

UNH T² Center Technical Note

Pavement Management Systems

In most municipalities, highway is the largest budget item. In some towns, the roads may have deteriorated to funding needs exceed available funds.

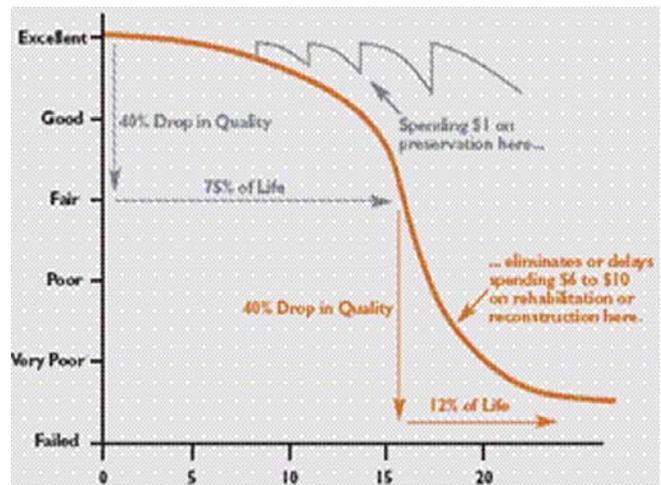
Typically, municipalities develop their street maintenance budget using one or more of the following techniques:

- **Last Year's Budget.** Based on last year's funding, possibly with an increase or decrease.
- **Standard Program.** A program based upon a periodic maintenance schedule, such as chip seal every five years and an overlay every 15 years, whether, or not, the street need it.
- **"Fighting Fires"**. Fix problems as citizens complain.
- **Worst First.** Fix the streets in the worst condition first. This approach has a certain logic (although incorrect).
- **Political Pressure.** Political considerations establish priorities and budgets.
- **Gut Feel.** Rely on the experience, knowledge and "gut feel" of managers and experienced employees.

A maintenance program focusing on rehabilitation and/or reconstructing roads is expensive and quickly uses the maintenance budget. It leaves little or no money for preventive maintenance. A few streets are restored while many deteriorate. Delayed maintenance is costly.

The most cost-effective solution is to choose which streets to repair based on the condition of the overall street system.

A pavement management system (PMS) allows managers to effectively manage the maintenance of



municipal streets. It is an organized approach to assure that all factors are taken into account.

What is a PMS?

PMS is a systematic, consistent approach to:

1. evaluate present condition of each pavement surface,
2. determine the proper type of maintenance to return the pavement to an acceptable level of service,
3. prioritize necessary repairs,
4. and generate useful reports.

Pavements deteriorate very slowly during the first few years and very rapidly as they age. Even though pavement design and materials vary, the deterioration of pavement is a standard curve. See the "pavement condition vs age curve" above.



Years of collecting pavement condition data have shown that it is more economical to preserve roads than to delay repairs and reconstruct roads. Studies show that as traffic levels increase, the costs of delaying repair work also increases. The traditional practice of repairing the worst roads first is costly. A PMS helps road managers determine the most cost effective method to do preventative maintenance.

The complexity of a PMS system can vary. It may be used to determine the best investment strategy every year for an extended number of years. A PMS will analyze scenarios and determine network condition if there are changes in funding levels or Maintenance, Reconstruction and Repair (MR & R) strategies.

Most municipalities require information such as the costs of each repair, the total cost of all repairs, etc. This information is generated with a simplified PMS. A PMS stores and analyzes data.

A “low-tech” computer program will work for most municipalities. However, it may not optimize investment over an extended period. It will select the proper MR&R techniques and apply them at the correct time.

A simple method using pencil and paper to record the condition of each road segment may be adapted. Use this system as a last resort.

Meeting with the Board

Generally, the selectboard will decide if PMS is implemented. A council member as an advocate may be crucial to getting pavement management on a meeting agenda. The advocate may be someone who considers public works a priority.

Explain the PMS process, present a general overview of PMS, focus on the potential benefits. Successful implementation occurs when everyone understands the basic concepts and how it benefits the community.

At the board presentation, discuss a suggested plan of action. The plan of action should contain:

1. Time frame for completing the PMS process,
2. Identify key points where board input is needed,
3. Plan for public communication, and
4. Create a steering committee.

Keep other departments and the public informed: use notices in the town’s newsletter, an informal public meeting, or a citizen participation process. Communities have benefited from the support and insight of the public when the public is informed about PMS activities.

PMS Implementation Process

Implementation varies based on agency needs. Keep it simple. As agencies become more comfortable, they can “step up” the complexity. A PMS includes these steps:

1. A systematic method to gather information about each road segment in the network such the length, width, surface, etc...
2. Develop repair strategies.
3. Budget funds focused on preventive maintenance.

What Information is Generated?

PMS should generate a series of reports that include the following:

Road Inventory. A list of each road segment in the network and the physical characteristics of each segment, including: road length, width, surface, traffic volume, etc...

Condition Summary. A summary of the condition of each pavement surface (results from the distress survey)

Repair Strategies. A summary of appropriate MR&R to improve each road segment.

Prioritized Repair Strategies. A summary listing road segments based upon priority. Priority is based on weighted factors such traffic, roughness, surface distress, and municipal needs.

