Road maintenance policy based on an expert asset management system

- Concept and case study -

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Outline of the presentation

• Road asset impacts rating
• Road asset maintenance programing
• Maintenance strategies
• Life cycle simulation
• Case study
Road maintenance impact rating

• Maintenance activities impact all road stakeholders: Financers, Agencies, Users, Neighbors, Society...
• Need for ratings (or Key Performance Indicators – KPIs) to quantify these impacts.
• KPIs are criteria to assess and therefore to decide maintenance strategies.
• KPIs are aggregation and combination of elementary data
“Road Condition” is synthetic KPIs which reflect impacts on financers, agencies and users.

Most countries are using some kind of PCI or PSI.

France is using two indicators (Structure, Surface) which varies from 0 (ruin) to 20 (as-new).

KPIs are often irrelevant for diagnosis and suggestions of remedial measures (critical information lost during the aggregation process).
Road maintenance programing

• When, where and how should be the numerous network sections maintained?

• With a given periodicity?
  • Sometimes used at the design stage, but not very realistic
  • Rarely applied

• Depending on the section condition?
  • Applies some strategies that define the need and priority of road works depending on road type, road condition, traffic, climate...
Maintenance strategies

• From a very simple one
  - If IRI < 5  No intervention
  - If IRI > 5  Overlay (traffic)

• To multi-criteria grids
  - Depending on cross analysis of extension of several distresses

• To expert strategies
  - Algorithms
Strat_C

Conditions

Description

```
SI (DEFG=0)
T1_4=GRILLE_XY_A(2,3,DEFT,F_TH,\n0,10,100,\n0,10,50,100,\n"","ReparLoc+BBTM","ReparLoc+ECF+BBTM",\n"BBM","BBM","BBM")
FIN

# Il y a des déformations graves
SINON
T1_4=GRILLE_XY_A(2,3,DEFT,F_TH,\n0,10,100,\n0,10,50,100,\n"ReparLoc+Colma","ReparLoc+BBTM","ReparLoc+ECF+BBTM",\n"FRAIS+BBSG","FRAIS+BBSG","FRAIS+BBSG")
FINSI

FINSI

SI (F_TH=0)
T1_4=SUPPRIMER_TACHE(T1_4,"ReparLoc")
T1_4=SUPPRIMER_TACHE(T1_4,"Colma")
FINSI

SI (FLTOT=0) T1_4=SUPPRIMER_TACHE(T1_4,"Colma")
```

Dupliquer
Nouveau (niveau interne)
Renommer
Supprimer
Montant
Descendant
Ouvrir l'arbre
Fermer l'arbre
Substitution de technique
Multiplication des seuils
Export HTML
Aide
OK
Annuler
Maintenance Strategies

Maintenance objectives:
- Acceptable distress levels
- Intervention frequency

Selection of appropriate strategies:
- Criteria, thresholds, type of works

Application of strategies:
- Exhaustive list of maintenance needs

Priority Criteria

Maintenance budget:
- Per year
- Per road category

Ranking

Annual program of maintenance interventions
Life cycle simulation

- Initial network condition
- Road condition assessment
- Annual maintenance scheduling
- Final network condition
- Maintenance strategies
- Road condition ratings
- Maintenance programs
- Pavement performance models

Crack evolution graph:
- Crack extend (%) vs. Age (years)
Case study

- 2 500 km of roadways
- Located in west of France
- Data available from 2005
- Rather homogeneous in functions
- A “reference” strategy technically sound
- A “reference” strategy applied to the whole network
- Simulation over 15 years
Case study

✓ Reference strategy
✓ Overall budget of 0.85€/m² (~ US$ 0.09/ft²)

- All budget is employed
- Condition indicator slightly increase from 17 to 18
Case study

- Reference strategy
- Overall budget of 0.95€/m² (~ US$ 0.11/ft²)

- Not all budget is employed (not enough distresses)
- Condition indicator slightly increase from 17 to 18
  ➔ Too high annual budget for the reference strategy
Case study

- Reference strategy everywhere
- Overall budget of 0.75€/m² (~ US$ 0.08/ft²)
  - All budget employed
  - Condition rating decrease from 17 to 16.5
  - Insufficient budget for the reference strategy
Case study

The optimal budget for the reference strategy is about 0.85 €/m² (~ US$ 0.09/ft²)

- A new strategy is generated by multiplying all thresholds by 1.5
  ➔ It should allow more distresses before an intervention is triggered
  ➔ It should triggered less interventions
  ➔ It should required less budget.

- The same approach is conducted. The optimal budget is about 0.75€/m² (~ US$ 0.08/ft²)
Case study

Optimal budget for a given strategy
Case study

Structural condition ($N_p$) after 15 years, with optimal budget
Conclusions

1. We defined flexible maintenance strategies deriving interventions from real road condition
2. We were able to assess the impact of this strategy over 15 years by a medium or long term simulation
3. It was then possible to compare different strategy and find an optimum, for a given type of impact
4. The various strategy were tested within a given family (by only varying thresholds); more different strategies can be compared as well.
Conclusions

5. Comparison criteria was the impact on road condition; other criteria can be used as well.

6. Especially, socio-economic and/or environmental criteria can be used.

7. The same method used for strategy analysis is applied for maintenance programming ➔ full consistency.