

Improving Pavement Preservation Treatment Strategy Selection using Expert System Approach

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1

What is Treatment Selection?

A process to assist maintenance personnel in making better and more informed decisions in selecting and applying maintenance treatments

In other words...

What do we do with this?



2

Maintenance Selection – Detailed Example

| Preventive Treatments | Raveling | Oxidation | Bleeding | Rutting | |
|--------------------------|----------|-----------|----------|---------|-------|
| | | | | <1/2" | >1/2" |
| | | | | | |
| Crack/Joint Seal | | | | | |
| Emulsion | N | N | N | N | N |
| Modified (Rubber) | N | N | N | N | N |
| Seal Coats | | | | | |
| Fog Seal (See note 1) | F | G | N | N | N |
| Rejuvenator (See note 1) | G | G | N | N | N |
| Scrub Seal (See Note 4) | G | G | N | N | N |
| Slurry Seals | | | | | |
| Type II (See note 1) | F | G | N | N | N |
| Type III | G | G | N | F | N |
| REAS | G | G | N | F | N |
| Microsurfacing | | | | | |
| Type II | G | G | N | G | F |
| Type III | G | G | N | G | G |

Maintenance Selection on Cracks - Overview

GENERAL GUIDELINES FOR EFFECTIVE MAINTENANCE TREATMENTS ON CRACKS

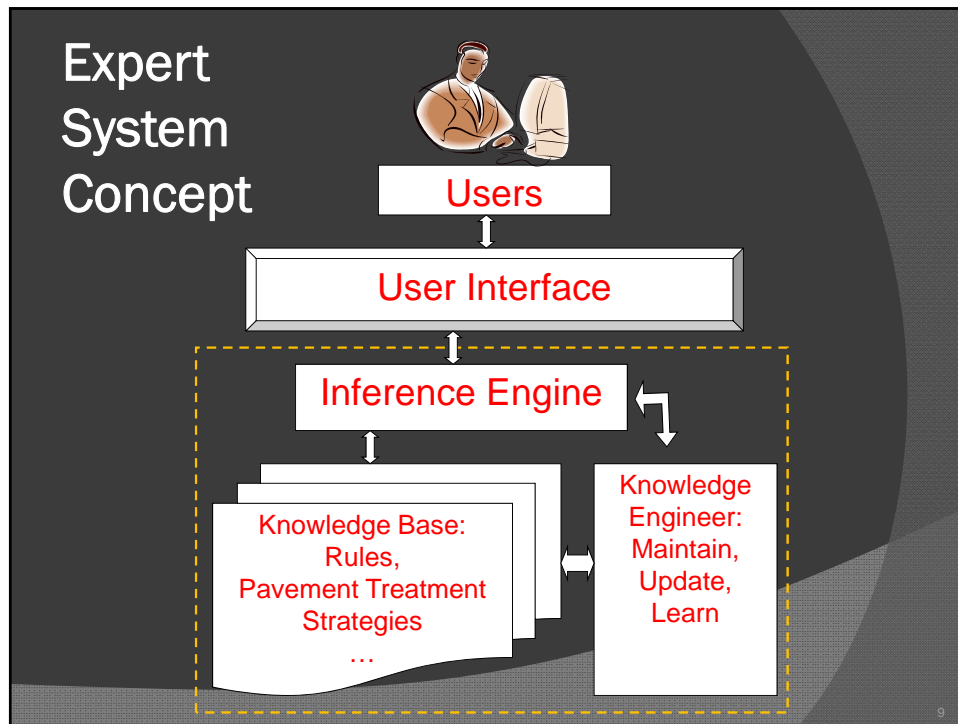
| Criteria | Type of Cracking | | | | | | | | | | | | | | |
|--|------------------|--------------|------------|---------------|----------------|----------------|---------------|----------------|------------|-------------------------|--------------|-------|---------------|---------------|---------------|
| | Alligator "A" | | | Alligator "B" | | | Alligator "C" | | | Longitudinal/Transverse | | | Edge | | |
| | Low | Medium | High | Low | Medium | High | Low | Medium | High | Low | Medium | High | Low | Medium | High |
| Width | <1/4" | >1/4", <1/2" | >1/2" | <1/4" | >1/4", <1/2" | >1/2" | <1/4" | >1/4", <1/2" | >1/2" | <1/4" | >1/4", <1/2" | >1/2" | No | >0%, <10% | >10% |
| Area | <10% | >10%, <20% | >20%, <30% | <10% | >10%, <20% | >20%, <30% | <10% | >10%, <20% | >20%, <30% | | | | Material Loss | Material Loss | Material Loss |
| Preventive Treatment | | | | | | | | | | | | | | | |
| Crack/Joint Seal (See Note 9) | | | | | | | | | | | | | | | |
| Emulsion | N | F | N | N | P | N | N | N | N | G | F | N | G | P | P |
| Modified (Rubber) | N | G | P | N | P | N | N | P | N | P | G | F | P | P | P |
| Fog Seal (See note 1) | G | P | N | G | N | N | F | N | N | F | N | N | F | P | P |
| Rejuvenator (See note 1) | G | N | N | G | N | N | F | N | N | F | N | N | F | P | P |
| Scrub Seals | G | F | N | G | F (See Note 4) | N | G | P (See Note 4) | N | F | P | P | F | P | P |
| Slurry Seals | | | | | | | | | | | | | | | |
| Type II (See note 1) | F | N | N | F | N | N | F | N | N | F | N | N | F | P | P |