Reports. Reports may include: number of streets that can be repaired based upon a specified budget, how much it would cost to upgrade all streets, etc.

Road Inventory

The inventory (survey) collects descriptive information for the roads in the network. The information might include:

- Section Description,
- Functional Classification,
- Type of Pavement,
- Length and Width,
- Construction History, and
- Traffic.

Inventory collection is the most time-consuming step. Gather inventory in three phases to make it more manageable.

1. Determine the types of data needed.
2. Determine which data already exists.
3. Determine the remaining data that must be gathered.

Surface Condition Survey

Road surface condition is a visual inspection of road each segment. Certain surface distresses are related to pavement deterioration. PMS links distress type to repair strategies. Train people who perform the condition survey. Correct data is crucial. Inaccurate data leads to inappropriate repair strategies, resulting in the inefficient use of funding.

This a list of recommended distresses to include in the condition survey:

- Alligator cracking,
- Longitudinal/transverse cracking,
- Edge cracking,
- Potholes/patching,
- Roughness,
- Rutting, and
- Raveling/Oxidation.

Record the severity and extent of the distress.

- Severity refers to the degree of deterioration (low, medium, or high).
- Extent refers to the frequency of occurrence or amount of road surface (percentage) subjected to a distress.

The severity and extent determine the repair strategy. For example, a pavement with alligator

cracking and a high severity but only a low extent requires only a patch. If the alligator cracking has a high severity and has a high extent, then reconstruct the road.

Repair Strategies

Municipalities must decide which repair alternatives to consider. Some municipalities may only use patching, overlays, and reconstruction. Others may consider options such as micro-surfacing and cold in-place recycling. After the initial set of repair alternatives is selected, additional alternatives may be added.

Group alternatives into repair strategy categories. There is a link between the type, severity and extent of a distress, and the recommended repair strategy.

It is generally accepted that there are five repair strategies to consider for road surfaces:

1. Routine Maintenance: patching, crack sealing, and other relatively low cost actions. Routine maintenance should be funded each year.
2. Preventive Maintenance: seals and other surface treatments designed to stop deterioration.
3. Deferred Action road sections in this category receive minimum funds for the current budget year. They are beyond preventive maintenance but do not need rehabilitation, yet. When an agency defers action, it must be prepared to fund rehabilitation or reconstruction later.
4. Rehabilitation usually includes thick overlays or recycling. Funding for completion of these major projects may depend upon long range planning and may be done in stages.
5. Reconstruction involves complete removal and replacement of failed pavement. It may also involve widening, improved alignment, grade changes, guard rail, and major drainage work. Several years of lead time may be necessary due to the cost of full reconstruction and the time required to develop a plan of action, secure permits, and establish special funding.



Technology Transfer Center
New Hampshire LTAP at UNH

Determine Network Needs

The initial report lists streets in alphabetical order. It does not consider priorities. Most municipalities do not have funding to repair all streets in one year. Perform analysis to prioritize network needs, then reports will list streets in repair order.

The prioritized repair list may require adjustment, as is difficult to schedule a large project within a given year. It may be necessary to hold money in reserve from one year to accomplish a large project in the next year. In some cases, money may be saved by scheduling improvements on adjacent streets in a single year even when the PMS places the improvements in different years.

PMS prioritization uses either the worst-first method or the best-first method. The worst-first method selects streets for repair in the worst condition first. The best-first method selects streets in good condition first (preserving good roads rather than delaying repairs and reconstructing roads).

Develop a Budget

Municipalities must determine the level of funding to allocate to end further road deterioration. Roads currently in good condition will deteriorate, requiring future repairs. Therefore, is it important to develop a short-term and long-term plan.

After selecting which streets to repair, examine them to determine the exact scope of work. A detailed survey will yield a more accurate cost estimate. This is necessary as the initial condition survey does not measure exact quantities. A detailed survey of every street is extremely time consuming and unnecessary at the network planning stage

Develop a Multi-year Plan

Most municipalities will only be able to fund a certain percentage of repairs. PMS provides an opportunity to develop a multi-year plan. For most agencies, an expensive state-of-the-art multi-year forecasting computer system is not practical. A prioritized repair list, common sense, and negotiation provide a reasonable three to five year picture of the agency's needs.

Summary

For most governments, the budget is the central planning document and often the only significant planning activity. The structural approach of a PMS, removes questions about the quality or objectives of the budget. PMS allows boards to clarify their objectives and target investment.

Sources:

Pavement Management Primer, <http://www.fhwa.dot.gov/infrastructure/as-stmgmt/pavement.htm> September 7, 2007

<http://www.kercherei.com/index.html>, August 1, 2007

Remaining Service Life

One way to access network condition is road service life.

If one mile of road is reconstructed at a cost of \$200,000 then an additional 20 years of life is added to the one mile of road to the entire network.

If the same \$200,000 is spent improving 20 miles of roads, with an average improvement to service life of six years, then 120 years of service life is added to the entire network (20 miles x 6 years). At the same time, all other roads depreciate by one year for each year they are not improved.

In the first example, a town with 100 miles of road, will gain 20 mile years but lose 99 thereby losing 79 mile years (one mile was improved).

In the second example, they gain 120 mile years and lose 80 mile years, thereby gaining 40 mile years.

This is why the UNH T² Center advocates the best first approach.