The experience of Eure et Loir local government authority

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CHAUSSEE

Why? How?

I – The road network to be managed

The French territorial Department of Eure-et-Loir, the administrative centre of which is the town of Chartres, is approximately 100 kilometres to the southwest of Paris, and has one of the most extensive Departmental Road Networks in the whole of France: total highway length is approximately 7,500 kilometres.

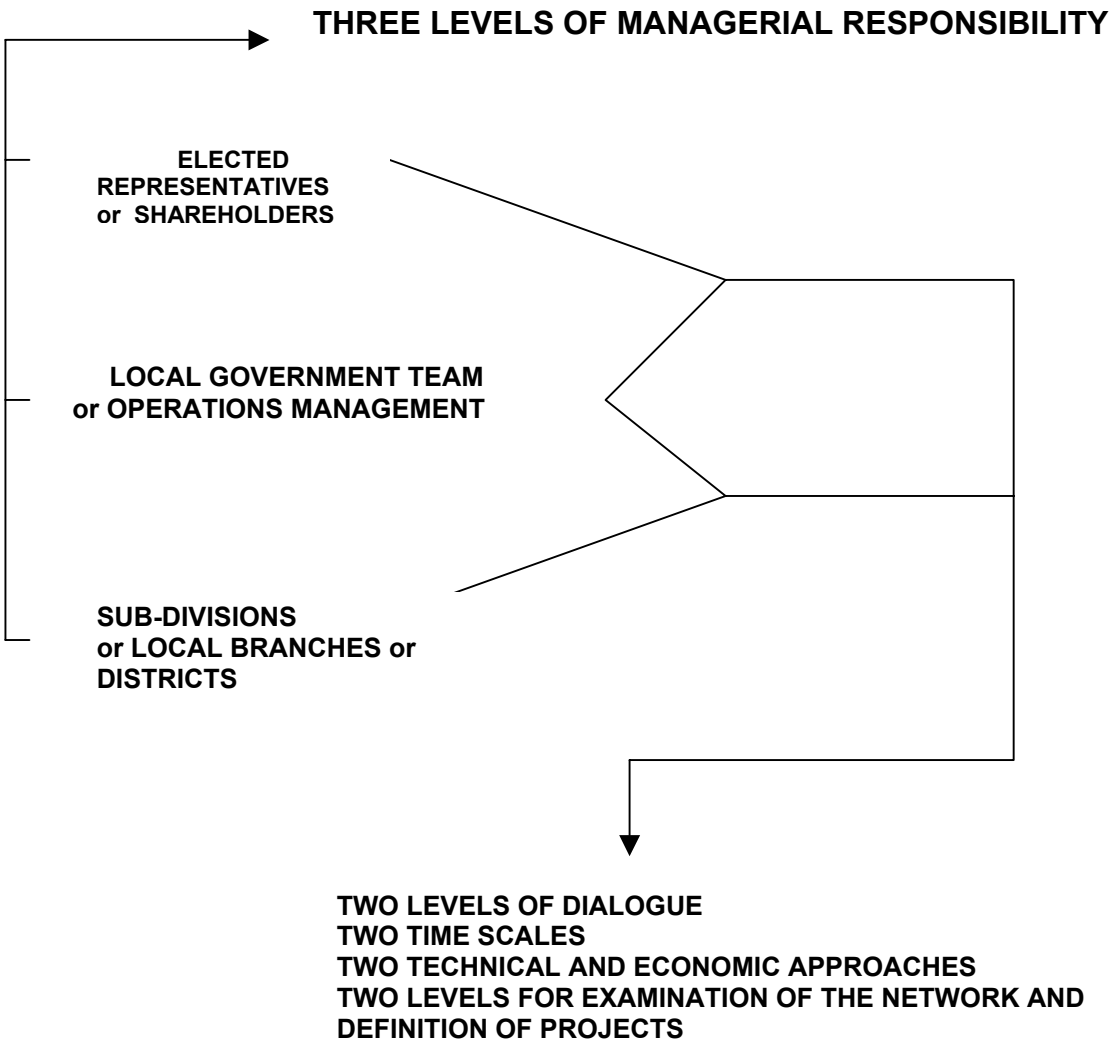
The local government authority [*Conseil Général*] has the responsibility of managing this asset, the value of which is substantial, set at FRF 27 billion.

The definition of the master plan for the Departmental Road Network made it possible to divide the network up into four ranked categories on the basis of criteria related to economic considerations, tourism and traffic load.