| Type III | F | P | N | F | P | N | F | P | N | F | P | N | F | P | P |
| Microsurfacing | | | | | | | | | | | | | | | |
| Type II (See note 2) | G | N | N | F | P | N | F | P | N | F | N | N | P | P | P |
| Type III | G | P | N | F | P | N | F | P | N | F | N | N | P | P | P |
| Chip Seal | | | | | | | | | | | | | | | |
| PME - Med. Fine | G | P | N | G | F (See Note 4) | N | G | P (See Note 4) | N | P | P | N | P | P | P |
| PME - Medium | G | P | N | G | F (See Note 4) | N | G | P (See Note 4) | N | P | P | N | P | P | P |
| PMA - Medium (See Note 3.) | G | P | P | G | F (See Note 4) | P | G | P (See Note 4) | P | P | P | N | P | P | P |
| PMA - Coarse (See Note 3.) | G | P | P | G | F (See Note 4) | P | G | P (See Note 4) | P | P | P | N | P | P | P |
| AR - Medium | G | G | F | G | G | F | G | F (See Note 4) | F | P | F | F | P | P | P |
| AR - Coarse | G | G | F | G | G | F | G | F (See Note 4) | F | P | F | F | P | P | P |
| PM Alternative > 30,000 ADT | | | | | | | | | | | | | | | |
| PBA OSAC | G | F | N | G | F (See Note 4) | N | G | F (See Note 4) | N | G | F | P | P | P | P |
| RAC-O | G | G | F | G | G | F (See Note 4) | G | G | F | G | F | P | P | P | P |
| RAC-O High Binder (HB) | G | G | F | G | G | F (See Note 4) | G | G | F | G | F | P | P | P | P |
| RAC-G | G | G | G | G | G | F (See Note 4) | G | G | G | G | F | P | G | G | G |
| Thin Bonded Wearing Course Rubber (BWCR) | G | G | G | G | F (See Note 4) | F (See Note 4) | G | F (See Note 4) | F | G | F | P | P | P | P |
| Maintenance Treatments | | | | | | | | | | | | | | | |
| Conventional | G | G | | | | | | | | | | | F | N | F |
| PBA | G | G | | | | | | | | | | | F | N | F |
| RAC | G | F | | | | | | | | | | | F | N | F |
| BWC | | | | | | | | | | | | | | | |
| Digouts | N | N | | | | | | | | | | | F | N | F |

Not another one

| Guidelines for Effective Treatments on Cracks – Detailed Example | | | | | | |
|---|---------------|-----------------|---------------|-------------------------|-----------------|-------|
| Criteria | Alligator "C" | | | Longitudinal/Transverse | | |
| | Low | Medium | High | Low | Medium | High |
| Width | <1/4" | >1/4", <1/2" | >1/2" | <1/4" | >1/4", <1/2" | >1/2" |
| | or | or | or | | | |
| Area | <10% | >10%, <20% | >20%, <30% | | | |
| Treatment | | | | | | |
| Microsurfacing | | | | | | |
| Type II (See note 2) | F | P | N | F | N | N |
| Type III | F | P | N | F | N | N |
| PM Alternative >30,000 ADT | | | | | | |
| PBA OGAC | G | F (Note 4) | N | G | F | P |
| RAC-O | G | G | F | G | F | P |
| RAC-O High Binder (HB) | G | G | F | G | F | P |
| RAC-G | G | G | G | G | F | P |
| Thin Bonded Wearing Course Rubber (BWCR) | G | F (Note 4) | F | F | F | P |

