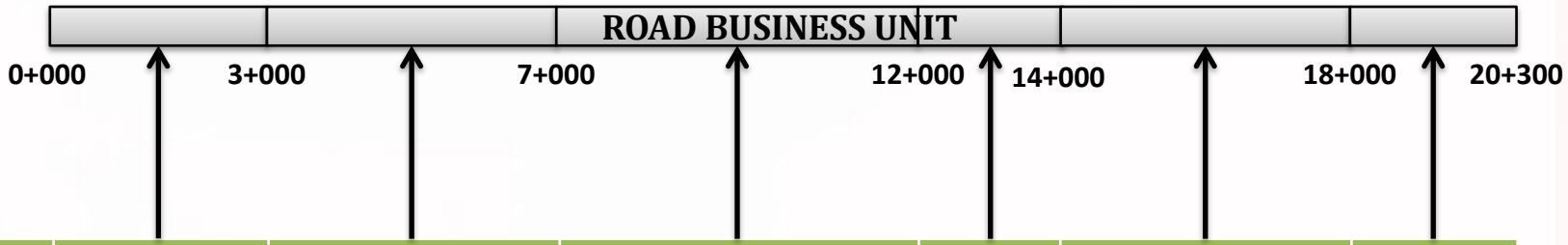
Year	Opt_2	Opt_3	Opt_2	Opt_2	Opt_4	Opt_3
1	WI1_2		WI1_2	WI_2	WI1_4	
2		WI1_3				WI1_3
(...)						
m	WI3_2	WI2_3	WI3_2	WI3_2	WI1_4	WI2_3

Work items corresponding to options with maximum NPV are applied to sections

Using maximum NPV as the sole decision criterion may result in treatments not suitable for toll motorways

Treatments for neighbour sections may differ significantly

APPLICATION OF HDM-4: OPTION EVALUATION BY ROAD BUSINESS UNIT



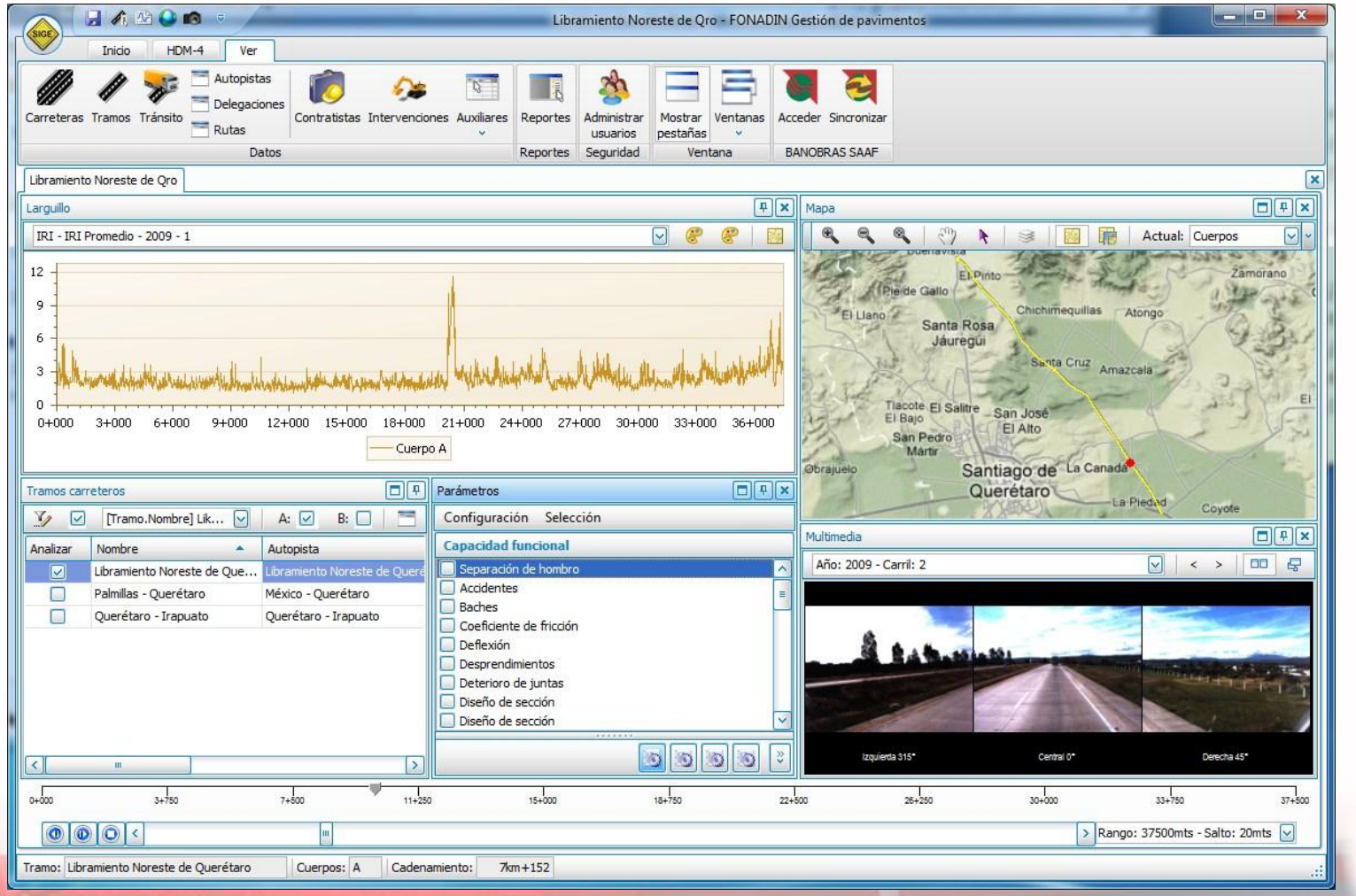
Year	Opt_2	Opt_2	Opt_2	Opt_2	Opt_2	Opt_2
1	WI1_2		WI1_2	WI1_2		
(...)						