The first two categories (3,020 kilometres or 40 % of the Department network) form the core network for the territorial Department and are used by a relatively high level of heavy goods traffic (more than 100 trucks per day per direction on approximately 20% of total highway length).

As an indication, and to help the associated goals and issues to be seen more clearly, the cost of bringing up the core Department road network to required standards is evaluated at FRF 400 million.

II – The issues



DIALOGUE

TWO TIMESCALES

. LONG TERM

. DEVELOPMENT OF NEEDS OVER TIME (BUDGETS)

. DEVELOPMENT OF NETWORK CONDITION OVER TIME

. SHORT TERM

. WORK SCHEDULING

. PRIORITIES

THE QUESTIONS RAISED
(FIRST LEVEL OF DIALOGUE)

* DEFENCE OF BUDGETS WITH ROBUST ARGUMENTS

* IMPACT OF BUDGET CHANGES ON THE LEVEL OF SERVICE PROVIDED

* REDUCTION OF COSTS TO A MINIMUM

* CHOICE OF THE BEST STRATEGY FOR A SET BUDGET

* EFFECTIVENESS OF THE POLICY IMPLEMENTED

* WHAT IMPORTANCE SHOULD BE ATTACHED TO THE MAINTENANCE OF THE EXISTING ROAD SYSTEM COMPARED WITH NEEDS FOR NEW INFRASTRUCTURE?

THE QUESTIONS RAISED
(SECOND LEVEL OF DIALOGUE)

* CHOICE OF PROJECTS TO BE IMPLEMENTED

* CHOICE OF TECHNICAL SOLUTIONS

* FAIRNESS OF SPLIT BETWEEN SUB-DIVISIONS → WHICH IS MOST URGENT: PRIORITY No. 1 IN SUB-DIVISION *X* OR PRIORITY No. 3 IN SUB-DIVISION *Y*?

* EFFECTIVENESS OF THE SELECTED TECHNICAL SOLUTIONS

In order to answer the questions raised, the Highways Management Agency wished to have available a resource offering total compatibility with the Road Database already in use, compatibility both in terms of the exploitation of data and the enrichment and updating of the database, plus a resource designed to provide a genuinely effective Management Aid for its Departmental Road Network.

The main functionalities of such a system were to be the following:

- evaluation of the condition of the road surfaces in the Network before and after maintenance work, on the basis of two criteria relating to structure and surface (physical examination phase followed by a diagnostic phase);

- simulation of the effect on the condition of the roads in the Network over the medium and long term of the application of differing maintenance strategies and budget constraints (also enabling evaluation of road refurbishment needs);

- assistance in short-term scheduling of road works by defining priority network sections and the type of maintenance work to be carried out, specifying the relevant costs.

It is obvious that proposals for work of structural nature are to be covered by prior benchmark studies requiring recourse to an expert system.

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The main features desired in this type of tool are the following:

- adjustment to suit the local context — it must therefore be possible to configure the system without compromising its underlying base logic,

- the system must lead to definition of homogeneous maintenance requirements if network sections homogeneous in terms of structure and defects are designated,
- the list of indicators of which account is taken in defining priority network sections must be open to configuration in order to take into account indicators independent of the tool used to assess the condition of the roads.