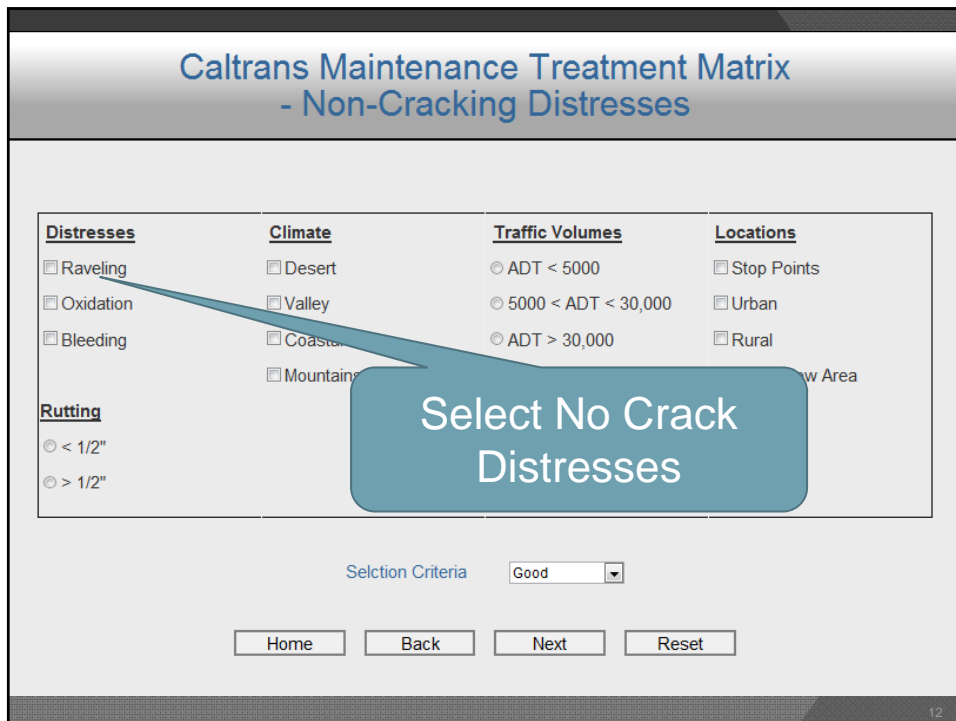
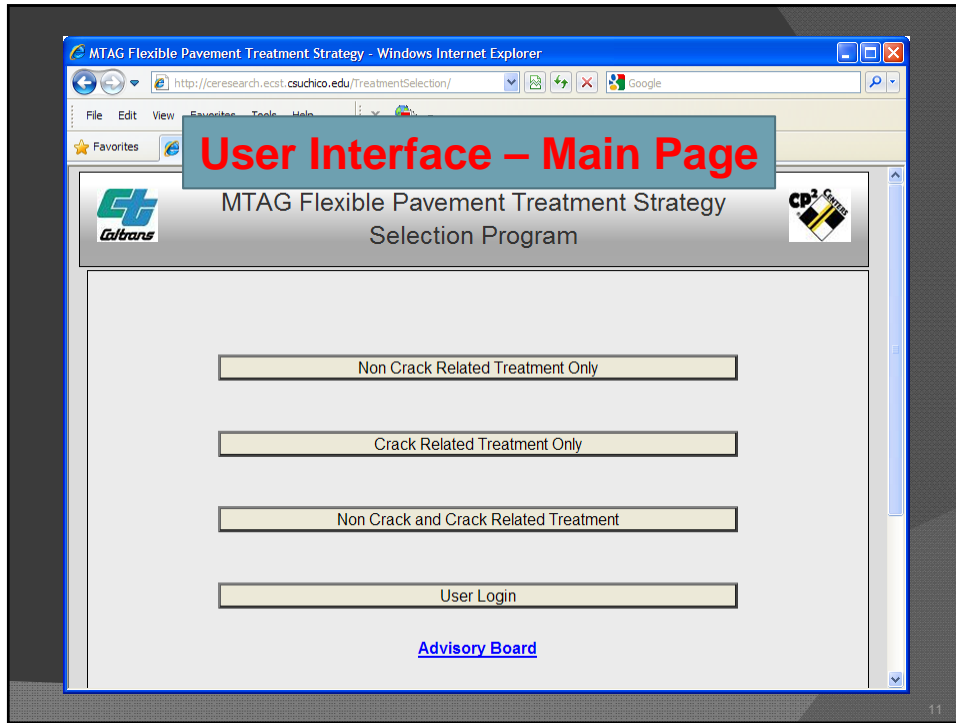
Difficulty of Using Traditional Decision Tree or Decision Matrix