Year	Opt_3	Opt_3	Opt_3	Opt_3	Opt_3	Opt_3
1						
(...)						

Year	Opt_4	Opt_4	Opt_4	Opt_4	Opt_4	Opt_4
1					WI1_4	
(...)						

Work programmes resulting from applying all options to entire business units are obtained and evaluated outside HDM-4

SOFTWARE TOOLS: INTERACTIVE INFORMATION QUERY



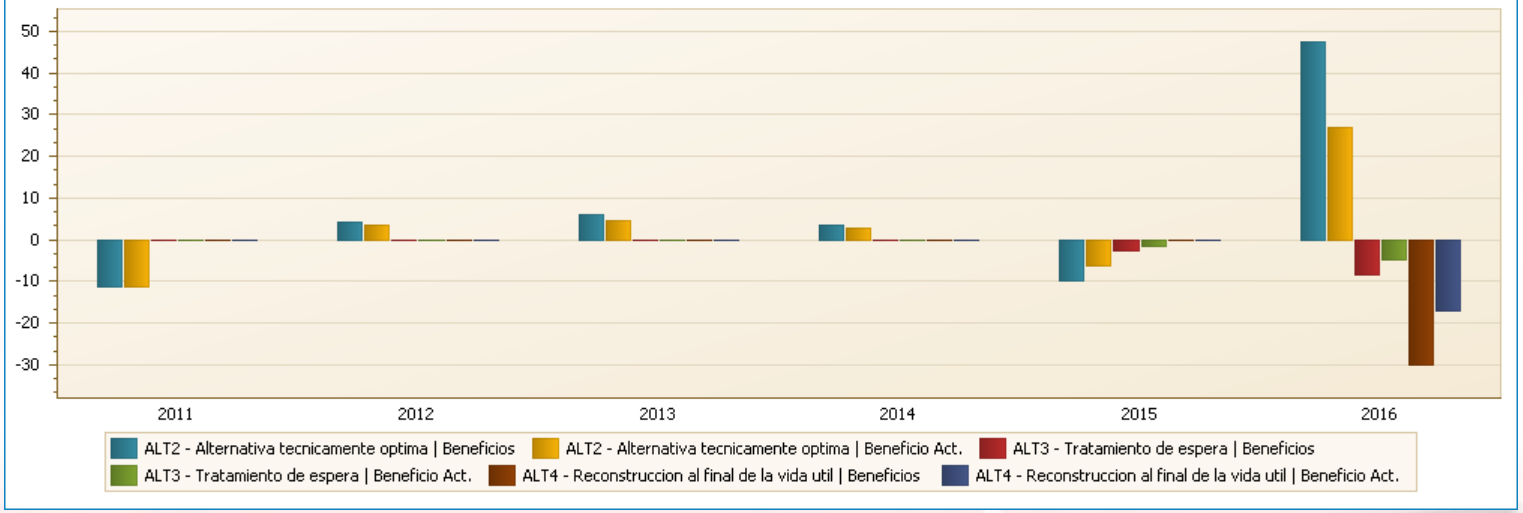
BENEFIT COST/ANALYSYS

Resumen de rentabilidad

Carreteras de queretaro | Analisis costo/beneficio social

Alternativa

Año	ALT2 - Alternativa tecnicamente optima			ALT3 - Tratamiento de espera					ALT4 - Reconstru
	ΔCOV	Beneficios	Beneficio Act.	ΔRAC	COV	ΔCOV	Beneficios	Beneficio Act.	ΔRAC
2011	$0.00	-$11.45	-$11.45	$0.00	$484.20	$0.00	$0.00	$0.00	$0.0
2012	$4.03	$4.03	$3.60	$0.00	$509.63	$0.00	$0.00	$0.00	$0.0
2013	$5.80	$5.80	$4.62	$0.00	$537.02	$0.00	$0.00	$0.00	$0.0
2014	$8.15	$3.57	$2.54	$0.00	$566.45	$0.00	$0.00	$0.00	$0.0
2015	$17.44	-$10.04	-$6.38	$2.53	$604.48	$0.00	-$2.53	-$1.61	$0.0
2016	$47.55	$47.55	$26.98	$38.47	$632.11	$29.89	-$8.58	-$4.87	$30.2
2017	$94.08	$91.79	$46.50	$2.29	$645.49	$94.25	$91.96	$46.59	$30.2