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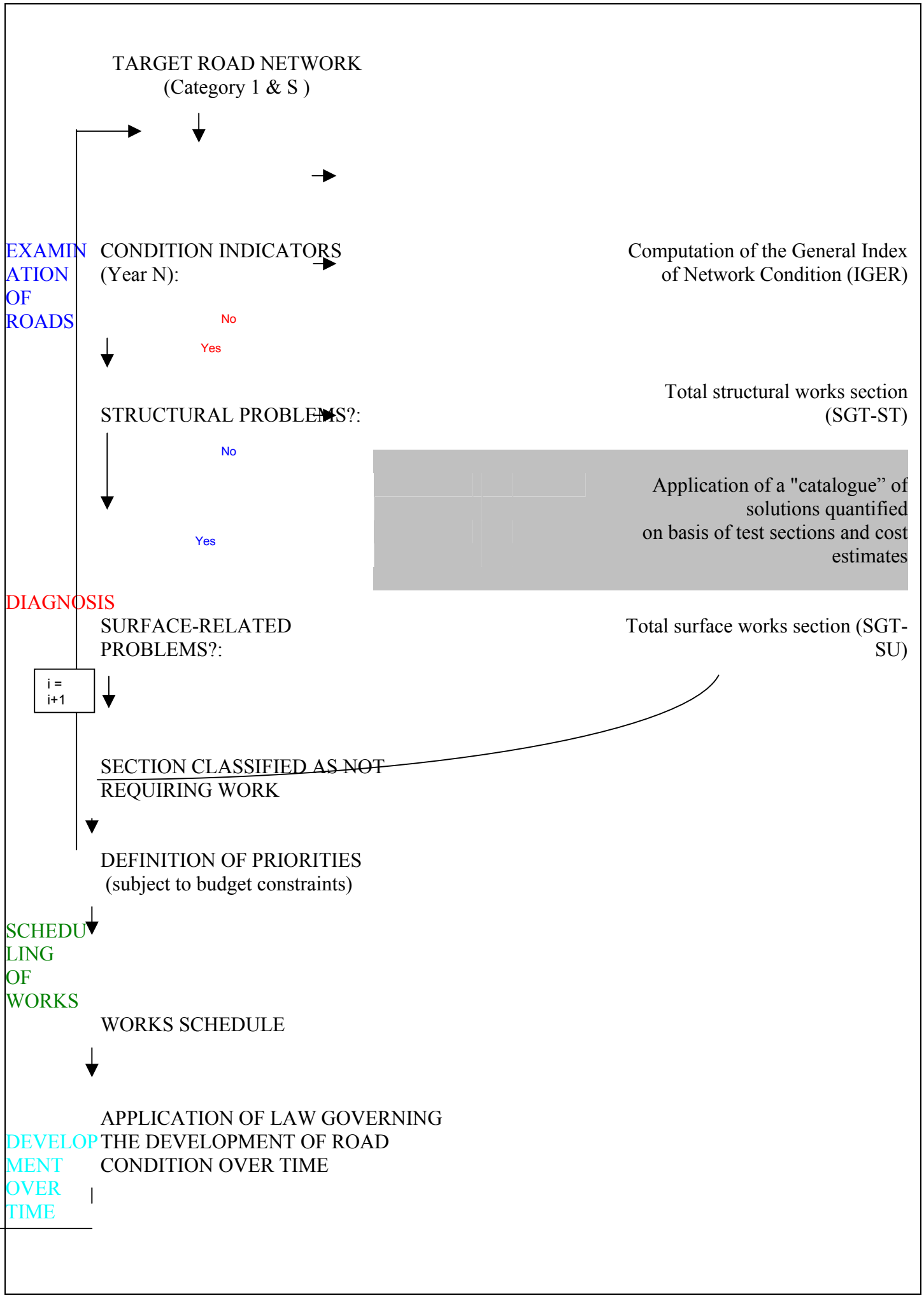
III – The Management Aid System for the Departmental Road Network (28)

The simplified flowchart summarises the chosen approach.


TARGET ROAD NETWORK
(Category 1 & S)
EXAMINATION OF ROADS
CONDITION INDICATORS
(Year N):
Computation of the General Index of Network Condition (IGER)
No
Yes
STRUCTURAL PROBLEMS?:
Total structural works section (SGT-ST)
No
Application of a "catalogue" of solutions quantified on basis of test sections and cost estimates
Yes
DIAGNOSIS
SURFACE-RELATED PROBLEMS?:
Total surface works section (SGT-SU)
i = i+1
SECTION CLASSIFIED AS NOT REQUIRING WORK
DEFINITION OF PRIORITIES
(subject to budget constraints)
SCHEDULING OF WORKS
WORKS SCHEDULE
APPLICATION OF LAW GOVERNING THE DEVELOPMENT OF ROAD CONDITION OVER TIME
DEVELOPMENT OVER TIME

The functionalities of this system are clarified in the paragraphs below.

III.1. Road condition indicators

The condition indicators used by the system are the ***Surface Priority Rating (NPSU)*** and the ***Structural Priority Rating (NPST)*** these being obtained by aggregating the values for ***Deterioration Gravity Rating*** and ***Smoothness***, these being themselves computed on the basis of a quantification of the damage to the road and a definition of thresholds validated by the Highways Management Agency.

The base parameters were chosen to reflect the types of road structure encountered with the thresholds applied being defined to reflect the local Departmental road category.

One special feature of the present system, in the initial decision cycle (i.e. the first year of analysis) is the automatic search for network sections that are homogeneous from the point of view of the condition indicators but at the same time realistic from that of the total highway length to be covered by future work.