- Several treatments may be feasible
- Cost and life of the treatment will vary
- Effect of the treatment on the life extension of the existing pavement needs to be quantified
- Other factors to consider



Advantage of the Preliminary Developed Expert System

- Uses Caltrans MTAG existing decision matrix
- Can deal with more complex scenarios
- Knowledge is retained to the system
- New treatments can be added



Caltrans Maintenance Treatment Matrix - Cracking Distresses

| | | |
|---|---|---|
| <p>Alligator Cracking A</p> <p><input type="radio"/> Low: (Width<1/4) or (Area<10%)</p> <p><input type="radio"/> Medium: (1/4<Width<1/2) or (10%<Area<20%)</p> <p><input type="radio"/> High: (Width>1/2) or (20%<Area<30%)</p> | <p>Alligator Cracking B</p> <p><input type="radio"/> Low: (Width<1/4) or (Area<10%)</p> <p><input type="radio"/> Medium: (1/4<Width<1/2) or (10%<Area<20%)</p> <p><input type="radio"/> High: (Width>1/2) or (20%<Area<30%)</p> | <p>Alligator Cracking C</p> <p><input type="radio"/> Low: (Width<1/4) or (Area<10%)</p> <p><input type="radio"/> Medium: (1/4<Width<1/2) or (10%<Area<20%)</p> <p><input type="radio"/> High: (Width>1/2) or (20%<Area<30%)</p> |
| <p>Longitudinal/Traverse Cracking</p> <p><input type="radio"/> Low: (Width<1/4)</p> <p><input type="radio"/> Medium: (1/4<Width<1/2)</p> <p><input type="radio"/> High: (Width>1/2)</p> | <p>Edge Cracking</p> <p><input type="radio"/> Low: No Material Loss</p> <p><input type="radio"/> Medium: Material Loss: (>0%,<10%)</p> <p><input type="radio"/> High: Material Loss: (>10%)</p> | |

Selection Criteria: ▼

13

Strategy Selection Methods

Analysis Method Selection

Simplified Cost Analysis

Expert Based Ranking System

14

Life Cycle Cost Analysis

| TreatmentID | Treatment Name | Expected Life, Years | Treatment Cost, \$/sqyd | Interest Rate, % | Equivalent Annual Cost, \$/sqyd/year | Notes |
|-------------------------|-------------------|----------------------|-------------------------|------------------|--------------------------------------|-------|
| Edit 1 | Crack/Joint Seal: | 5 | 0.75 | 3 | 0.16 | |
| Edit | | | 1.75 | | | |
| Edit | | | 2.9 | | | |
| Edit 15 | Medium | 7 | 4.75 | 3 | 0.76 | |

- Treatment Life
- Treatment Cost
- Interest Rate

→

Equivalent Annual Cost

Home Back Calculate

15

Expert System Approach


Ranking Questions


Do you have a qualified contractor?

Microsurfacing: Type II [See MTAG Chapter 9](#)

PM Alternative: PBA-O Yes No [More information see MTAG Chapter 10](#)

See MTAG for More Info

1. Do you have qualified contractor?
2. Can the treatment meet the environmental impact regulations?
3. ?

[MTAG Chapter 10](#)
[MTAG Chapter 10](#)
[MTAG Chapter 11](#)

16



Weight Factors

| Weight ID | Weight Factor Name | Weight Factor Value |
|-----------------------------------|-----------------------------------|---------------------|
| Edit 1 | Expected Life | 20 |
| | Seasonal Effects | 5 |
| | Pavement Structure Influence | |
| | Condition of Existing Pavement | |
| Edit 5 | Initial Cost | |
| Edit 6 | Equivalent Annual Cost | 30 |
| Edit 7 | Availability of Quality Materials | 0 |
| Edit 8 | Weather Limits | 0 |
| Edit 9 | Traffic Disruption | 0 |
| Edit 10 | Noise | 0 |
| Edit 11 | Surface Friction | 20 |
| Total Weight Factor Value: | | 100 |

Multiple Objectives

Weight factors are editable

The System can recommend values


Evaluation Questions Sheet


W01: What is the expected treatment life in years?