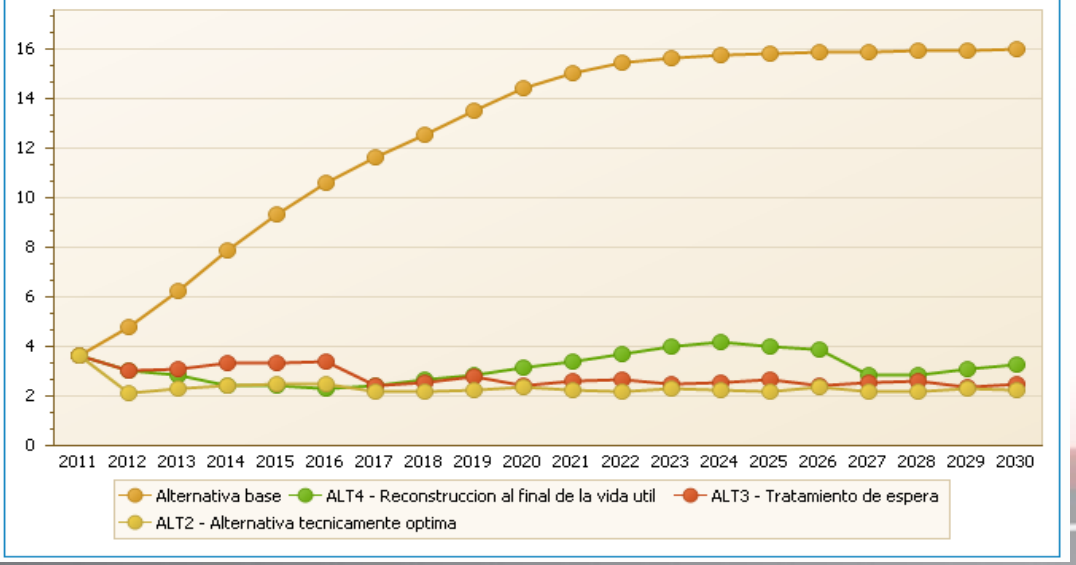
OPTIONS PERFORMANCE

IRI promedio

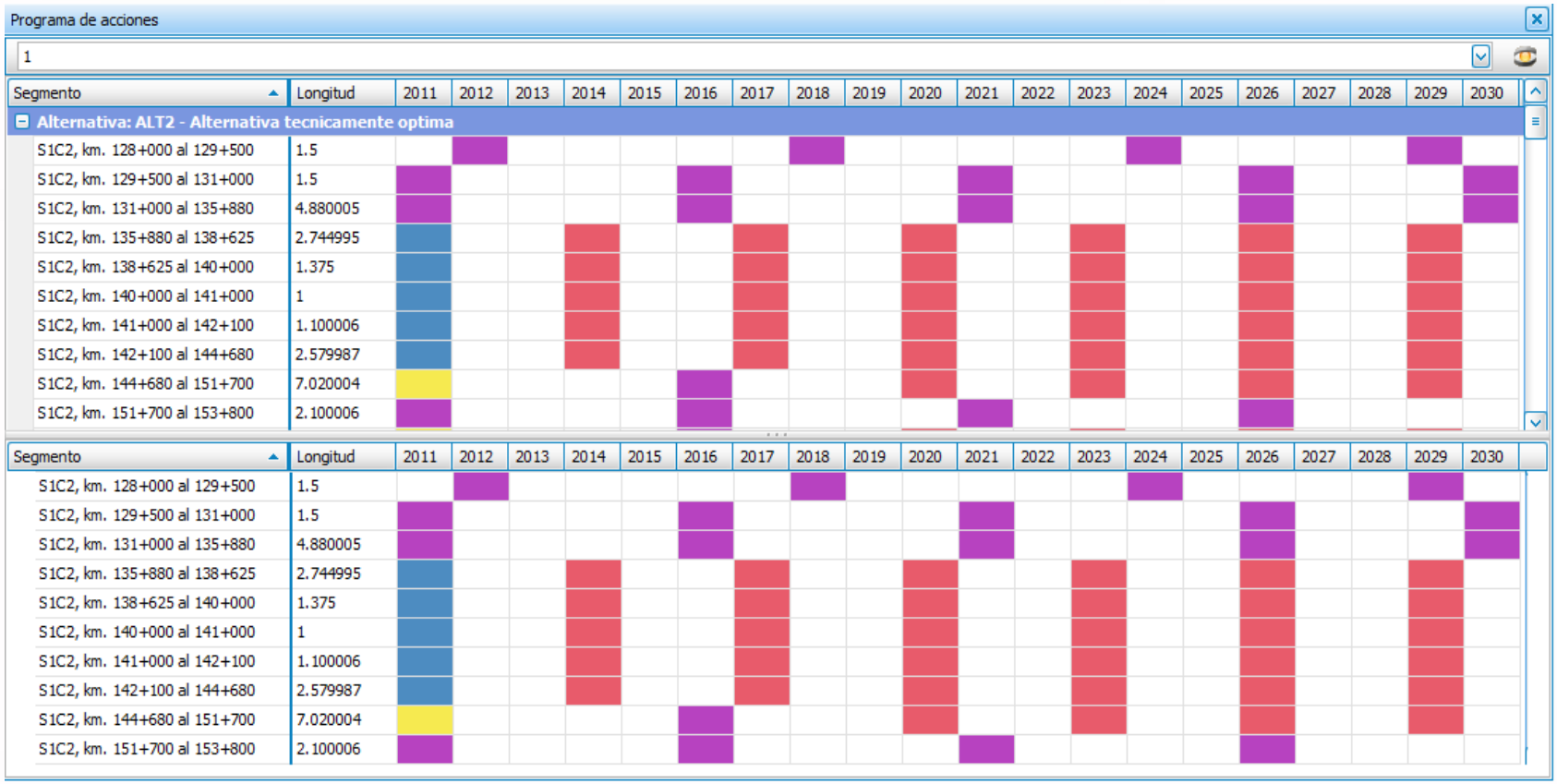
1 | IRI promedio por alternativa

Pond. IRI | Alternativa

Año	Alternativa base	ALT4 - Reconst...	ALT3 - Tratamie...	ALT2 - Alternati...
2011	3.62	3.62	3.62	3.62
2012	4.76	3.01	3.05	2.13
2013	6.25	2.85	3.09	2.27
2014	7.89	2.44	3.33	2.41
2015	9.31	2.42	3.34	2.50
2016	10.58	2.32	3.42	2.48
2017	11.63	2.44	2.40	2.16
2018	12.53	2.64	2.54	2.21
2019	13.52	2.87	2.79	2.23
2020	14.39	3.13	2.43	2.39
2021	15.01	3.41	2.57	2.24



WORK PROGRAMME ADJUSTMENT



REMAINING CHALLENGES

- Enforce the institutional provisions required for effectively applying the management cycle
- Under budget constraints, adjust work programmes and prioritise candidate projects automatically
- Monitor the performance of executed works
- Start a calibration and adaption process for HDM-4 deterioration models
- Undertake the development of other management systems (road safety, bridges, etc.)

ACKNOWLEDGEMENTS

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