Since one of the goals of the system is to make it possible, within defined budget constraints, to analyse the development over time of the level of service provided by the network, it was decided to describe that level of service in the form of an ***General Index of Network Condition*** (**IGER**) calculated using ***Priority Ratings for Homogeneous Network Sections***, those ratings being weighted by the length of the sections concerned:

IGER = (2NPST+NPSU)/3

III.2. Detection of possible road problems

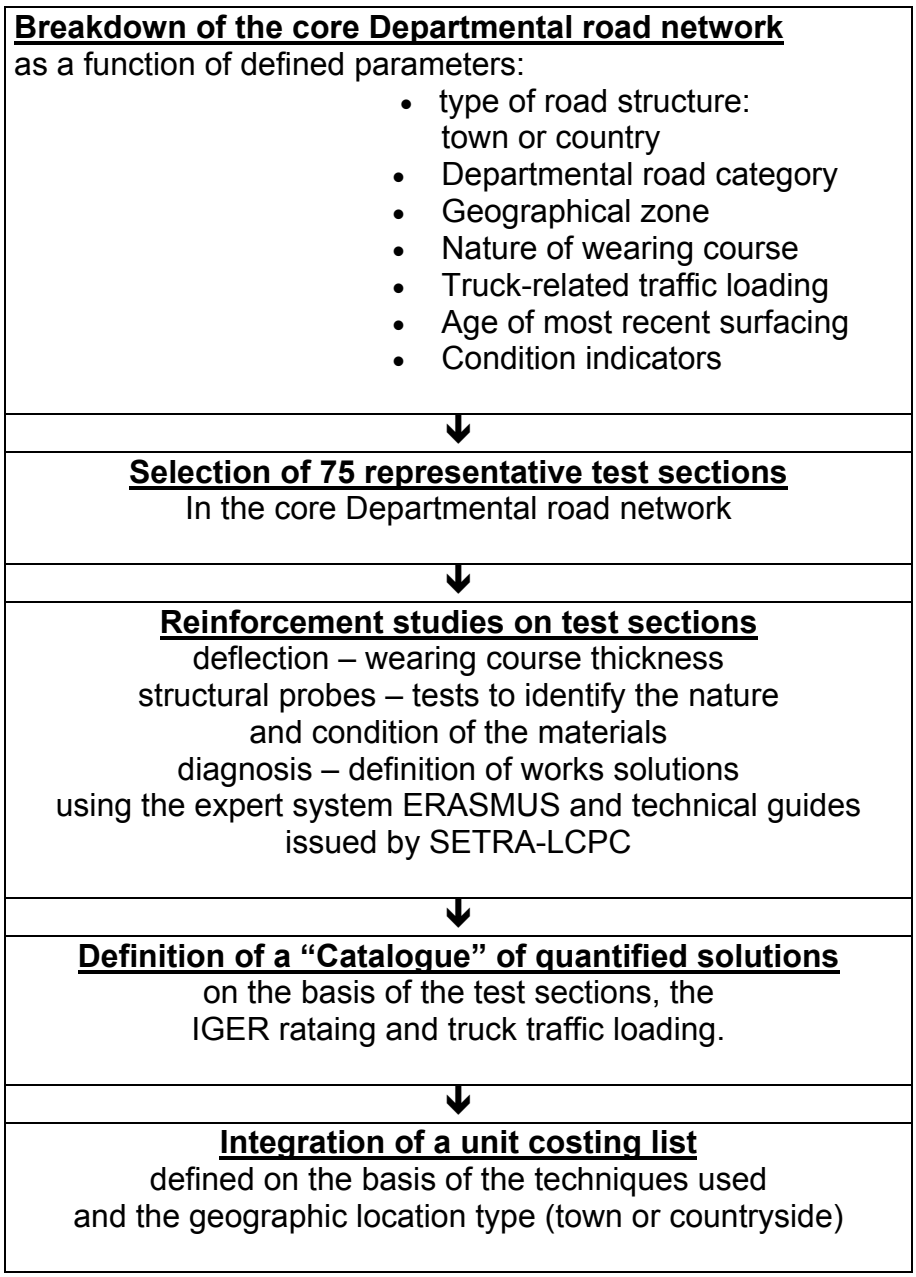
Threshold values defined by the Highways Management Agency for each of the two ***Priority Ratings*** determine the point at which work may be triggered on homogeneous sections; the system detects in this way in turn ***Total Structural Work Sections*** (***SGT-ST***), ***Total Surface Work Sections*** (***SGT-SU***) and ***Sections not requiring work (SST)***.