Microsurfacing: Type II

PM Alternative: PBA-O

PM Alternative: RAC-O High Binder (HB)

PM Alternative: Thin Bonded Wearing Course (BWC)

Thin Lifts Overlays: Conventional

W02: What is the seasonal effect on the treatment?

Obtain value from database

Values are editable

Ranking of Treatment Results

| | TreatmentName | WeightedScore |
|----|----------------------------------|---------------|
| | Type II | 410 |
| | High Binder (HB) | 257 |
| 19 | PM Alternative: PBA-O | 242 |
| 24 | PM Alternative: BWC Course (BWC) | 227 |
| 26 | Thin Lifts | 212 |

Home Back Calculate Expanded View Report

Knowledge Engineer

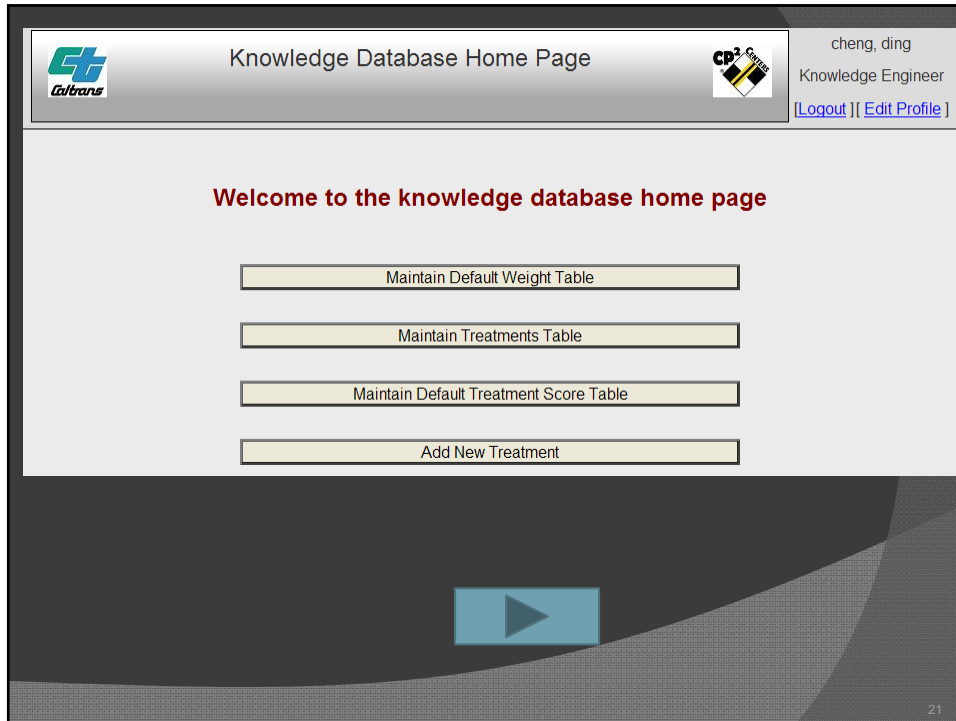
Treatment Selection. Please Login.

Username
 Password
 UserType

[New User? Click here to create an account. Create New User](#)
[Forgot Password?](#)
[Submit Feedback](#)

Four User Groups

- General user
- Advanced user
- Knowledge Engineer
- Admin



Knowledge Database Home Page

cheng, ding
Knowledge Engineer
[Logout](#) | [Edit Profile](#)

Welcome to the knowledge database home page

- Maintain Default Weight Table
- Maintain Treatments Table
- Maintain Default Treatment Score Table
- Add New Treatment

21

Summary

- Expert systems can help inexperienced engineers to select appropriate treatments.
- Supports seasoned engineers streamline and explicitly present their decision making process.
- Expert system is flexible and expandable

Questions?

MTAG Flexible Pavement Strategy Selection

Website:

<http://ceresearch.ecst.csuchico.edu/TreatmentSelection>

Contact

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