Another specific feature of the system is that it preserves on file the data on the basis of which work is triggered for a given sections where the relevant road surfacing is less than 5 years old.

Similarly, due to the cost of the works involved, network sections located in urban areas are constantly identified throughout the process.

III.3 Quantification of solutions and costing of road works

The flowchart below makes clear the method followed in drawing up a “Catalogue” of quantified solutions using test sections representative of the Departmental road network (28).



When this tool was created there were no catalogues of quantified work solutions specific to road bases incorporating bitumen-stabilised and hydraulic-binder-treated gravel (these accounting for 2.3% and 2.2% respectively of the total length of the core Departmental road network).

The "***traditional road surface***" catalogue was therefore applied to all the ***Total Work Sections***, and the information on road bases incorporating bitumen-stabilised and hydraulic-binder-treated gravel was retained throughout the process with a view to later additional analysis.

Example of quantified work solutions for traffic loads T0, T1, T2, T3+

	1≤ IGER<1.33	1.33≤ IGER<1.66	1.66≤ IGER<2.00	2.00≤ IGER<2.33	2.33≤ IGER<2.66	2.66≤IGER≤ 3.00
T0	20 BB	16 BB	10 BB	9 BB	5 BB	5 BB
T1	20 BB	16 BB	10 BB	9 BB	Surf./Cat (2)	Surf./Cat (1)
T2	16 BB	10 BB	9 BB	6 BB	Surf./Cat (2)	Surf./Cat (1)
T3+	10 BB	9 BB	6 BB	Surf./Cat (2)	Surf./Cat (1)	Surf./Cat (1)

	Category 1	Category S
Surf./Cat (1)	ECF	ES
Surf./Cat (2)	BBUM	ES

III.4. Definition of priorities

The imposition of budgetary constraints led the Highways Management Agency to define a ***Priority Index*** applied to each of the ***Total Work Sections***.

This priority index is calculated using the following criteria, weighting the quantifiers produced:

- Whether or not the relevant network itinerary, according to category, belongs to the regional master road system.

- The type of road problems detected.

- The age of the most recent road surfacing and notably the percentage of the total highway length for which that age is higher than ten years.

- The degree of homogeneity of the level of service offered by the itinerary concerned.

- The financial impact of a postponement of road works for five years.

If required, the ***IGER*** index makes it possible to order the priorities defined as above in a time-based series.

One specific feature of the System – which is not far from being financial optimisation – function is that it can assign priority to those ***Total Work Sections*** for which the cost of the work needed rises most quickly if that work is postponed.

III.5. Work schedule

Year after year during the period of analysis, the ***Road Network Management Aid System*** defines the work schedules. Such schedules are obtained firstly by applying the decision trees linked to the ***NPSU*** and ***NPST*** condition indicators, and secondly, where a budget constraint is imposed, by assigning an order of priority.

III.6._Application of physical laws governing development of network condition over time

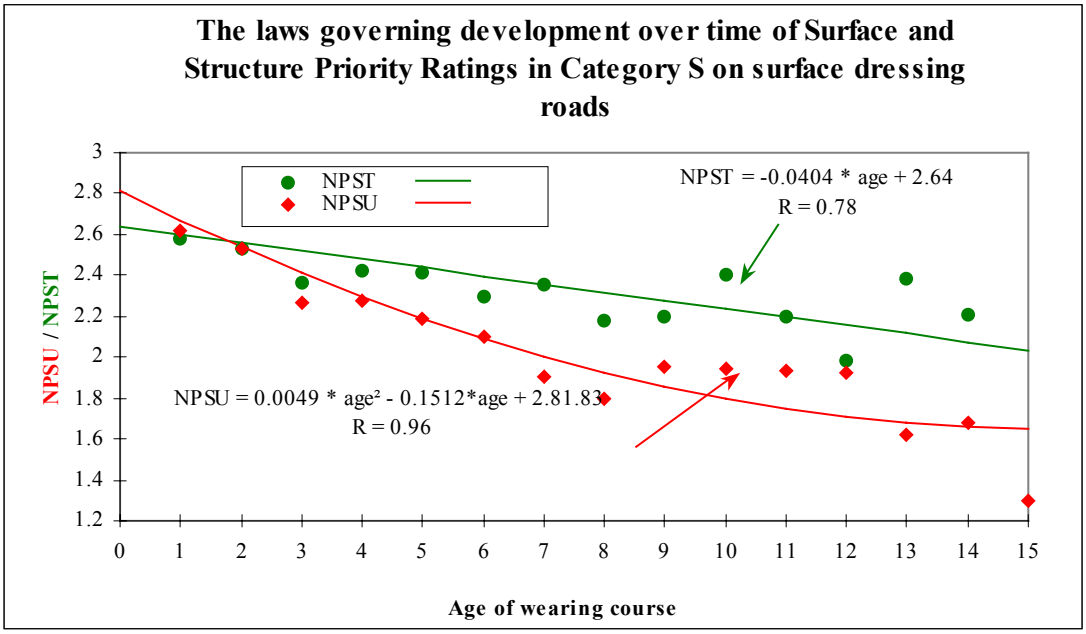
An intrinsic characteristic of such a ***Road Network Management Aid System*** is to provide a forecast of the condition of the Road Network over time. There is for this reason a need to define rules for the development over time of road condition specific to the network concerned and to all of its characteristics.

The chosen method is to plot for each condition indicator (***Structure*** and ***Surface***), the value of that indicator as a function of the age of the most recent surfacing at the date of measurement.

In this way, curves were plotted by interpolation for each condition indicator, with weighting based on the length of each base sample. The total number of such plots is equal to the number of possibilities of variation in the parameters taken into account in the breakdown of the ***Core Departmental Road Network***.

For each such plot, a basic law governing development over time is computed using conventional statistical methods.

The next step was to reduce the number of such basic laws by studying the influence of each parameter.



IV – Applying the Management Aid System to the Departmental Road Network (28)

The overall ***Departmental Road Network Management Aid System*** must make it possible for ***official highways and general management agencies*** to formulate proposals for submission to elected representatives at the various stages:

- Defining strategies and policies,
- Planning and scheduling road works.

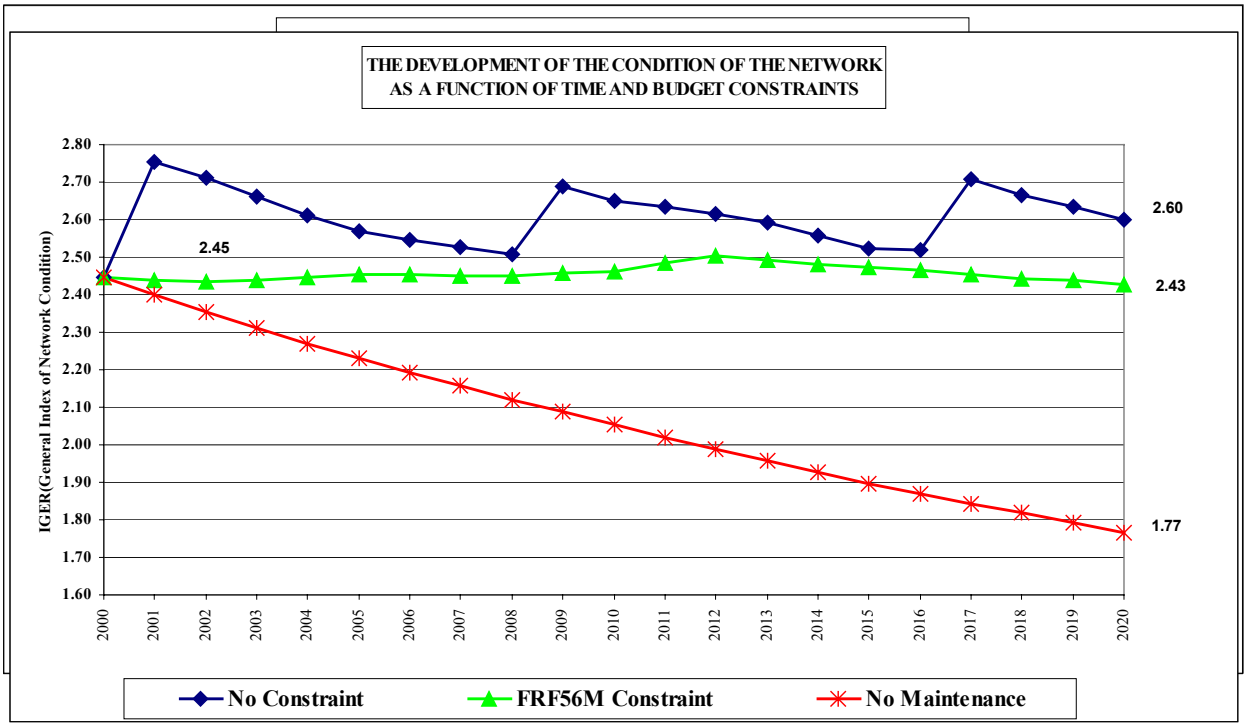
To achieve this, it is desirable to determine the overall level of budgeted funds necessary, firstly for the restoration to the required standard of the ***Core Departmental Road Network***, and secondly to provide appropriate maintenance for the whole of the network.

The Management Aid System, as described in this chapter, allows an overall quantification to be arrived at for the work needed in order to maintain or restore the required level of network service.

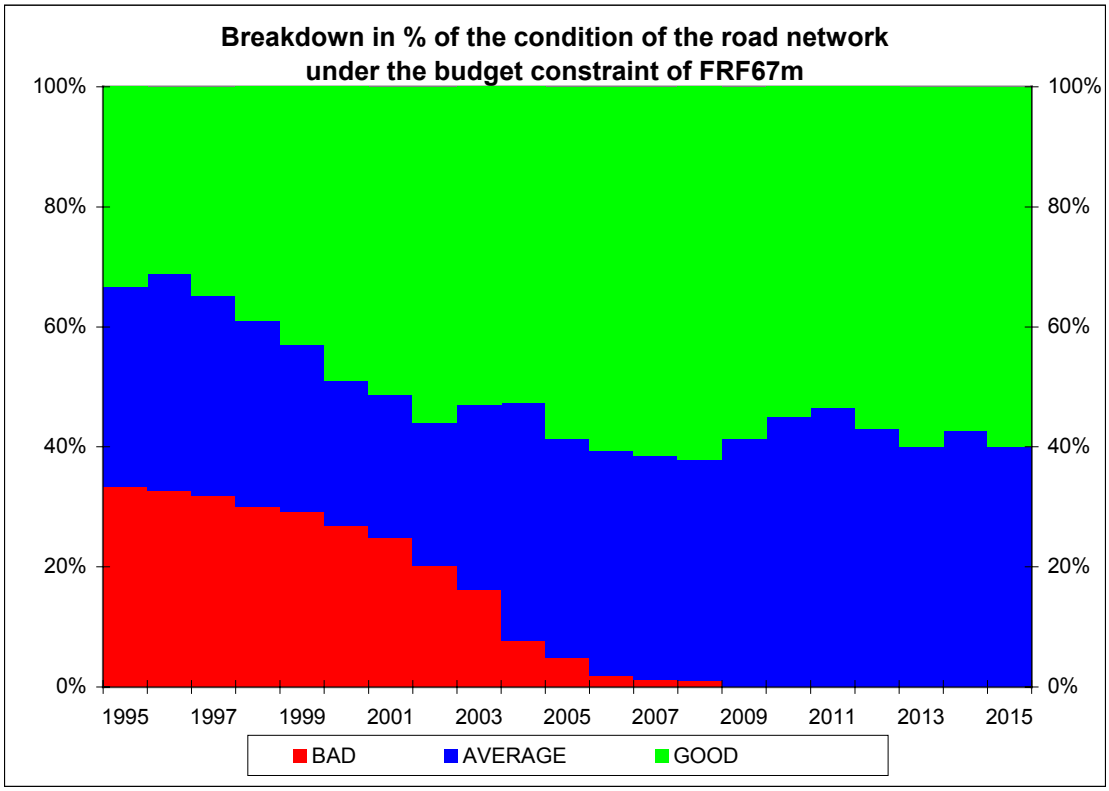
IV.1 – Using System results for the definition of the roads policy of the territorial Department.

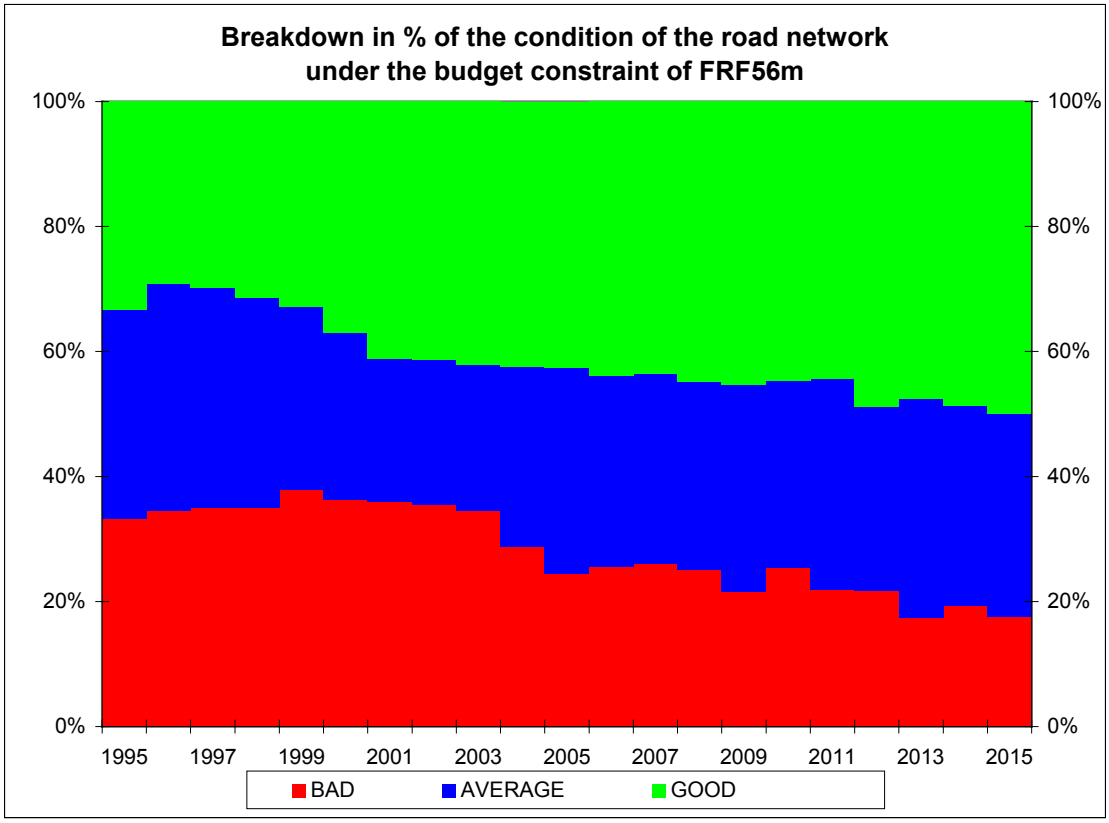
For any given strategy, the development over time of the level of service provided by the Departmental road network with or without the imposition of budget constraints, is illustrated here in two forms:

- IGER – the General Index of Network Condition = f(t)



Distribution of network condition levels = f(t)
(Distribution of the three phases is assumed to equally probable for the first year of the period of analysis).


Breakdown in % of the condition of the road network
under the budget constraint of FRF67m
100%
80%
60%
40%
20%
0%
1995
1997
1999
2001
2003
2005
2007
2009
2011
2013
2015
BAD
AVERAGE
GOOD


Breakdown in % of the condition of the road network
under the budget constraint of FRF56m
100%
80%
60%
40%
20%
0%
1995
1997
1999
2001
2003
2005
2007
2009
2011
2013
2015
BAD
AVERAGE
GOOD

IV.2 – Applying Management Aid System results to the scheduling of maintenance works

In the short term, the works schedule defined using this System can be applied by the highways management agency as part of a rationalized approach in three distinct phases:

- critical analysis of Management Aid System results, notably including recorded data such as for the nature of road structure, location inside or outside urban areas and age of the most recent wearing course, especially where this is less than 5 years,

- validation of the results by local government subdivisions,

- application of any necessary technical corrections (the studies involved here are of “project” kind).

V - Conclusions and prospects for the future

The current system, which has been in operation for 5 years, meets the objectives defined by the highways management agency and remains open, upgradeable and capable of further improvement in both form and base structure.

At all stages in the process it allows implementation of any modifications or additions requested by the highways management agency.

To date, this software is in use by the highways management agency.

Thanks to regular monitoring of the condition of the road network and completed design studies, the improvements currently under way relate to the following points:

- the catalogue of quantified solutions (notably for road bases using bitumen-stabilised and hydraulic-binder-treated gravel, and integration of geographical zoning),

. the laws governing development of highway condition over time (refinement of the plots used, plotting of significant curves for bitumen-stabilised and hydraulic-binder-treated gravel road bases, and examination of the possible advantages of using differentiated condition indicators as opposed to aggregated condition indicators).

. the impact of changes in strategy in terms of the network service provided within budget constraints,

. the impact of completed works on condition indicators.

To conclude, mention should be made of the fact that the use of the management aid system the Departmental road network (28) has led to improvements in the quality of the dialogue between those involved:

- field operatives have a more comprehensive perception of maintenance problems;

- the highways management agency has a way of obtaining the extra maintenance funding it needs,
- elected representatives can see in concrete terms the effects of their choice of budget option.

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